

# **ANALYSES AND PROJECTIONS OF ECONOMIC DEVELOPMENT**

## **II. The Economic Development of Brazil**

*A study prepared by the Joint Working Group  
of the Banco Nacional do Desenvolvimento Econômico (Brazil)  
and the Economic Commission for Latin America*



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## EXPLANATORY NOTE

The following symbols have been used throughout this report :

Three dots (...) indicate that data are not available or are not separately reported.

A dash (—) means that the amount is nil or negligible.

A blank in a table indicates that the item is not applicable.

A minus sign (-) indicates a deficit or a decrease.

A stroke (/) is used between years when a crop or fiscal year is meant ; e.g., 1953/54.

References to " tons " indicate metric tons, and to " dollars ", United States dollars, unless otherwise stated.

The term " billion " signifies a thousand million.

Details and percentages in tables do not necessarily add to totals, because of rounding.

The initials " ECLA " are those of the Economic Commission for Latin America, and " BNDE " those of the Banco Nacional do Desenvolvimento Econômico of Brazil.





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## FOREWORD

The *Introduction to the Technique of Programming*, published in 1955 and constituting the initial volume in the series entitled "Analyses and Projections of Economic Development", is now followed by this analysis of the economic development of Brazil, which is the first of the country studies. This is in accordance with the recommendations of the General Assembly appearing in resolution 627 (VII) and with those of the Economic Commission for Latin America adopted at different sessions (resolutions 7 (IV) and 49 (V)).

This study originated from a request of the Brazilian Banco do Desenvolvimento Econômico, with whom the secretariat concluded an agreement in April 1953 providing for a joint study of the elements required to prepare a programme using the basic procedure suggested in Volume I of the series. The application of this method is fundamentally based upon resolution 48 (V) which was adopted by the Commission at its fifth session held in Brazil during 1953.

Research into the economic development of individual countries is carried out with the co-operation of the government agencies or departments concerned, and fulfils a dual purpose :

(a) To collect and analyse information in order to measure the rate of economic growth in the immediate past; and

(b) To establish projections of series on the different sectors of the economy, with the aim of assisting governments by providing them with the background data and bases required to draw up an over-all programme of economic development.

The programme for Brazil is the outcome of the co-operation between economists of the Economic Commission for Latin America and those of the Brazilian Development Bank, who together formed the joint working group created in April 1953.

The technique of projection, whose broad outlines were sketched in the preliminary document presented to the fifth session (Rio de Janeiro, April 1953), is basically a method of analysis designed to provide an integrated and dynamic picture of the economic process and an approximate estimate of the consequences of adopting—or of failing to adopt—certain measures at the opportune moment. From the point of view of the secretariat, the present study constitutes a step towards transforming the technique of projection into a practical instrument for the formulation of economic policy.

The value of the technique as a method of analysis can be gauged from the experience acquired during a study of the interesting and complex problems that the development of the Brazilian economy at present displays. Proof has also been provided of the degree of feasibility—within the framework of available statistics—of a system of projections to be used in programming.

The fundamental interest of the study for the secretariat is methodological, but this does not preclude its intrinsic practical value for the Administration of the BNDE in the formulation of an investment policy. During the organization and execution of the work, due consideration was given to the anxiety of the BNDE to find practical instruments with which to incorporate its investment programme into the general picture of the development of the Brazilian economy.

This task could not have been accomplished within the time available without the enthusiastic and unwavering collaboration of the Bank's Administration or without the active interest of the personnel of its Department of Economics. The ECLA secretariat owes a debt of gratitude both to the staff concerned and to the directors of the institution. The praiseworthy studies previously carried out by the Joint Brazil/United States Economic Development Commission—in many instances with the direct collaboration of the present directors and personnel of the BNDE—constituted, on more than one occasion, the bases for the present research.

The technique of projection is no more than the first phase of programming economic development. In this, as in any other specific case, at a subsequent stage a critical study would have to be undertaken of the measures available to the authorities whereby the economy could be induced to attain those targets which the projections had helped to establish. Not less important and urgent, within the general framework of projections by activity groups, are special studies, such as that undertaken on transport, whose findings are included in Part Two.<sup>1</sup> Without these it would be impossible to give direct assistance where it is needed.

The wide interest at present shown in Brazil in the problems of programming economic development is an encouraging sign that the efforts initiated in the present study may be followed up in the future.

<sup>1</sup> See chapter III.





## INTRODUCTION

After a decade of exceptionally intensive growth, in 1955 Brazil was faced with the need to discover new incentives to counteract the weakening of those which had permitted the recent acceleration of the rate of development.

Brazil, in common with the other countries of Latin America, was provided, during the first five post-war years, with an extremely satisfactory world market in process of rapid recovery and registering relatively high prices for raw materials. The foreign exchange reserves accumulated during the period of hostilities increased this sense of prosperity by enabling imports to continue their expansion for some time after exports had lost their impetus.

In 1949, no sooner did the incentives that were linked directly with the recovery disappear and the country begin to experience increasing balance-of-payments difficulties, than there was a sharp rise in coffee quotations. After twenty years of depression, the price of this commodity—which traditionally represents more than half of Brazil's exports—recovered almost at once. Thus the Brazilian economy entered upon a second five-year period of exceptional prosperity.

Although the part played by external elements during these two periods of intensive growth is of basic importance, the role of internal factors—particularly industrial investment—should not be overlooked. Without the expansionist force of the latter, external incentives would not have provoked the tremendous growth which took place. The large-scale investment in the industrial sector would be difficult to account for without the complex of favourable conditions constituted by an increase in the capacity to import, an improvement in the terms of trade, the exchange rate stabilization policy (whose repercussions in other sectors were not equally favourable), import selection designed to intensify industrialization, etc. Only thus was it possible to import increasing quantities of equipment and raw materials at relatively stable prices, at a time when domestic prices were rising. When competitive imports were eliminated by means of selective control, decreasing relative costs of equipment were combined with a growing effective demand.

From an estimate of the per capita rate of growth of income over the last decade, an average annual rate of expansion of approximately 5 per cent was calculated. This is more than double the historical rate of development in the industrialized countries. In Brazil, average per capita income, which had been \$162 (at 1952 prices) in 1945, reached \$246 in 1954. If this rate of growth were to continue over another decade, Brazil, with a per capita income of nearly \$400 and a population of 71.5 millions would constitute a market comparable in size with that of Western Germany today.

One of the most important conclusions to be drawn from the present study is that the rate of growth which prevailed during the last ten years is most unlikely to continue in the immediate future. It should be borne in mind that the terms of trade, whose improvement provided Brazil with several billions of dollars in the last five years, are beginning to deteriorate

and that prospects for the near future are not bright; that the period of drawing on reserves and accumulating external debts is now being followed by yet another of heavy foreign commitments; and that the real value of depreciation reserves accumulated in recent years is being reduced owing to an increase in the prices of imported equipment. Hence it may well be asked whether or not the period of exceptionally favourable conditions that is now drawing to a close will be followed by a phase which would be less propitious in every respect.

From a careful study of the trends and present behaviour of the factors playing a strategic role in development, it is possible—even within the limitations of economic forecasts—to define the probable extent and scope of future development. The process of identifying these strategic elements is of twofold interest, since it not only provides some knowledge of present trends but also enables a policy for accelerating development to be formulated.

To facilitate analysis and projection, the strategic factors determining the rate of growth of Brazil's economy are summarized as the three following variables: (a) domestic saving; (b) fluctuations in the terms of trade; and (c) the net inflow of foreign resources. These three factors are interconnected, and their individual behaviour could not easily be explained without reference to the others. Of particular interest is the relationship between the rate of saving and the fluctuations in the terms of trade. In certain sectors, improvements in the terms of trade imply real capital gains. Thus there is a dynamic re-distribution of income in favour of the entrepreneurial sector, which determines a greater relative saving, without requiring additional effort from the economy—that is, without a prior reduction of consumption.

These analytical instruments have been used to establish various hypotheses of the probable rate of growth of the Brazilian economy during the next few years. It is impossible, from both the theoretical and the practical point of view, to dogmatize about possible developments in the terms of trade. However, meticulous study will provide a clear indication of their probable movements and—what is vitally important in the Brazilian context—the possible consequences of a movement in this or that direction.

Fundamental importance may also attach to the inflow and outflow of resources. One of these movements (remittances abroad for the servicing of capital) is of vital interest as a balance-of-payments problem. Another (that of long-term capital) merits special emphasis on account of its potential significance. A serious deterioration in the terms of trade—for example, a return to the 1928 level—would have consequences on income and growth that could not be offset by an inflow of long-term capital of less than \$500 million, even on the assumption that the servicing of the capital in question would create no immediate balance-of-payments problem.

The rate of saving seems relatively stable; even its short-term fluctuations lie within fairly narrow limits, at least if those

cases of unemployment arising from inadequate demand are excluded. It is true that other factors, such as a reduction of capital productivity, can inhibit saving. But this stability—an expression of the relatively consistent efforts towards development—nevertheless exists and may be considered the starting-point in an examination of the effects on economic growth of the other strategic factors.

Thus, hypothetical economic patterns can be inferred from an integrated analysis of the really significant factors. These latter indicate merely the degree of probability in a forecast of events. The assumptions must be revised in so far as the elements involved undergo a transformation. At all events, it is clear that the efforts required to attain any definite target can be organized only on the basis of the most probable hypothesis as to the future behaviour of the forces in play.

Nowadays, development is accepted almost everywhere as an aim of economic policy. Whether individually, or collectively under the aegis of the United Nations, the great majority of governments acknowledge, with as much vigour as the principle of full employment was defended a few years ago, that development is one of the central objectives of economic policy in those countries which are at present underdeveloped. The Government of Brazil, through its representatives in the United Nations and in repeated official statements, has been one of the first national authorities to recognize economic development as a general principle of domestic and foreign policy.

In chapter II of Part One, an attempt has been made to define the scope and targets of a development policy for the Brazilian economy during the next few years. This chapter gives an indication of the practicability of the different targets, taking account of the probable behaviour of the economy's salient factors and strategic elements.

To judge by the medium-term trends up to the first half of 1955, the most likely annual rate of growth of per capita income until 1962 will be barely 1.5 per cent. This rate compares very unfavourably with that of 3 per cent registered for the period 1940-54, and even more unfavourably with that of the last decade. What are the possibilities of intensifying this rate of growth, or better, of preventing it from deteriorating in the way described?

The probable effects of raising the rate of saving from 11 to 13 per cent are pointed out in chapter II. Such an increase might be one of the objectives of a programme. Similarly, an attempt is made to assess the results of persistent efforts to improve the degree of utilization of existing and future productive capacity. The part which could be played by a sizeable inflow of external resources is also examined. A conjunction of favourable hypotheses on the foregoing factors might conceivably raise the 1.5 per cent rate to something like 4 per cent. A simultaneous fulfilment of all the most propitious hypotheses would appear to be somewhat artificial, even if each individual assumption is entirely realistic. Only consistent and co-ordinated action affecting the system as a whole could create such a combination of factors favourable to development.

A continuance of the rate of growth of the Brazilian economy during the last ten years would thus appear to be too ambitious a goal as far as the immediate future is concerned. As an illustration, a very much lower target of 2 per cent per annum has been adopted in this study. But even so this rate is 25 per

cent higher than that which would result should present trends prevail. The choice of a somewhat modest rate has at least the advantage of defining the minimum effort at co-ordination required by the adoption of a programme.

Many stages have yet to be accomplished before the Brazilian economy is in a position to undertake an intensive programme, although advances have been made during recent years. Awareness of the need to intensify investment in the basic sectors has taken the form of plans for the development of coal, petroleum and electric energy production. The Banco Nacional do Desenvolvimento Econômico is making efforts to remove the barriers to the development of railway transport. The technique of budgeting foreign exchange has been developed—an instrument of considerable range in the implementation of programmes. Some progress has been made in reforming the federal budget, so that it may be more adaptable to governmental action in the economic sphere. There is a growing conviction, manifest in the numerous measures of the Superintendência da Moeda e do Crédito, of the need for concerted action to modify the banking system—a pre-requisite for the clear definition of objectives within a credit policy.

Despite this progress, intensive programming would undoubtedly require more thorough and up-to date economic knowledge than has yet been attained in Brazil. In addition, it would call for the adaptation of existing governmental instruments for guiding economic activity, a process which in itself would take some time to achieve results. If the target set is a more modest one, such considerations lose significance. Moreover, the effort required might help to show where the economy is most in need of improvement.

What conclusion can be reached about this modest target of 2 per cent as the annual rate of growth of per capita income? It might seem surprising that the first inference to be drawn would be that so low a rate would necessitate greater structural modifications than those accompanying the much more intensive growth of the last decade. This will be seen to be the case when the problem of import replacement is broached.

For a better understanding of what a target of 2 per cent implies in the context of a programme, its most important consequences are summarized from three different standpoints: (a) the probable development of exports; (b) import replacement requirements; and (c) the internal productive effort which must be made in the principal sectors, including those of transport and energy.

The capacity to import forms an autonomous element in a development programme. Whether or not an over-all programme exists—and apart from extra-economic considerations—the objective must be to increase this capacity to the maximum. Chapter IV of Part One analyses Brazilian experience in this field during the last fifteen years. If Brazil has managed to maintain its share in world trade, and even to improve on its pre-war position, this has been entirely due to the increase in the relative prices of its exports. Nevertheless, during the period 1948-53, Brazil's share actually fell, despite the exceptional rise in coffee prices. Thus it may be concluded that during the last five years Brazil lost more from the reduction in the volume of its exports than it gained from the higher coffee prices.

An analysis of the problem in terms of future prospects requires an examination of two cardinal points. The first

refers to the trend of coffee prices, the main aspects of which are discussed in Part Two.<sup>1</sup> As a working hypothesis, it was assumed that prices would be stabilized around the levels prevailing between 1949 and 1952. The second point is related to the recovery of the quantum of other Brazilian exports.

In 1954, the first steps were taken towards achieving this recovery, which forms one of the main objectives of current exchange policy. If the quantum of exports were to grow at an annual rate of 6.5 per cent between 1955 and 1960, by the latter year the 1946 level (which was virtually the same as that of 1939) would have been regained. These figures give a clear idea of how much ground has been lost.

A great effort must therefore be made in the sphere of export recovery and might well be considered as one of the chief targets of a programme. If, between 1955 and 1960, an annual rate of increase of 6.5 per cent were attained, and if the terms of trade were barely to regain their 1952 level, in 1956 the capacity to import—given the country's financial commitments at that time—would still be 10.5 per cent lower than in 1954 and 31.2 per cent lower than in 1951. By 1962, the capacity to import would have exceeded the 1954 level by 23.3 per cent, but even then would not have recovered that of 1951. In this way, the share of imports in community expenditure, which stood at 14 per cent during the period 1947–53, would have to be reduced to about 10 per cent in 1962, notwithstanding the modest rate of growth of income which was set as a target in a programme of minimum development.

These elements are the basic points of reference in estimating the effort required to achieve the necessary import replacement. If the share of imports in over-all expenditure should fall from 14 to 10 per cent, then their growth would be 30 per cent less than expenditure. To measure the real degree of replacement, the income-elasticity of demand for staple imports must be assessed. Since it is known empirically that this elasticity is not less than unity, it may be concluded that the minimum degree of replacement would be about 30 per cent. With an income-elasticity coefficient of 1.5, replacement would exceed 50 per cent. If it is remembered that during the last five years the share of imports in total domestic supply remained at the pre-war level,<sup>2</sup> it may be inferred that the degree of replacement required in the future will be rather higher than that which accompanied the intensive income growth during the last decade.

Chapter IV attempts to show to what extent such a degree of replacement would be compatible with national conditions. By means of preliminary research into the income-elasticity of demand for consumer goods, it was possible to forecast the probable modifications in the structure of such demand as per capita income rises. An endeavour was made to assess the degree of replacement required in the principal sectors on the basis of the present share of imports of each main group of commodities. In this, as in other aspects of programming, some general criteria must be established. These criteria emerge from an acceptance of various broad principles and from observation of the changing situation. Among such principles, the following deserve special mention: the expe-

diency of achieving a relative intensification of manufactured capital goods imports—that is, of those commodities by means of which the techniques of more highly developed countries are disseminated; and the need to take account of the requirements of strictly bilateral trade. Imports that cannot easily be replaced, such as those of petroleum, were projected in terms of a probable increase in domestic production; on the other hand, imports of consumer manufactures were estimated in the context of an intensive replacement policy.

How would this problem present itself in practice? During the period 1947–54, the share of imports in the domestic supply of foodstuffs stood at 8.4 per cent. The aggregate projections show that demand for foodstuffs will probably expand by approximately 30 per cent between 1954 and 1962. Such an increase is greater than the 23-per-cent expansion estimated for the capacity to import. If the phenomenon is viewed over a longer term, there is evidence of a continual contraction in the share of imports in the domestic supply of foodstuffs—from barely 20 per cent in 1925 to 12.4 per cent in 1939 and to an average of less than 9 per cent in the post-war period. Thus one of the targets of a programme might be the reduction of this share to something like 7 per cent. This would imply stabilizing foodstuffs at the 1954 level. Given this general objective, its feasibility should be ascertained through a study of the principal groups of imported foodstuffs. By means of such an examination it would be possible, on the one hand, to discover how far the replacement targets are attainable, and, on the other, to establish the required level of domestic production in the strategic sectors. A study of this type has been undertaken in the case of wheat.<sup>3</sup>

The consumer manufactures sector plays a basic role in the question of replacement. Its share in imports fell from 20 per cent in 1939 to 17 per cent and 14 per cent in 1949 and 1954, respectively. Nevertheless, this rate of replacement is likely to prove inadequate in the future. It is pointed out in chapter IV that, under such conditions, imports would increase by approximately 30 per cent between 1954 and 1962, notwithstanding the substantial slackening of demand for these commodities owing to the fall in the rate of income growth. Once this need to intensify replacement had been conceded, a study was undertaken of the principal groups of manufactures. During the last five years, there was evidently no replacement of certain non-durable goods imports; quite the reverse was true of pulp and paper and pharmaceutical products. The feasibility of reversing these trends was manifest, and in 1955 this actually took place in the case of the commodities mentioned. As the relevant data clearly demonstrate, it will be easy to intensify replacement in this sector, given a policy to guide and stimulate those groups of industries which were left at a certain disadvantage after the recent exchange reform.

As regards durable goods, special attention has been given to the motor vehicle industry, whose development is dependent upon incentives of a more conclusive and far-reaching nature. The size of the motor vehicle market is to a large extent governed by the sales price of the article. In a preliminary estimate, it was calculated that if this price did not,

<sup>1</sup> See chapter II.

<sup>2</sup> Both at constant prices.

<sup>3</sup> The study, which was planned as part of this report, will be published separately at an early date.

on an average, exceed 150,000 cruzeiros, at the beginning of the period 1955-62 demand—excluding that for freight vehicles—would not be less than 50,000 units, rising ultimately to 80,000.

A special study on the demand for fuels appears in Part Two.<sup>4</sup> According to this study, if the economy developed in the way described, the consumption of refined petroleum products would increase from 7.6 to 15.3 million tons between 1954 and 1962. The most intensive growth would take place in aviation petrol and the least in fuel oil. Imports were projected in accordance with a hypothetical development of domestic production, which is an extremely modest one in view of certain official statements made in Brazil after the discovery of the Nova Olinda oilfield in Amazonas. This hypothesis is contingent upon a production of slightly more than 3.5 million tons and a refining capacity of about 10 million. If these targets are attained, in 1962 fuel imports will absorb approximately the same proportion of the capacity to import as they did in 1953—namely, about 18 per cent.

An analysis of replacement possibilities permitted a definition of the effort required from domestic production in the principal groups of consumer goods. But its usefulness does not end here. As soon as an idea is obtained of that proportion of the capacity to import absorbed by consumer goods and fuels, there will be no difficulty in assessing the capacity to import capital goods. In reality, once the hypotheses on the replacement of consumer-goods imports are accepted, it can be inferred that capital-goods imports will increase by 60 per cent over the 1954 level. According to the final section of chapter V of Part One, this intensive increase in the capacity to import capital goods is an indication of the low level to which these imports had fallen in 1954. In relation to 1951, the increment will not exceed 14 per cent.

As regards the production of capital goods, it was considered advisable, as a general principle, to maintain and prolong the trend towards a more intensive replacement of semi-manufactured goods—building materials and industrial metals. Special projections were established of the demand for the most important commodities—cement and ferrous metals. Steel ingot production, which reached nearly 1.2 million tons in 1954, must rise to 2.5 million in 1962 if it is to meet aggregate demand, excluding that for special steels. To reach this target of self-sufficiency, the share of domestic production in total supply, which rose from 40 to 80 per cent in the post-war period, must merely continue its present trend. The report gives an account of the main projects which are either at the planning stage or actually under way. These would indicate that autarky can be achieved, provided that investment

continues to receive the stimulus that was given to it in the past.

The projection of the demand for cement postulates that consumption will reach 4.5 million tons, which is equivalent to a rise of 63 per cent in relation to 1954. It may be expected that domestic production will also be able to satisfy the country's over-all requirements, since the projects under way would indicate that the intensive rate of growth of production, which was doubled between 1949 and 1954, will continue for some time to come. In 1954, imports formed barely 12 per cent of domestic supply.

The intensive increase in the production of semi-manufactured goods will make possible a greater expansion of imports of equipment. Nevertheless, a greater effort will be needed if production is to increase by approximately 90 per cent between 1954 and 1962. This will imply the maintenance of the post-war rate of expansion.

If the details are set aside and attention concentrated on the productive effort as a whole, it will be appreciated that such an effort is on a fairly large scale, given the modest nature of the targets set for growth and economic welfare. For example, the rate of growth required for agriculture (3.7 per cent annually) is well above that of the period 1940-54 (2.3 per cent) and even greater than that of the last five years (3.5 per cent). This can be well understood if it is recalled that throughout the entire period 1940-54 production for export remained stationary, and it would therefore be essential to promote the recovery of this sector. The growth of aggregate manufacturing production would attain an annual rate of 6 per cent (5 per cent in consumer-goods industries and 8 per cent in those of capital goods). On the face of it, this would seem lower than the rate of 7.9 per cent at which industrial production increased during the last five years. However, in the light of the effects of the recent exchange reform on the capacity of industries to finance their own undertakings, as great an effort would have to be made in the future as in the past.

Finally, in the strategic sectors of energy and transport, there is still much ground to be covered. If the effort of recent years to re-equip the railways is maintained, there is every hope that the target of an annual increase of 6 per cent in freight transported will be attained. Should this not be the case, then it must be assumed that deficient transport will continue to obstruct the expansion of domestic production, particularly that of agriculture. An annual increase of 7.2 per cent is the target for electric energy production. This is more or less in conformity with the objectives of the Brazilian Government's electrification plan, funds for the implementation of which have already been partially approved by Congress. In this instance, therefore, the problem is to put the existing plans into operation.

<sup>4</sup> See chapter IV.

**Part One**

**PROJECTIONS FOR A DEVELOPMENT PROGRAMME**



## MACRO-ECONOMIC ANALYSIS OF DEVELOPMENT SINCE 1939

### 1. INTRODUCTION

The development of a national economy is based on the increase in the physical productivity of its labour force. This increment, in turn, is made possible by the accumulation of capital and by technical progress.

At the present time, the under-developed countries have at their disposal the technical knowledge accumulated by the more advanced economies, and therefore changes in technology do not constitute a factor limiting their development.<sup>1</sup> Thus, in the specific case that will be considered, the accumulation of capital represents the corner-stone of development.

The accumulation of capital is the process whereby, during a given period, a proportion of the goods and services available in an economy is incorporated into that economy's productive capacity. This process has two fundamental aspects: it may be considered, on the one hand, as a deferment of the enjoyment of the fruits of labour and, on the other, as an increase in productive capacity. The problems of saving and of investment can be brought into focus by an examination of each of these two aspects, respectively.

However, the key to an explanation of the whole development mechanism of an economy such as Brazil's is not to be discovered here. There are other factors, unconnected with productive effort, which may play a decisive role. These are the elements that influence the level of aggregate domestic supply, without any prior alteration in productive capacity,<sup>2</sup>—namely, changes in the terms of trade and the net inflow of foreign resources.

These two factors directly influence available goods and services, independently of the process of accumulation—that is, without the pre-requisite of the creation of productive capacity. In the case of a net inflow of resources, the effect is concentrated in investment, entering into direct contact with the process of accumulation. As regards an improvement in the terms of trade, the repercussions are more complex: according to the sector in which the increase in real income is concentrated, there will be a greater or lesser re-distribution of such income and therefore a greater or lesser change in the savings coefficient. Even on the assumption that this latter remains constant, there will always be an increase in saving

in so far as real income expands. As the level of saving rises, the volume of investment will also increase, thus accelerating the process of accumulation.

Finally, it is pertinent to consider a problem specific to under-developed economies—namely, that of the possibility of transforming saving into real investment. It is well known that in a developed economy saving does not necessarily imply growth, since in this case it is the level of effective demand that conditions the process of accumulation. Similarly (but for other reasons), saving in an under-developed economy is not always an effective cause of growth. There must also be the possibility of converting this saving into real investment—a possibility dependent, to a varying degree, upon the capacity to import. As the domestic production of capital goods increases, this dependence will tend to wane, the importance of foreign trade in the process of accumulation thus being reduced, without detriment to the part it plays in the general process of development and as one of the factors determining the level of effective demand.

In the present chapter, an analysis will be made in macro-economic terms of the development of the Brazilian economy since 1939. This analysis is centred on the following points:

- (a) Available goods and services and expenditure; factors determining the level of supply and composition of expenditure; share of the public sector;
- (b) The process of accumulation; strategic factors conditioning the rate of growth;
- (c) The production process; production for domestic and foreign markets; agricultural and manufacturing production;
- (d) The capacity to import; quantum of exports and the terms of trade;
- (e) Utilization of the capacity to import; the role of imports in consumption and accumulation;
- (f) The inflationary process; consequences for the public and private sectors.

### 2. AVAILABLE GOODS AND SERVICES AND EXPENDITURE

#### (a) *Production and external factors*

The growth of domestically available goods and services depends fundamentally on three factors: (1) domestic production; (2) the effect of the terms of trade on real income; (3) the net inflow of external resources.

Table 1 gives a calculation of available goods and services during the period 1939–54, at 1952 prices. This supply rose from 176.2 to 413.2 billion cruzeiros, that is, at a cumulative annual rate of 5.9 per cent. Since the annual average growth of the population was 2.4 per cent, it may be concluded that the per capita supply increased by 3.4 per cent per annum, during the period in question. Given the length of the period, this represents a relatively intensive rate.

<sup>1</sup> For an analysis of another aspect of this problem, see *Problemas Teóricos y Prácticos del Crecimiento Económico*. In this study, attention is drawn to the fact that the techniques available to the under-developed countries do not always correspond to their real needs, which arise from their degree of development. Furthermore, it should always be borne in mind that the assimilation of techniques in certain under-developed areas creates a series of problems whose elucidation exceeds the limits of economic analysis.

<sup>2</sup> Problems related to the variations in the level of utilization of productive capacity will not be considered here. Purely from the point of view of analysing projections, in a preliminary approximation, cyclical factors may be considered as exogenous elements.

Table 1. Brazil : gross product, gross income and available goods and services

(Billions of cruzeiros at 1952 prices)

Year	Gross product	Effect of terms of trade	Gross income	Effect of net inflow of external resources	Available goods and services
1939 .....	200.3	-21.4	178.9	- 2.7	176.2
1940 .....	200.3	-20.0	180.3	- 0.9	179.4
1941 .....	210.0	-14.7	195.3	- 5.3	190.0
1942 .....	203.5	-14.7	188.8	- 9.3	179.5
1943 .....	209.0	-17.5	191.5	- 8.6	182.9
1944 .....	219.4	-13.7	205.7	- 8.4	197.3
1945 .....	234.6	-13.1	221.5	-10.4	211.1
1946 .....	257.7	-12.2	245.5	- 9.1	236.4
1947 .....	278.3	- 6.1	272.2	3.8	276.0
1948 .....	294.1	-11.5	282.6	- 1.4	281.2
1949 .....	302.1	- 8.1	294.0	0.6	294.6
1950 .....	324.1	5.5	329.6	- 6.3	323.3
1951 .....	346.5	1.0	347.5	8.7	356.2
1952 .....	360.9	—	360.9	16.6	377.5
1953 .....	376.1	3.3	379.4	- 5.3	374.1
1954 <sup>a</sup> .....	409.2	7.0	416.2	- 3.0	413.2

Sources : Banco Nacional de Desenvolvimento Econômico and Economic Commission for Latin America, Joint Commission.

NOTE.—The production series, at 1952 prices, was obtained by using the index of real production (see table 8) and the 1952 value of gross income at market prices. Gross income, at the prices of a given year, is equal to production at the prices of the same year plus or minus the changes in the real value of production caused by variations in the terms of trade. If the part not utilized in the country is subtracted from gross income, and external resources (including capital inflow) are added, the available goods and services will be obtained.

<sup>a</sup> Preliminary estimates.

The period under study consists of three very distinct phases : the first corresponds to the war years (1939-45), the second to the post-war recovery (1945-49), and the third to recent years (1950-54), during which the high level of coffee prices was registered. The first and second periods are clearly abnormal, in the sense that the rate of growth was extremely low and extremely high, respectively. For purposes of analysis, it has therefore been considered more accurate to deal with the period 1940-49 as a whole. If the rate of growth of the per capita supply of goods and services which prevailed in this decade is compared with that of the most recent quinquennium, it will be found that the former rate is half as great. The increase in available goods and services which took place in the period under study resulted as much from the expansion of domestic production as from the action of external factors.

In order to estimate the relative shares of domestic production and external factors, recourse will again be had to the data in table 1 for calculating the effect of the terms of trade with 1939 as the base year. The index of the terms of trade rose to 270 in 1954,<sup>3</sup> the effect of this improvement amounting to 49.3 billion cruzeiros.<sup>4</sup> If a further calculation of available goods and services is made on the basis of these new values for the effect of the terms of trade—zero in 1939 and 49.3 billion in 1954—the following values will be obtained for the first and last years of the series : 197.6 and 455.5 billion cruzeiros respectively. The difference between these two values—257.9 billion—represents the increase in available goods and

services. A comparison of this figure with the sum corresponding to the effects of the improvement in the terms of trade will confirm that the share of the latter rose to 19.1 per cent.

As can be deduced from table 1, the cumulative result of the improvement in the terms of trade rose to 156.8 billion cruzeiros over the whole period—that is, to approximately \$5.3 billion at 1952 prices. The net outflow of resources reached 41 billion cruzeiros (\$1.4 billion). The cumulative share of external factors must therefore have increased to 116 billion cruzeiros (\$3.9 billion).

The discrepancy between the rate of growth of the product and that of available goods and services is a very obvious one which reflects the favourable action of external factors. (See table 2.)

Table 2. Brazil : annual average per capita rates of growth (Percentages)

Period	Product	Available goods and services
1940-45 .....	0.3	0.7
1946-49 .....	4.0	6.2
1950-54 .....	3.8	4.5
1940-49 .....	1.9	2.8
1940-54 .....	2.4	3.4

Source : Table 1. Data on population used to compute these rates were supplied by the Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics).

<sup>3</sup> See table II of the Statistical Appendix to Part One of this study.

<sup>4</sup> The quantum of exports, at 1952 prices, decreased from 39.4 billion to 29 billion cruzeiros. (See again table II of the Statistical Appendix.) An increase of 170 per cent in the terms of trade pre-supposes the addition of 49.3 billion cruzeiros to the real value of the 29 billion exported in 1954.

This discrepancy is of major importance in a study on the development trends of the Brazilian economy during the next few years. The deterioration in the terms of trade, already strongly manifest in 1955, as well as the burden of



recent financial obligations, can reverse this trend in such a way that available goods and services will grow less rapidly than production. This gives some indication that in the immediate future it will not be easy to maintain the rate of growth prevailing over the last five years, unless measures are adopted to counteract the changing tendency of external factors.

(b) *The structure of expenditure*

An examination should now be made of the way in which available goods and services were utilized. A proportion,

corresponding to net investment, was used to increase productive capacity; another part was destined to replace the stock of capital; and yet another to meet the community's consumption needs. Estimates are given for each of these items in table 3. The data demonstrate the great stability of the consumption-expenditure ratio. Variations are encountered which range from 90.4 to 82.6 per cent—the extremes to be observed in the years 1945 and 1952, respectively.

Modifications in the volume of expenditure on consumption are primarily a function of changes in the community's level

Table 3. Brazil : distribution of expenditure between investment and consumption  
(Billions of cruzeiros at 1952 prices)

Year	Expenditure	Depreciation	Net investment	Consumption	Consumption as a percentage of expenditure
1939 .....	176.2	12.0	10.7	153.5	87.1
1940 .....	179.4	12.2	10.4	156.8	87.4
1941 .....	190.0	12.5	11.6	165.9	87.3
1942 .....	179.5	12.9	6.7	159.9	89.1
1943 .....	182.9	13.1	7.2	162.6	88.9
1944 .....	197.3	13.4	10.8	173.1	87.7
1945 .....	211.1	13.6	6.7	190.8	90.4
1946 .....	236.4	13.8	15.7	206.9	87.5
1947 .....	276.0	14.3	24.8	236.9	85.8
1948 .....	281.2	15.1	20.2	245.9	87.4
1949 .....	294.6	16.3	30.3	248.0	84.2
1950 .....	323.3	17.2	34.5	271.6	84.0
1951 .....	356.2	18.2	41.7	296.3	83.2
1952 .....	377.5	19.3	46.3	311.9	82.6
1953 .....	374.1	20.5	37.2	316.4	84.6
1954 <sup>a</sup> .....	413.2	21.8	37.2	354.2	85.7

Source : Statistical Appendix.

NOTE.—The series of expenditure is that which appears in table 1 as "available goods and services".

<sup>a</sup> Preliminary estimates.

of income. The increase that took place in expenditure during the period under consideration resulted not only from the growth of domestic production, but also from the improvement in the terms of trade, both of which are determinants of the level of income. Given this more rapid growth of income than of production, the logical outcome was for consumption to outstrip the latter as well, which in fact it did.

Table 4. Brazil : annual average per capita rates of growth  
(Percentages)

Period	Income	Consumption
1940-45 .....	1.2	1.3
1946-49 .....	4.8	4.3
1950-54 .....	4.7	4.9
1940-49 .....	2.6	2.4
1940-54 .....	3.3	3.2

Sources : Tables 1 and 8.

Although the margin of error may be wide, there is an evident affinity between the rates shown in table 4. Thus, during the entire period 1940-54, the rate of growth of production was 2.4 per cent, that of consumption 3.2 per

cent, that of income 3.3 per cent, and that of available goods and services or expenditure 3.4 per cent. The difference between the growth of consumption and the increase in production is particularly apparent. For a better understanding of this discrepancy, it should be recalled that, as shown in table 1, the absolute increase in the product during 1939-54 was 208.9 billion cruzeiros. Since the absolute increase in consumption reached 201.4 billions (see again table 3), it may be inferred that the conditions created by external factors were so favourable that consumption was able to absorb the entire benefit of the increased productive effort, without any reduction in the rate of saving.

The statement made in the preceding paragraph brings to light another factor of basic importance in projecting the development of the Brazilian economy, namely, that the intensive growth during 1939-54 took place at a time when consumption was increasing with greater intensity than the product measured in terms of hours worked and physical productivity.

(c) *Share of the public sector in expenditure*

The data available on the public sector do not permit from 1939 onwards, an analysis such as that outlined for the economy as a whole. In this case the period under review must be restricted, and consequently will begin with the year 1947.

Governmental action, from the economic point of view, is taken at two levels: (a) it renders direct and indirect services to the population; and (b) it contracts labour, and purchases the goods and services destined for the maintenance, operation and expansion of organizations rendering these services.

Current governmental expenditure, aimed at providing such services as security, defence, education, health, etc., from the point of view of the community as a whole, represents expenditure on consumption. On the other hand, public expenditure made for the purpose of increasing the capacity to render such services—the construction of barracks, schools, hospitals, etc.—, as well as the expenditure destined to increase the productive capacity of the economy as a whole—roads, ports, etc.—, is classified as investment. In addition to this current and capital outlay, the state authorities also effect expenditure of another type, the final destination of which it is not easy to define. This expenditure consists of transfer payments within the private sector. Through them the government alters the structure of private sector expenditure and occasionally the composition—though not the level—of total expenditure.

Table 5 shows the distribution of expenditure between the private and public sectors, including, in the latter instance, all transfers made by governmental authorities.

There is an obvious tendency on the part of the public sector to increase its share in total expenditure. However, this increase did not take place regularly, since it was concentrated in the period 1948–49 and in 1953. From 1949 to 1952, there was a relative stability of the public sector's share in aggregate expenditure.

Table 5. Brazil: distribution of expenditure between the private and public sectors

(Billions of cruzeiros)

Year	Expenditure	Private sector	Public sector	Public sector expenditure as a percentage of total
1947 .....	171.5	142.30	29.20	17.0
1948 .....	190.7	155.69	35.01	18.4
1949 .....	218.2	172.85	45.35	20.8
1950 .....	247.2	193.06	54.14	21.9
1951 .....	314.6	252.03	62.57	20.0
1952 .....	377.5	300.21	77.29	20.5
1953 .....	415.8	314.78	97.80	23.5

Source: Statistical Appendix.

An increased participation by the public sector can occasion a relative increase of consumption expenditure or of investment, according to which type of expenditure grows the faster. Table 6 gives some details of the composition of public expenditure in the period under consideration.

Approximately one-quarter of public sector expenditure is composed of transfers—that is, funds collected for the purpose of subsidizing private sector activities. Although many of these activities are government-owned—railways, shipping companies, etc.—such enterprises operate as private organizations, even when directly aided by the public authorities.

Table 6. Brazil: composition of public expenditure

Year	Expenditure on goods and services		Expenditure on capital account		Transfers		Total
	(A)	(B)	(A)	(B)	(A)	(B)	
1947 .....	15,801	54.1	5,858	20.1	7,504	25.8	29,199
1948 .....	18,805	53.7	8,221	23.5	7,963	22.8	35,009
1949 .....	22,766	50.1	11,686	25.8	10,902	24.1	45,354
1950 .....	27,409	50.6	14,321	26.5	12,412	22.9	54,142
1951 .....	31,816	50.9	15,628	25.0	15,121	24.1	65,565
1952 .....	39,154	50.7	19,876	25.7	18,257	23.6	77,287
1953* .....	47,700	48.8	24,500	25.1	25,600	25.6	97,800

Source: Statistical Appendix.

Note.—(A) = Millions of cruzeiros. (B) = Percentage of total.

\* Preliminary estimates.

Table 7. Brazil: share of the public sector in capital formation and in consumer expenditure

(Billions of cruzeiros)

Year	Aggregate gross investment	Public investment	(B) as a percentage of (A)	Total consumer expenditure	Governmental current expenditure	(D) as a percentage of (C)
	(A)	(B)		(C)	(D)	
1947 .....	26.5	5.86	22.1	145.0	23.34	16.1
1948 .....	25.9	8.22	31.7	164.8	26.79	16.3
1949 .....	33.6	11.69	34.8	184.6	33.67	18.2
1950 .....	36.7	14.32	39.0	210.5	39.82	18.9
1951 .....	52.8	15.63	29.6	261.8	46.94	17.9
1952 .....	65.6	19.88	30.3	311.9	57.14	18.3
1953 .....	64.0	25.60	40.0	351.8	73.30	20.8

Source: Statistical Appendix.

"Expenditure on goods and services" constitutes the item that may strictly be considered as the direct rendering of services to the community. Its share in the total expenditure of the public sector declined from 54.1 to 48.8 per cent. This decrease took place precisely in those periods (1947-49 and 1953) during which the share of the public sector in expenditure grew. This demonstrates the fact that it was mainly public investment which accounted for the expansion in the government sector.

In table 7 the growth of governmental current expenditure (including transfers) is compared with the community's consumption expenditure, and public investment with aggregate investment.

### 3. THE PROCESS OF ACCUMULATION

Provided there is always an adequate level of effective demand, the possibility of growth in an under-developed economy depends directly on the supply of resources for accumulation.<sup>5</sup> Given the existence of potential natural resources, of an elastic labour supply, and of an entrepreneurial class in the process of formation (as in the case of Brazil), the intensification of development becomes a problem of increasing the volume of resources destined for accumulation.<sup>6</sup>

Such resources emanate mainly from the flow of income generated in the country. Experience demonstrates that the level of income is the principal determinant of the level of consumption and therefore of the level of saving. It also indicates that when there is no unemployment of factors due to inadequacy of effective demand, the community tends to consume a relatively stable part of its income. When income is reduced through insufficiency of such demand, consumption tends to contract less than proportionately.

These observations are of great importance in an analysis of the process of accumulation. They demonstrate that the volume of resources destined for investment is only a residual element and that, under conditions of spontaneous development, the growth of income is a pre-requisite for an increase in these resources. Since the growth of income, in turn, pre-supposes investment, it is easy to perceive that, when the supply of labour and technical skill is elastic, development tends to take place at a uniform rate,<sup>7</sup> provided that the product-capital ratio remains stable and that other factors, such as those determining cyclical fluctuations, do not intervene.

However, in the case of the under-developed economies, the action of certain factors which occasionally attains a funda-

mental importance should not be overlooked. For example, it should always be borne in mind that resources not used within the country are destined as much for investment as for the fulfilment of external commitments. Thus the supply of resources for accumulation depends as much on domestic saving as on the volume of the net outflow of resources. As will be seen later, the irregularity of this flow of resources abroad accounts to a large extent for fluctuations in the rate of investment.

Once the strategic factors determining the rate of growth—towards which the economy tends spontaneously—are identified, the time is ripe to establish a hypothesis on the most probable pattern of development in the immediate future and to endeavour to influence these strategic factors so that development may be accelerated.

In the course of this study,<sup>8</sup> an attempt will be made to postulate the development of the Brazilian economy during the period 1955-62. To establish the basis of this hypothesis, an analysis will now be made of the behaviour of the principal factors determining the rate of accumulation during the period 1939-54.

### 4. THE PRODUCTION PROCESS

As was noted earlier, the level of income is the principal determinant of accumulation. The rate of investment—withstanding the effect of external factors—fluctuates around the rate of saving, which is a function of the level of income. The same may be said of the relationship between the growth of income and that of the product. It is well known that variations in the terms of trade also influence the level of income. However, the latter fluctuates around the level of the geographic product.

The influence of external factors makes itself felt, therefore, on two planes: first, on the level of income (terms of trade) and, secondly, on the level of accumulation (net outflow of resources).

From the first viewpoint, the production process can be examined. Table 8 shows the indices of the geographic product and its principal components, while table 9 summarizes the behaviour of these indices.

To facilitate a better understanding of these data it must be borne in mind that the product is destined both to satisfy domestic demand and to swell the flow of exports. These latter, if measured by their quantum, remained stationary, or even declined, during the period under consideration, while domestic demand grew as a function of the increase in income.

If the quantum of exports is compared with the gross product (see table 10), it can be ascertained that the share of the former in the latter was reduced from 19.7 per cent in 1939 to less than 10 per cent in 1952-54. This explains why production for the domestic market grew at an annual per capita rate of 3.0 per cent, during the period 1940-54, while the rate for the product as a whole was 2.4 per cent.

However, the rapid growth of production for the internal market does not mean that imports have lost ground. They grew with practically the same intensity as domestic production, maintaining their share in the supply of goods and services.

<sup>5</sup> The problem of the capacity to import will be considered in section 5 of this chapter.

<sup>6</sup> It is not proposed that there should be discussed here the problem of the limits to the capacity to absorb new capital, which are generally assumed to be narrow in under-developed economies. However, this supposition is based on empirical and isolated observations, and has no more logical foundation. The capacity to absorb capital is, in fact, very great in an under-developed economy, given the elasticity of the supply of labour which characterizes such economies. The problem therefore lies in preventing the demand for consumer goods from growing disproportionately to the supply, and this is not an easy problem to solve.

<sup>7</sup> The historical growth series of free-enterprise economies point to the existence of this stable rate; in the United States, for example, the historical rate of growth per capita was 1.9 per cent per annum. An identical phenomenon has been observed in other countries. See *An Introduction to the Technique of Programming*, which formed volume I of this series of studies.

<sup>8</sup> See chapter II of Part One.

Table 8. Brazil : indices of the geographic product  
(1939 = 100)

Sector	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Agriculture .....	94.7	100.3	93.9	98.4	98.7	97.7	107.5	108.0	113.6	119.7	125.2	125.0	131.0	131.1	140.7
Industry .....	105.1	116.1	112.0	125.0	130.1	137.1	160.2	167.2	183.1	194.2	216.1	233.6	249.1	265.6	284.5
Commerce .....	94.8	100.8	91.6	98.5	103.9	106.6	120.9	134.9	137.0	131.2	154.5	174.5	175.3	170.7	...
Transport .....	107.3	115.4	111.6	115.9	124.2	125.9	128.2	136.5	154.5	165.0	180.0	198.8	211.6	232.6	...
Housing .....	102.0	105.0	108.0	110.0	114.0	118.0	125.0	132.0	138.1	143.1	149.1	156.1	165.1	176.1	...
Government .....	100.0	96.9	96.9	84.4	87.5	100.0	106.3	96.9	109.4	115.6	128.1	134.4	131.3	...	...
Other services .....	100.0	102.7	102.7	102.7	113.5	137.8	154.0	194.6	197.3	191.9	194.6	229.7	218.1	...	...
Total .....	100.1	104.9	101.6	104.4	109.6	117.1	128.6	138.9	146.8	150.8	161.9	173.0	180.2	187.7*	201.2*

Sources : Banco do Desenvolvimento Econômico and Economic Commission for Latin America, Joint Commission.

NOTE. — (1) Basic data from the Fundação Getúlio Vargas and the Banco Nacional do Desenvolvimento Econômico.

(2) The aggregate indices by sector were prepared according to the "Laspeyres" formula. The total index follows the "Paasche" formula, with the series of real value weighted in each year by the price index,

which was obtained by dividing the index of value for each sector by the corresponding quantum index.

(3) The housing index shows the fluctuations in the stock of dwellings, on the assumption that these represent the real services rendered by them.

(4) The commerce index was obtained by the aggregation of the series, at 1949 prices, of industrial production, agricultural production and imports.

\* Provisional data.

Table 9. Brazil : annual rates of growth of production

Sector	1940-54	1940-45	1940-49	1950-54
Agriculture .....	2.3	0.4	1.8	3.3
Industry .....	7.2	5.4	6.9	7.9
Services .....	4.7	2.7	4.0	6.2

Source : Table 8.

Table 10. Brazil : distribution of the product between the domestic and foreign markets  
(Billions of cruzeiros at 1952 prices)

Year	Geographic product	Exports	Production for the domestic market	Exports as a percentage of the product
1939 .....	200.3	39.4	170.9	19.7
1940 .....	200.3	32.5	167.8	16.2
1941 .....	210.0	25.7	184.3	12.2
1942 .....	203.5	28.1	175.4	13.8
1943 .....	209.0	28.9	180.1	13.8
1944 .....	219.4	31.7	187.7	14.4
1945 .....	234.6	34.1	200.5	14.5
1946 .....	257.7	42.2	215.5	16.4
1947 .....	278.3	39.8	238.5	14.3
1948 .....	294.1	40.1	254.0	13.6
1949 .....	302.1	36.1	266.0	11.9
1950 .....	324.1	31.7	292.4	9.8
1951 .....	346.5	34.9	311.6	10.1
1952 .....	360.9	26.1	334.8	7.2
1953 .....	376.1	30.9	345.2	8.2
1954 .....	409.9	29.0	380.9	7.1

Sources : Table 1 and the Statistical Appendix.

NOTE.—The series of geographic product is that of table 1. Data on exports are based on an index of the quantum at 1948 prices. The series of production for the domestic market is residual.

The relative decline in production for the foreign market provoked perceptible changes in the structure of Brazilian production. Measured at constant prices, the share of agricultural output, which represented 39.3 per cent of the total in 1939, had declined to 29.5 per cent in 1953. In the meantime, industry's share had grown from 14.4 to 22.0 per cent. However, these structural changes are not apparent when current values are observed. The growth in the relative prices of agricultural products was sufficient to offset the loss caused by the relative lag in that sector. This phenomenon is intimately linked with the improvement in the terms of trade. As was to be expected, the relative rise in export prices caused a relative increase in agricultural prices within the country, thus enlarging the share of agriculture in income.

Table 11. Brazil : the share of agricultural production  
(Percentages)

Year	In gross product <sup>a</sup>	In gross income <sup>b</sup>
1939 .....	39.3	32.7
1945 .....	34.2	31.5
1949 .....	32.7	29.5
1953 .....	29.5	30.6

Source : Statistical Appendix.

<sup>a</sup> At 1952 prices.  
<sup>b</sup> At current prices.

The data in table 11 illustrate the behaviour of the agricultural sector with respect to the product and to income.

The increase in production for the domestic market took place both in the industrial sector and in the agricultural. In table 12, total supply is divided into industrial and agricultural products, domestic production being separated from imports. The agricultural production destined for the domestic market increased by 84 per cent between 1939 and 1954, that is, at an annual per capita rate of 1.7 per cent.

Table 12. Brazil : growth in the supply of agricultural and manufactured products in the domestic market  
(1939 = 100)

Year	Agricultural products		Manufactured products	
	Domestic production	Imports	Domestic production	Imports
1945 .....	125	120	137	87
1949 .....	153	104	194	182
1950 .....	166	139	216	183
1951 .....	167	160	234	290
1952 .....	168	147	249	252
1953 .....	180	176	266	177
1954* .....	184	184	285	233

Source : Statistical Appendix.

\* Preliminary estimate.

The fact that production for the domestic market kept pace with the growth of foodstuffs imports is of particular significance, considering that the latter were practically unrestricted and, in addition, received the benefit of a hidden exchange subsidy. The minimum conclusion that can be drawn from these facts is that domestic production responded to the needs of rising demand. Consequently, the relative decline in agricultural production, mentioned earlier, reflects purely and simply the stagnation of the foreign sector, the relative importance of which diminished throughout the period under review.

The supply of manufactured products of domestic origin grew, between 1939 and 1954, at an annual average per capita rate of 4.7 per cent. In this sector also, imports maintained their share, at least until 1952.

The data presented afford one more conclusion of importance in preparing a hypothesis of short-term development trends—namely, that the rapid growth of income in the period as a whole coincided with an expansion in the quantum of imports both in agriculture and in manufacturing industry. In other words, the import-replacement effort required from the Brazilian economy was minimum in the phase of growth under consideration, although the composition of imports had had to undergo a radical change.

## 5. THE CAPACITY TO IMPORT

This exceptional growth of imports was made possible by an unusual improvement in the terms of trade. Although the quantum of exports remained stationary, or even declined, the terms of trade rose by nearly 170 per cent between 1939 and 1954. (See table 13.)

It has already been observed that in an under-developed economy the capacity to import plays a fundamental role in the process of accumulation. But if the capacity to import

Table 13. Brazil : indices of foreign trade

	1945	1949	1954	1954
	(1939 = 100)		(1949 = 100)	
Quantum of exports ..	86.7	91.8	74.0	80.1
Terms of trade .....	135.3	170.4	269.5	158.2
Capacity for external payment .....	116.7	155.6	231.2	148.9
Quantum of imports ...	97.7	155.6	216.4	139.1
Available goods and services .....	119.8	167.2	234.9	140.5

Source : Statistical Appendix.

has grown so rapidly, what then is the explanation for the tendency towards permanent disequilibrium in the balance of payments, characteristic of the whole post-war period? This tendency is directly related to the disparity between the prices of production for the domestic market and those of imports. A phenomenon of vital importance which took place during this period was the strong rise in the prices of exports over those of imports. The result of this divergence was an improvement in the country's terms of trade, which made itself apparent in the acceleration of the growth of income in relation to that of the product. Given the characteristics of the Brazilian economy, a rise in export prices could not easily be prevented from spreading to production for the domestic market, particularly in the agricultural sector. In certain areas, some competition for factors has been observed between the two branches of production. A rise in agricultural prices would necessarily tend to have its repercussions on the general price level and to spread to the other sectors. Part of such a rise was absorbed by industry and services, resulting in a relative increase in the income of farmers. However, the rise in the general price level was very great, the relation between the prices of commodities for the domestic market and the prices of imports being substantially modified. The data in table 14 give a clear demonstration of these discrepancies in the evolution of prices.

Table 14. Brazil : comparison of some price indices

	1945	1949	1953	1953
	(1939 = 100)		(1949 = 100)	
Exports .....	234.6	407.7	707.6	173.4
Agricultural production for export .....	233.5	434.8	938.2	215.8
Agricultural production for the domestic market ..	237.9	365.5	601.0	164.4
Industrial production for the domestic market ..	213.6	333.2	431.8	129.6
General domestic price level .....	214.1	337.4	505.0	149.7
Prices of imports .....	186.5	241.0	273.0	113.5

Source : Statistical Appendix.

The disequilibrium between domestic prices and those of imports gave rise to a persistent and growing pressure on the capacity for external payment. In failing to adopt a system of multiple exchange rates, Brazil found itself in the following dilemma : if the currency were devalued, the terms of trade would deteriorate; if, on the other hand, there were no devaluation, a growing pressure on the balance of payments

would be created. The application of the second alternative until the end of 1953 resulted in an aggravation of the external disequilibrium.

## 6. UTILIZATION OF THE CAPACITY TO IMPORT

Since the capacity to import grew parallel with income, it was to be expected that imports of consumer goods would increase in the same proportion as consumption. Moreover, as the prices of national agricultural commodities rose more rapidly than those of domestically produced manufactures (other factors being constant) it was likely that imports of agricultural products would increase with especial intensity.

Table 15. Brazil : indices of consumer goods imports and of total consumption

	1945	1949	1954	1954
	(1939 = 100)		(1949 = 100)	
Consumer goods .....	94	139	216	155
Foodstuffs .....	120	104	184	177
Fuels .....	74	188	368	196
Chemical products .....	87	203	373	184
Pulp and paper .....	103	116	257	222
Final manufactured goods ..	51	199	154	78
Total consumption .....	124	162	206	128

Sources : Statistical Appendix and the special studies which form Part II of this work.

The strong impetus given to consumer-goods imports, owing to the movement of relative prices, was partially offset by the barrier which a selective import control attempted to establish. This control made itself felt more rigorously in the final manufactured goods sector, creating, as an indirect consequence, a stimulus to investment in domestic industrial production.

The situation which arose may be summarized as follows : on the one hand, income expanded and this determined a large increase in the demand for manufactured goods, the income-elasticity of which is notoriously high; on the other, imports of manufactured consumer goods were severely restricted. The combination of these two factors was bound to result in a great stimulus to investment in the country's manufacturing industry. To realize such investment it was necessary to have equipment, the demand for which had to grow even more rapidly than that for manufactured consumer goods, owing to the well-known accelerator mechanism. It was here that the increase in the capacity to import played a fundamental role in accelerating growth. The share of capital goods imports in the value of investment rose from 27 per cent in 1939-41 to an average of 34 per cent in the period 1945-54. This phenomenon is apparent from the data in table 16.

The decline in the capacity to import, which became manifest in 1953,<sup>9</sup> necessarily had a more adverse effect on imports of capital goods than on those of consumer goods, since items of great rigidity, such as raw materials and fuel, weigh heavily among the latter. Repercussions on the economy's

<sup>9</sup> The reduction in imports, which began in 1953, reflects not exactly a decline in the capacity to import, but rather the burden of financial commitments accumulated in 1951 and 1952. It was not until 1955 that the depressive effect of a combination of the two factors was to become apparent.

Table 16. Brazil : share of imports in capital formation  
(Billions of cruzeiros at 1952 prices)

Year	Total investment	Capital goods imports	Domestic production of capital goods	Imports as a percentage of the total
1939 .....	22.7	6.8	15.9	30.0
1940 .....	22.6	5.5	17.1	24.3
1941 .....	24.1	6.3	17.8	26.1
1942 .....	19.6	3.4	16.2	17.3
1943 .....	20.3	4.4	15.9	21.7
1944 .....	24.2	6.2	18.0	25.6
1945 .....	20.3	7.4	12.9	36.5
1946 .....	29.5	12.1	17.4	41.0
1947 .....	39.1	17.9	21.2	45.8
1948 .....	35.3	14.3	21.0	40.5
1949 .....	46.6	13.9	32.7	29.8
1950 .....	51.7	13.0	38.7	25.1
1951 .....	59.9	22.4	37.5	37.4
1952 .....	65.6	20.5	45.1	31.3
1953 .....	57.7	12.0	45.7	20.8
1954 .....	59.0	16.0	43.0	27.1

Source : Statistical Appendix.

rate of growth will immediately be felt, creating new problems for development. However, difficulties of this type, which can give rise to structural modifications in the economy, always have positive aspects, to which careful attention should be paid.

It is well known that the protection afforded to the industrial sector by the post-war exchange policy was concentrated in the production of final consumer goods as well as of some producer goods, such as iron and steel, which had been the object of special planning. As regards the other manufactured products, especially those of the heavy engineering and precision-tool industry, not only were these unprotected, but investment in their domestic production was strongly discouraged, owing to the circumstances created by the exchange policy. The domestic engineering industry found itself in an extremely unfavourable competitive situation, especially after the devaluation of the pound sterling and other European currencies. The same may be said of some semi-manufactured goods—pulp, caustic soda, etc.—imports of which were guaranteed.

As a result of this state of affairs, important industries, particularly in the mechanical sector, began to operate below capacity, despite their having been able to take advantage of the favourable exchange situation to renovate and even expand their equipment. There is every indication that modifications of exchange policy, which took place at the end of 1953, substantially affected the position of these industries and that, given a continual increase in the supply of iron and steel, the engineering industry will find opportunities for rapid expansion.

## 7. THE INFLATIONARY PROCESS

### (a) Definition of the problem

The period under consideration was characterized throughout by the existence of a process of open inflation, although various types of disequilibria predominated at different stages. No attempt is made, nor would it be of much interest for the

accomplishment of the desired aims, to analyse all these disequilibria. All that is required is a description of the recent inflationary process—namely, that which commenced in 1950 and which, to all appearances, reached its climax in 1954. As a consequence of this inflation, in the latter year the Brazilian economy was characterized by a series of distortions and disequilibria on various levels, the correction of which must evidently form a subject of study in the context of a development programme. While such distortions remain acute, the work of programming will inevitably prove much more arduous. If it is already difficult to make any analysis of future trends during a period of accelerated inflation, it will be even more difficult to do so during the period of readjustment which precedes the restoration of stability. However, it should not be inferred that such a task cannot be accomplished.

Open inflation manifests itself through a rise in the general price level. The cause of the underlying disequilibrium is generally the attempt by an economic group or sector to increase its share in the distribution of real income. If the various groups come into conflict, each clinging obstinately to its demands, the initial disequilibrium will tend to degenerate into an inflationary spiral. Table 17 indicates the way in which prices behave.

Table 17. Brazil : evolution of price indices during the period 1947-54  
(1947 = 100)

Year	Exports	Imports	Domestic level
1948 .....	100	106	108
1949 .....	106	95	119
1950 .....	148	83	123
1951 .....	182	102	142
1952 .....	174	113	161
1953 .....	184	107	178
1954 .....	191	...	...

Source : Statistical Appendix.

The data on the general price level give a clear picture of the phenomenon of accelerated inflation from 1951 onwards. Between 1949 and 1950, the rise in the general price level was 3.4 per cent, and in the following year, 15.4 per cent. This abrupt acceleration of the rise in the general level was preceded by an even sharper rise in export prices. The rate of increase of the latter grew from 6 to 40 per cent between 1948-49 and 1949-50. Another observation on the data in table 17 is that import prices remained practically stable during the entire period; moreover, it was precisely when the most abrupt rise of export prices took place (1949-50) that import prices fell by 13 per cent.

Was the rise in export prices bound to have repercussions on the general price level? The answer is certainly no. But the rise in prices could hardly have been prevented from spreading, in view of the following considerations :

(1) That the system was already operating under inflationary pressure;

(2) That the agricultural sector producing for export competes in the market for factors of production—albeit to a limited extent—with the agricultural sector producing for the domestic market;

(3) That the increase in monetary income of the export sector was concentrated over a short period of time and in specific areas;

(4) That a heavy pressure on the balance of payments, which had been felt beforehand, brought about an intensification of exchange control. This occurred simultaneously with the rise in export prices and had the aim of utilizing the increased foreign exchange to settle pending financial commitments;

(5) That a clear preoccupation with maintaining a high rate of growth found outlet in a policy restricting imports of consumer goods in favour of capital goods.

The rise in the level of export prices in relation to that of import prices meant a gain in real income and is not, therefore, a phenomenon of an inflationary nature. It is, however, a potentially inflationary phenomenon, whose effect cannot easily be neutralized. The causes of this situation are of great significance. The large majority of Brazilian exports consists of articles which are also sold on the domestic market. Thus, when export prices rise, the domestic consumer has to pay more for these commodities. This second rise in prices is a typically inflationary phenomenon; in other words, it is an attempt to re-distribute real income in favour of the groups producing and trading in these goods.

But this is not the principal aspect of the problem. The relative rise in export prices is not in itself an inflationary phenomenon, since the increase in monetary income is offset by an equally large increase in the capacity to import, which it is presumed will be used automatically. But this increase in supply may be barely nominal. Here the time factor plays a fundamental role. Between the increase in monetary income and that in real supply, there elapses a period of time of considerable inflationary potentiality, which can reach a high degree if the economy is undergoing a phase of intensive activity and therefore operating with a reduced level of stocks. If a situation of open inflation already exists when monetary income expands, this potentiality is automatically converted into a new inflationary impulse.

In table 17, it was seen that the price level had already risen in the period that preceded the large increase in monetary income of the export sector. This implies that domestic supply had already lost its ability to absorb increases in demand, by the mobilization of inventories or by a short-term intensification of the utilization of productive capacity. In such a situation, an increase in the monetary income of the export sector must necessarily accelerate the rise in the general price level.

This rise in the general price level does not imply that the sector where the expansion began will lose all the initial

improvement. In the economic system there are elements of inertia which prevent the recovery of the relative positions of all groups. Certain data will enable an examination to be made of the behaviour of the internal terms of trade as between the principal sectors. (See table 18.)

It can be seen that in the period under review there was a large re-distribution of income in favour of the agricultural sector. If the three indices shown in table 18 are compared with those of table 17, it is possible to verify the existence of certain phenomena which are of great significance in a study of the recent inflation :

(1) The index of prices of industrial products rose with less intensity than the general price level. This demonstrates that income had been re-distributed to the detriment of the industrial sector;<sup>10</sup>

(2) The services sector more or less maintained its position, although it lost some ground during the period 1951-52, which was characterized by a recrudescence of inflation;

(3) Throughout the entire period, the index of agricultural prices rose more rapidly than the general level, and also increased with greater intensity than did export prices.

The third observation offers confirmation of the first. The agricultural sector, and of course the export sector as a whole, managed to retain the benefits accruing from the improvement in the terms of trade; moreover, they were successful in provoking an additional re-distribution of income in their favour. The second re-distribution apparently resulted from the rise in the domestic prices of export products and from the relative increase in prices of agricultural production for the domestic market. This latter was a result of pressure created by competition for factors of production, owing to the rapid rise in the profitability of export agriculture.

#### (b) *Consequences for the public sector*

The observations made bring to light the profound disequilibrium introduced into the economy by the export sector. Some of its consequences should now be examined. In the first place, consideration must be given to the impact on the public sector.

The way in which Brazil's agricultural production is organized keeps this important activity relatively far from the reach of the fiscal system. A large increase in income concentrated mainly in the agricultural sector almost inevitably creates difficulties for the public sector. This is because an increase of activity in rural areas requires greater public investment, particularly in transport, whereas public revenue does not tend to grow with income, owing to the relative tax exemption of agriculture. In attempting to increase taxation in order to find an adequate means of financing the new expenditure, the Government tends to increase the pressure on the other sectors. Thus these sectors may be exposed to two convergent pressures—on the one hand, that of the re-distribution of income caused by inflation; and on the other, that of the relative increase in the tax burden, which becomes another form of income re-distribution.

Table 18. Brazil : price indices of the principal sectors  
(1947 = 100)

Year	Agriculture	Industry	Services
1948 .....	114	99	102
1949 .....	121	106	117
1950 .....	143	108	122
1951 .....	166	128	131
1952 .....	188	145	154
1953 .....	220	138	170

Source : Statistical Appendix.

<sup>10</sup> If the analysis were extended to cover a longer period, it would be seen that in the earlier period, which was characterized by a relatively great scarcity of manufactured goods, the contrary occurred. In actual fact, the industrial sector merely surrendered what it had gained in the period 1939-46.



In the period 1947-50 a sharp decline is noticeable in the surplus on the Government's current account. This surplus is the principal source for the non-inflationary financing of public investment. As the Government does not have access to the community's voluntary saving, the decline in the surplus on its current account will result either in a reduction of public investment or in inflationary forms of

financing that investment. In a phase of development and of strong demand for government assistance in overcoming the obstacles to this development, it is not strange that deficit financing is adopted as the line of least resistance. The data presented in table 19 help to achieve a better understanding of this problem.

It may be observed that in the period 1949-50—precisely

Table 19. Brazil : surplus on the current account and deficit on the capital account of the public sector  
(Millions of cruzeiros)

	1947	1948	1949	1950	1951	1952
(A) Public revenue on current account . . .	28,834	33,826	40,470	46,459	62,158	70,233
(B) Surplus on current account . . . . .	6,959	7,984	8,176	7,747	16,832	14,525
(C) (B) as a percentage of (A) . . . . .	24.1	23.6	20.2	16.7	27.1	20.7
(D) Expenditure on capital account* . . .	7,324	9,168	13,060	15,430	17,238	21,579
(E) Deficit on capital account . . . . .	360	1,025	4,796	7,633	385	6,880
(F) (E) as a percentage of (D) . . . . .	4.9	11.2	36.7	49.5	2.2	31.9

Source : Statistical Appendix.

\* Including financial investments.

when the export sector introduced a strong disequilibrium into the economy—the Government was confronted with a sharp relative reduction in its surplus on current account. This possibly caused it to resort to inflationary sources for the financing of its investments. In 1950, virtually one-half of the resources earmarked for investment were of this origin. A considerable effort towards restoring equilibrium was initiated in 1951, but this was of short duration, since it did not even extend into 1952. Being unsuccessful in achieving adequate means for financing its expenditure, the public sector began to take part in the creation of inflationary pressure.

The following question should now be asked : What type of income re-distribution provokes the inflation originating in the public sector? In the case of an economy such as Brazil's, which is characterized by an elastic labour supply, an increase in public expenditure does not necessarily imply the withdrawing of factors of production from other activities. By financing the deficit of transport companies and by expanding public works, the Government provokes a re-distribution of income in favour of certain groups of the population. This phenomenon may possibly be responsible for the apparent stability of the internal terms of trade of the

services sector. Most probably, certain groups of services have suffered heavy losses, which are concealed by the increase in income of governmental origin.

#### (c) Consequences for the private sector

The consequences of inflation for the private sector are more difficult to identify, especially as available statistics do not permit a break-down of the income generated in agricultural activities, where the most intensive re-distribution apparently took place. However, the data relating to the non-agricultural sectors afford a preliminary estimate, which may serve as a basis for conjecture. Table 20 contains certain significant data on the behaviour of consumption during the period 1947-53.

These data reveal a relative decline in the consumption of the wage-earning classes during 1951-52, a period which witnessed an acceleration of the inflationary process. However, by 1953 a reversal of the trend had already begun, although this was accentuated in the private wage-earning sector.<sup>11</sup>

<sup>11</sup> In 1954, this reversal will certainly have been sharpened in the private sector, with the large rise in the minimum wage.

Table 20. Brazil : share of income of the wage-earning sector in total consumption  
(Billions of cruzeiros)

Year	Total consumption	Income of the wage-earning sector*		Private wage-earnings*	
		Total	As a percentage of consumption	Total	As a percentage of consumption
1947 . . . . .	129.2	44.1	34.1	34.5	26.7
1948 . . . . .	146.0	50.0	34.2	38.4	26.3
1949 . . . . .	161.8	58.6	36.2	44.9	27.8
1950 . . . . .	183.1	66.5	36.3	50.4	27.5
1951 . . . . .	230.0	76.8	33.4	58.0	25.2
1952 . . . . .	272.7	91.4	33.5	70.4	25.8
1953 . . . . .	304.1	105.3	34.6	79.3	26.1

Sources : For total consumption : Statistical Appendix; for income in the wage-earning sector : Fundação Getúlio Vargas.

\* Excluding agricultural wages.

The relative reduction of consumption may have been offset by an increase of consumption among agricultural workers rather than among the non-wage-earning urban population. It would be advisable to discover to what extent the contrary may prove to be true. In table 21 the savings of the private sector are compared with the income of the non-agricultural capitalist and entrepreneurial groups. Unfortunately, the data relating to private saving include the saving of the agricultural population, since statistics do not permit the separation of the two series. However, as the income of the agricultural sector—particularly that of entrepreneurs—grew with greater intensity than total income, it is logical to assume that agricultural saving increased more than that of non-agricultural entrepreneurs. Consequently, the saving of the private non-agricultural sector would in reality be less than that to be inferred from the figures.

Table 21. Brazil : consumption and saving  
of the higher income sector  
(Billions of cruzeiros)

Year	Income of capitalist and entrepreneurial sector *	Private saving		Consumption of capitalist and entrepreneurial sector
		Total	As a percentage of income	
1947 .....	41.1	18.3	44.5	22.8
1948 .....	42.9	17.7	41.3	25.2
1949 .....	48.2	21.4	44.4	26.8
1950 .....	56.1	27.3	48.7	28.8
1951 .....	72.9	29.6	40.6	43.3
1952 .....	76.4	29.0	38.0	47.4
1953 .....	90.7	44.2	48.7	46.5

Sources : For private saving : Statistical Appendix; for income of the capitalist and entrepreneurial sector : Fundação Getúlio Vargas.

\* Including profits, income of managers of firms, interest and rent.

The first observation to be made on the data in table 21 concerns the low savings coefficient of the upper income groups. If it is borne in mind that the figures include the saving of the agricultural sector, it may be inferred that the savings coefficient of the capitalist and entrepreneurial groups represents little more than 30 per cent of their income. If account is also taken of the fact that the data refer to gross saving—that is, including funds destined to replace the stock of capital, it may be concluded that the real savings coefficient will not be much above 20 per cent.

The second observation is that the savings coefficient underwent strong fluctuations, but without showing any definite trend. Thus an unusual growth in the income of the capitalist and entrepreneurial sector, as in the period 1947–53, was not expressed as an acceleration of the process of accumulation. In other words, the increase in consumption attained the same proportions as that of income.

If the data are examined more carefully, it will be seen that the consumption of the capitalist-entrepreneurial sector received an exceptional impetus during the period of inflationary acceleration—that is, in 1951–52. This is perhaps due more to the freeing of imports than to the recrudescence of inflation. As is well known, imports constitute a means for the diversification of luxury consumption in Brazil. Since there is no possibility of importing certain commodities, alternative uses of income are found in the consumption of certain services and in the construction of luxury dwellings. On either of these two assumptions, the utilization of income tends to create a flow of wages. Thus it can be explained that in the period of unrestricted imports the volume of wages grew relatively less and the consumption of the higher income-groups grew relatively more. The indices given in table 22 illustrate this phenomenon.

Table 22. Brazil : indices of the growth of consumption  
(1949 = 100)

Year	Total consumption	Private wage-earning sector	Public wage-earning sector	Capitalist and entrepreneurial sector	Imports of durable consumer goods
1950 .....	114	112	118	107	85
1951 .....	142	129	137	162	108
1952 .....	169	157	153	176	121
1953 .....	188	177	190	173	35

Source : Previous tables.

The difference between the index of total consumption and the other indices give an idea of the behaviour of rural consumption, which apparently grew more than the total of the three sectors examined. Since these three sectors represent approximately the urban population, it is to be concluded that the relative rise in agricultural income found expression in an effective improvement in consumption in rural communities.

Given the validity of the data upon which the analysis is based, it would appear that the great concentration of income existing in Brazil does not constitute a motive force for development. This degree of concentration becomes clearly apparent when it is noted that, in the period 1947–53, the level of income of capitalists and entrepreneurs varied between

85 and 100 per cent of the total income of private and public wage-earners. It is commonly assumed that, in view of the high marginal savings coefficient of the upper income groups, this concentration is an efficient driving force for accumulation in periods of rapid income increase. Experience would appear to indicate, however, that the behaviour of the higher income groups may be identical with that of the lower income groups, the marginal coefficient of saving levelling off with, and under certain conditions, even exceeding, the average coefficient.

Since this mechanism of spontaneous accumulation does not function, the question arises as to whether it would be indispensable to resort to fiscal action if advantage is to be

taken of favourable periods to intensify the process of development. Given a low marginal and average savings coefficient among the upper income groups, when the public sector does not act firmly as an instrument of accumulation, the rate of growth will inevitably be reduced if the best opportunities of accelerating it are lost.

In conclusion, there was no significant re-distribution of income within the urban sector during the period under study, although wage-earners, and particularly private wage-

earners, lost ground in 1951-52. During that period the large increase in consumption of the upper income groups took place mainly at the expense of private sector saving, being apparently more closely connected with the freeing of imports than with a re-distribution of income. Finally, the unusual increment of real income during the period, which was due in large measure to the improvement in the terms of trade, apparently had no positive effect on the rate of saving of the private sector.

## Chapter II

### THE BASIC ELEMENTS OF A DEVELOPMENT PROGRAMME

#### 1. INTRODUCTION

The aim of this chapter is to present a system of projections of Brazilian economic development. The recent trends of such development having been observed and the country's potentialities taken into consideration, an attempt will now be made to forecast the alternatives which will present themselves in the near future and which will constitute the basis upon which to elaborate a policy designed to accelerate growth. There is nothing to indicate that the Brazilian economy will stagnate during the next few years. The abundance of its unutilized natural resources, the rapid population growth, the acknowledged dynamism of its entrepreneurial class, and the enormous amount of scientific and technical knowledge accumulated in more highly developed countries to which it has access—these are all elements contributing to the Brazilian economy's ability to reach and maintain spontaneously an appreciable rate of growth, despite factors of instability.

The initial problem is not whether the Brazilian economy will or will not develop in the next few years. The factors at present favouring its development will continue to operate in the future. Unless phenomena of a non-economic order radically change the nature of the problem, it may be assumed, with a considerable degree of certainty, that the country's per capita income will continue to rise in the next few years. However, this rise may take place at very different rates; that is, within ten years the per capita income of Brazil will exceed the present level by 60 per cent, although it is equally probable that the increase will be one-quarter as great.

An attempt will be made in the following pages to demarcate the limits for the probable rate of growth of Brazil's economy in the near future, or in fact up to 1962. Subsequently, there will be an endeavour to identify the factors that must operate if a consistent and reasonably high rate of growth is to be maintained.

#### 2. PROJECTIONS OF PRODUCTION, INCOME AND CONSUMPTION

To project the economic development of a country or region implies, in the final instance, the establishment of various hypotheses on the future supply of goods and services which will be available to the population of that country or region during a given period. Such a volume is governed by the level of the product and by the action of external factors.

As a beginning, it would be advisable to consider the problem of the level of the product. What are the basic factors determining its rate of growth? An analysis of this problem has already been fully discussed in another volume of this series of studies;<sup>1</sup> suffice it to recall here that the level of the product is determined by the economy's productive capacity

and by the degree of utilization of this capacity. Thus, as long as maximum utilization of installed capacity is postulated from the outset, it may be assumed that an expansion in productive capacity is the only prerequisite for the growth of the product. But such an expansion in productive capacity is a function of the accumulation of capital and of technical progress.<sup>2</sup> Consequently, the problem consists in projecting capital accumulation and in determining the effect of this new capital (and the technical knowledge brought in its train) on the economy's productive capacity.

The intensity of capital accumulation is a function of the rate of investment, or of that proportion of net income which is converted into new capital within a given period. On the other hand, the effect of this new capital (and of the technical knowledge incorporated with it) on the productive capacity of the system can be measured with the aid of the marginal product-capital ratio. Thus, given a hypothesis on the average productivity of new investment during a certain period, the rate of growth of the product will be determined by the proportion of income destined for investment.

##### (a) Product-capital ratio

If the gross product is related to the volume of the country's stock of reproducible capital, it will be possible to obtain a coefficient reflecting the average productivity of this capital, provided that this latter is not unemployed owing to lack of effective demand. Similarly, if the volume of net investment realized in a productive period is related to the increment in the product observed in the subsequent period, a coefficient of productivity of the new capital will be obtained, or, in other words, a marginal product-capital ratio. If the second coefficient is calculated for a series of years—or of productive periods—it tends to approach the first, since total reproducible capital is nothing more than the sum of net depreciated investment effected in the past. There would therefore be no difference in working with either of these coefficients, provided that the marginal ratio for a series of years characterized by a uniform capital utilization can be calculated.

Despite the unreliability of the basic data, an attempt was made to estimate the average and marginal product-capital ratios of the Brazilian economy. To obtain the average ratio, an estimate was computed of the country's real stock of reproducible capital. The 1940 census<sup>3</sup> enabled this calculation to be made for the year 1939. With the data on net investment over the period 1939–53, a series of real reproducible capital was obtained for these years. Table 23 shows the average product-capital ratio derived from the series in question and

<sup>1</sup> On the implicit assumption that the supply of labour is elastic, given that there exists surplus labour which will be progressively absorbed by development.

<sup>2</sup> The data of the 1950 census are much more difficult to use, since the declarations of enterprises show the historical value of their fixed capital, which is of little significance during a period of price inflation.

<sup>3</sup> See *Analyses and Projections of Economic Development. I. An Introduction to the Technique of Programming.*

from that of the product presented in the previous chapter. With regard to the period as a whole, the average product-capital ratio is expressed by the coefficient 0.52. This coefficient seems to have risen by about 12 per cent between the pre-war period and the most recent years. But conclusions of great validity cannot be drawn in this instance, owing to the unreliability of investment data, particularly as regards the war years. Nevertheless, the more intensive utilization of the factors of production employed in agriculture—a result of the marked improvement in the profitability of agricultural enterprises—probably had a favourable effect on the average productivity of capital invested in this sector. The same may be said of the reclamation of good arable land which was undertaken during the last five years. Finally, since the increase in electric energy consumption by manufacturing industries is greater than the expansion of their installed capacity, it would appear that industrial equipment is being used more intensively.

Table 23. Brazil: calculation of the average productivity coefficient of reproducible capital

Year	Capital (Billions of cruzeiros at 1952 prices)	Product	Product-capital ratio
1939 .....	410	200.3	0.49
1940 .....	421	200.3	0.48
1941 .....	432	210.0	0.49
1942 .....	443	203.5	0.46
1943 .....	451	209.0	0.46
1944 .....	458	219.4	0.48
1945 .....	470	234.6	0.50
1946 .....	477	257.7	0.54
1947 .....	492	278.3	0.57
1948 .....	519	294.1	0.57
1949 .....	561	302.1	0.54
1950 .....	593	324.1	0.55
1951 .....	627	346.5	0.55
1952 .....	667	360.9	0.54
1953 .....	713	376.1	0.53

Sources: Data presented in chapter I and the Statistical Appendix.

The marginal product-capital ratio is subject to much sharper fluctuations than the average ratio. Since an increase in production is determined not only by new investment but also by the degree of utilization of the stock of capital—which substantially exceeds annual net investment—any variation in the degree of utilization of capital will necessarily appear in a magnified form in the marginal product-capital ratio. This ratio was calculated with the most accurate data available for the period 1947–53. The two extremes reached by the product-capital ratio were 0.73 (1950) and 0.34 (1952). The average of these two extremes gives a coefficient of 0.514, which is fairly close to that of the average ratio mentioned earlier.

What will be the pattern of the product-capital ratio during the next five or ten years? It is fairly improbable that this ratio will depart significantly from the average reached during the last decade. It may be assumed, as a possibility, that part of the improvement in the average productivity of capital invested in agriculture will be retained, even though the prospects for coffee export prices are unfavourable. On the other hand, account must be taken of the fact that the substitution of domestic production for imports will have to

be intensified during the next decade, since there is no reason to foresee an increase in the capacity to import comparable with that of the recent past. In the case of Brazil, an intensification of the process of import replacement is accompanied by greater capital requirements per unit of product, since it implies, in the final analysis, the domestic production of manufactures which were formerly traded for extensively produced primary agricultural commodities. Evidently, it is thus impossible to measure the future action of all these factors, although it should not be forgotten that the product-capital ratio is extremely stable in a specific economy. The experience of other countries, for which there exist far more extensive series, confirms this observation.

#### (b) Rate of investment

Given one or several hypotheses on the product-capital ratio, the projection of development will depend upon the probable behaviour of the net investment rate. During the period 1939–53, this rate underwent considerable fluctuations, which ranged from 3.2 per cent (1945) to 13.6 per cent (1952). The average for the period as a whole was 7.9 per cent.

What factors are responsible for fluctuations in the rate of investment? In a period characterized throughout by inflationary pressure—that is, when there was no factor unemployment due to a deficiency in effective demand—the rate of investment could be expected to demonstrate a greater stability. For a better understanding of this problem, the two principal components of the rate of investment in the Brazilian economy—the rate of saving and the net inflow of external resources—will be considered separately.

Given the absence of factor unemployment through deficient effective demand, it is a current observation that the rate of saving remains relatively stable.<sup>4</sup> The data relating to Brazilian experience indicate that, in 1939–53, this rate fluctuated within relatively narrow limits around an average value of 9.4 per cent. The range of fluctuation was from 1 to 1.9, but if the two extreme values (those for 1940 and 1952) are eliminated it is merely from 1 to 1.3.

This stability of the rate of saving is still more significant if account is taken of the heterogeneity of the period under study. By dividing the period into five-year phases, it can be seen that the rate of saving tends to rise slightly. The movement is from an average of 8.4 in 1939–43 to 9.0 in 1944–48, and to 10.9 in 1949–53. This point will be dealt with at a later stage.

Some of the resources not allocated to consumption<sup>5</sup> are destined to meet foreign commitments. It is true that the outflow of resources, whether in the form of an export

<sup>4</sup> The reasoning implicit is the following: given a certain level of income, the population determines the volume of consumption; and, as long as there is no unemployment and no abrupt changes take place in the level of employment, the relation between consumption and income is relatively stable. Since saving constitutes the residual of income (income less consumption), its share in income—i.e., the rate of saving—is also stable.

<sup>5</sup> Resources not allocated to consumption represent saving, within the system of national accounts. But as regards “geographic” data, it should be borne in mind that part of these resources can take the form of remittances abroad of interest and dividends on foreign capital. Although not computed in national income, such resources are part of geographic income. Whenever the outflow of resources, in the form of capital or its servicing, exceeds the inflow, there will be a proportion of “resources not allocated to consumption” which does not necessarily constitute

of capital, in its strict sense, or of a remittance of interest and dividends, may be offset by an inflow of other resources. There is no other reason for referring to a net inflow of resources. The important point is that this item is subject to strong fluctuations, which are independent of the rate of saving.

The fluctuations of the two variables, to which reference has just been made, determine the changes in the rate of investment. From an examination of table 24, it is easy to see that such changes are governed mainly by the behaviour of the second variable.

Table 24. Brazil : determinants of the fluctuations in the rate of investment

Year	Net geographic savings <sup>a</sup>	Net inflow of external resources	Net investment	Rate of saving <sup>b</sup>	Rate of investment <sup>c</sup>	(B) as a percentage of (A)
	Billions of cruzeiros at 1952 prices					
	(A)	(B)	(C)			
1939 .....	13.3	- 2.7	10.6	8.0	6.4	-20.3
1940 .....	11.4	- 0.9	10.5	6.8	6.2	- 7.8
1941 .....	16.8	- 5.3	11.5	9.2	6.3	-31.5
1942 .....	16.0	- 9.3	6.7	9.1	3.8	-58.1
1943 .....	15.8	- 8.6	7.2	8.9	4.0	-54.4
1944 .....	19.2	- 8.4	10.8	10.0	5.6	-43.8
1945 .....	17.1	-10.4	6.7	8.2	3.2	-60.8
1946 .....	24.8	- 9.1	15.7	10.7	6.8	-36.7
1947 .....	21.0	+ 3.8	24.8	8.1	9.6	+18.1
1948 .....	21.6	- 1.4	20.2	8.1	7.6	- 6.5
1949 .....	29.7	+ 0.6	30.3	10.7	10.9	+ 2.0
1950 .....	40.8	- 6.3	34.5	13.1	11.0	-15.4
1951 .....	33.1	+ 8.7	41.8	10.0	12.7	+26.3
1952 .....	29.7	+16.6	46.3	8.7	13.6	+55.9
1953 .....	42.5	- 5.3	37.2	11.8	10.4	-12.5
1954 .....	40.2	- 3.0	37.2	10.2	9.4	- 7.5

Sources : Data presented in chapter I and the Statistical Appendix.

<sup>a</sup> See footnote 5 for the definition of this concept.

<sup>b</sup> Saving less depreciation over net income.

<sup>c</sup> Gross investment less depreciation over net income.

During the period 1939-53, sharp fluctuations took place in the net inflow of external resources. The limits to these variations were reached in 1945 and 1952. In the former year, not less than 60.8 per cent of the net resources not allocated to consumption were diverted abroad, while in 1952 there was an inflow of resources corresponding to 55.9 per cent of savings. These large-scale variations can be explained, on the one hand, by the involuntary accumulation of foreign exchange reserves during the war years and, on the other, by the substantial trade indebtedness contracted in 1951-52.

The fact that large-scale variations in the net inflow of resources do not seem to have any perceptible influence on the rate of saving is of fundamental interest for the technique of projection. According to available information, the community has always tended to consume a stable share of its income, independently of the possible destination of the resources it abstained from consuming. When these resources could not be invested, they remained immobilized in idle foreign exchange reserves (short-term export of capital). On the other hand, when the inflow of resources exceeded the outflow, the rate of investment rose without any inevitable reduction in saving. For example, the rate of saving rose in the period 1949-53, when more resources entered the country than left it.

Footnote 5 (continued)

saving, in the normal sense of the word. Thus the concept of "resources not allocated to consumption" or "geographic saving" used in the present study can be defined as the difference between geographic income and consumption within the country.

The general background data should now be reconsidered. It has been seen that the rate of growth of the product is a function of the product-capital ratio and the rate of net investment. Given the stability of the product-capital ratio, the rate of investment becomes the sole strategic variable. This rate of investment is determined by that of saving and by the net inflow of resources. Since the rate of saving is a function of the level of income, it can be inferred that the changes in the item "net inflow of resources" are a variable of fundamental importance in determining the rate of growth.

But the rate of investment governs the rate of growth of the product as distinct from that of income, since the latter is also influenced by changes in the terms of trade. If it is recalled that these changes affect the distribution of income, it can be assumed that they influence savings at two levels : directly, by altering the level of income, and indirectly, by altering its distribution. The conclusion can therefore be drawn that, provided there is no deficiency of effective demand, the rate of investment is determined by the net inflow of resources and by fluctuations in the terms of trade.

An understanding of the probable future behaviour of the "net inflow of resources" and of the terms of trade is therefore of great importance for any projection. This second variable calls for careful study, since the task of projection always pre-supposes one or more hypotheses on its future behaviour pattern. This point will be examined later. For the moment it will be sufficient to examine the main components of this item. In the first place, there is the voluntary or involuntary

accumulation of international reserves (foreign exchange and gold). Involuntary accumulation—such as that which took place during the war—must be considered as an abnormal and unpredictable phenomenon. Voluntary accumulation, either for purposes of anti-cyclical policy or for the financing of an investment plan, will be included within the framework of a general programme and is therefore not the subject of forecast.

Apart from the accumulation of reserves, four other sub-groups should be considered: (a) servicing of the public debt; (b) interest and dividends on private capital directly invested in the country (a net figure); (c) net inflow of directly invested long-term private capital; (d) short-term capital movements.

The data relating to the servicing of the public debt present no difficulties, since all the commitments are known. This group includes the loans granted to governments, as well as to private enterprise with a governmental guarantee, or

to those conceded to private enterprise by the Export-Import Bank of Washington without the guarantee of the Brazilian Government.

The series consisting of interest and dividends on directly invested private capital is difficult to project. The volume of interest and dividends remitted abroad depends not only on the level of economic activity, but also on the exchange situation. The same applies to the inflow of long-term capital. Table 25 presents data for these two sub-groups and a comparison of their total with net geographic saving for the period 1939–53. Dollars were converted into cruzeiros at the moving exchange rate shown in table VI of the Statistical Appendix. The sum of cruzeiros used to purchase exchange remitted overseas thus differed from that in the table. However, the assumption preferred was that the interested parties fixed the net sum of the remittance in dollars and that the exchange rate, which was artificially high (during the initial years) or low (during recent years) resulted in a capital gain or loss.

Table 25. Brazil: relation between saving and the net outflow of resources in the private sector

Year	Income from direct investments	Long-term private capital movements	TOTAL		Net geographic saving	(A) as a percentage of (B)
	(Millions of dollars)		(Millions of dollars)	(Millions of cruzeiros)	(Billions of cruzeiros)	
				(A)	(B)	
1939 .....	—11.7	— 0.3	—12.0	—158.4	3.5	4.5
1940 .....	—26.8	—29.4	—56.2	—775.6	3.1	25.0
1941 .....	—34.4	—35.2	—69.6	—939.6	4.7	20.0
1942 .....	—40.8	—29.3	—70.1	—974.4	5.4	18.0
1943 .....	—53.7	+50.2	— 3.5	— 57.1	7.1	0.8
1944 .....	—68.5	+19.6	—48.9	—934.0	10.5	8.9
1945 .....	—62.5	—16.0	—78.5	—1,577.9	9.5	16.6
1946 .....	—64.6	+24.8	—39.8	—847.7	15.9	5.3
1947 .....	—51.4	+21.0	—30.4	—671.8	14.8	4.5
1948 .....	—96.9	+47.7	—49.2	—1,102.1	14.8	7.4
1949 .....	—91.9	+34.6	—57.3	—1,421.0	21.4	6.6
1950 .....	—90.2	+17.1	—73.1	—1,827.5	29.6	6.2
1951 .....	—80.1	—13.1	—93.2	—2,488.4	29.2	8.5
1952 .....	—33.4	+ 5.4	—28.0	—828.8	29.7	2.8
1953 .....	—43.6	+ 8.0	—35.0	—1,141.0	47.1	2.4

Sources: Data presented in chapter I and balance-of-payments statistics from the Superintendência da Moeda e do Crédito.

During the period as a whole, the balance of the two sub-groups absorbed 8.7 per cent of the resources which were not allocated to consumption. However, in more recent years, a pronounced decline can be observed in this percentage, reaching an average of 4.8 during the last six years, 1949–54.<sup>6</sup>

Finally, the inflow of short-term capital should be considered. These resources consist either of speculative capital, which arrives and departs according to the business situation, or of the accumulation of short-term trade debts. The latter constitute an anomaly which does not exist when there is a deliberate control of the exchange situation. The same may be said of capital for speculation, the action of which is limited as much as possible.

In brief, the rate of investment is determined by the rate of saving and by the net inflow of resources. On the assumption that the first of these two factors is stable, it would be pertinent

to discover what determines the second. As has already been seen, these elements are the servicing of the public debt, the flow of private capital and the servicing of the latter. The first of these elements can easily be pre-determined. The second comprises the income from direct investments of foreign capital and the net inflow of new long-term private capital. The net balance of these two sub-groups, although not of great relative importance, is subject to fluctuations which must be observed with care.

The strong variations in the rate of investment registered during the period 1939–53 were largely determined by short-term capital movements: involuntary accumulation of reserves in the first stage and liquidation of these reserves with the formation of commercial arrears in the second. Once the influence of such capital movements is removed—an influence which is controllable when not the result of entirely abnormal situations—a hypothesis can be formulated on the probable behaviour of the rate of investment. This assumption

<sup>6</sup> For 1954, a value identical with that of the previous year was assumed.

will be based on observation of (a) the rate of savings; (b) the servicing of the foreign public debt and (c) the balance of the item "income from direct investment and inflow of long-term capital". This rate of investment must be calculated from year to year, since at least one of its governing factors—the servicing of the foreign public debt—is subject to strictly foreseeable variations.

### 3. PROJECTION OF PRESENT TRENDS

With the elements described in previous sections, a projection can now be made of the over-all development of the Brazilian economy. At the outset, this projection will be limited in scope, presenting a hypothesis on probable short-term development—that is, a hypothesis which gives expression to present trends. Each of the pertinent factors will then be considered individually.

(i) *Product-capital ratio.* It has already been noted that the average product-capital ratio for 1939–53 was 0.52. During the period, this coefficient showed an upward trend. However, the highest point was reached in 1947–48, after which there was a decline. It will be assumed that this decline will come to an end in 1956 and the ratio will be stabilized at an average value of 0.52.

(ii) *Terms of trade.* This factor was of fundamental importance during the whole fifteen-year period under review. The year 1954 witnessed the turning point in the upswing of coffee prices. The future price pattern of this commodity will depend upon a series of factors, one of the most outstanding being Brazil's export policy. This matter will be studied in greater detail in Part Two,<sup>7</sup> but for the moment, the formulation of three working hypotheses is justifiable. The first assumes the recovery of the terms of trade prevailing at the end of 1954; the second postulates the re-establishment of the 1952 terms of trade, that is, a return to the situation which prevailed before the great frost of 1953; and the third presupposes the loss of all the margins of profit gained since the end of 1949—that is, a return of the terms of trade to the level prevailing before the rise in coffee prices, which was a result of the exhaustion of the stocks held by the Brazilian Government. The second hypothesis seems to be the most reasonable for a projection of the type mentioned above. At a later stage, an illustrative alternative based on the third hypothesis will be presented.

(iii) *Rate of saving.* The stability of this rate constitutes one of the fundamental elements in the technique of projection. The slight rise observed during the fifteen-year period which began in 1939 was probably due to variations in income distribution, motivated either by inflation or by changes in the terms of trade. As it is improbable that any large-scale movement in the opposite direction will take place (it has already been assumed that the terms of trade will not fall below the 1952 level), it can be accepted, as a preliminary estimate, that the rate of saving will not stray far from the average of the five-year period, 1949–53.

(iv) *Income from direct investment of private capital and net inflow of long-term capital.* This item absorbed a relatively insignificant volume of the resources not allocated to consumption, at least during the post-war years. The average for 1939–54 is not entirely representative, since the war years

represent an abnormal period. The average for the post-war years exceeds 5 per cent, but is characterized by a downward trend. The first projection will take the percentage of 4.8, which was registered in the period 1949–54.

Table I of the annex to this chapter shows a projection of present trends. The data indicate that, if the trends manifest in 1954–55 continue for the next few years, the Brazilian economy's rate of growth will be appreciably reduced. The annual rate of growth of the per capita product, which reached 2.1 per cent in 1939–53,<sup>8</sup> fell to 1.7 per cent. The greatest effect may be observed in consumption, the rate of which will decline from 2.8 to 1.2 per cent, as may be seen in table 26.

Table 26. Brazil : annual per capita rates of growth

	1939-53	1949-53	1954-52
Production .....	2.1	3.1	1.7
Income .....	3.0	4.1	1.5
Consumption .....	2.8	3.8	1.2

The relatively high rate of growth in the product during the period 1939–53 fundamentally arose from the increase in the rate of net investment from an average of 6.3 in 1939–41 to 11.7 during the five-year period 1949–53, reaching the peak of 13.6 in 1952. This rise was caused principally by the radical changes in the item "net inflow of external resources". While this item absorbed an annual average of 20 per cent of resources not allocated to consumption in the period 1939–41, it helped to increase these resources by 11.3 per cent in the five-year period 1949–53.

The data under analysis are the basis for a hypothesis with the highest possible degree of objectivity, in that it endeavours to reflect present trends. However, some of these trends are not clearly defined. The most important case to be considered is undoubtedly that of the terms of trade. It has been assumed that the index of the terms of trade will continue to decline (a tendency in evidence since the latter half of 1954), but will be stabilized at the 1952 level. It is, however, conceivable that the decline in coffee prices will be even more precipitate and that the index will return to the 1948 level. The effect of this loss on the rate of growth of production will be relatively small, provided that the rate of saving is maintained. The annual per capita rate of growth will decline from 1.7 to 1.6 per cent. However, the effect on the growth of income will be rather more accentuated, the rate being lowered from 1.5 to 0.9 per cent. The same is true of consumption, the rate of which will decline from 1.2 to 0.8 per cent. The development of this alternative hypothesis appears in table II of the annex to this chapter. The data included therein show that, if the present trend towards a deterioration in the terms of trade continues, there will probably be little significant change in the consumption levels of the Brazilian population during the period 1955–62.

### 4. BASIC ELEMENTS OF A DEVELOPMENT POLICY

Observations refer so far merely to hypothetical development in the period 1955–62. The value of such a hypothesis lies

<sup>8</sup> Owing to the unreliability of some of the estimates made for 1954, the projections were constructed mainly on the basis of data relating to the period 1939–53.

<sup>7</sup> See chapter II.



in its role as a starting-point from which to formulate a development policy. The identification of unfavourable trends does not necessarily imply a reduction in the rate of growth, but simply forecasts what might occur if the necessary measures to neutralize the effects of retarding factors are not taken. It is now pertinent to define these measures.

(a) *Increase in the average productivity of capital*

The product-capital ratio reflects the average (physical) productivity of capital accumulated by the productive system. If this productivity can be increased, an acceleration of growth will be obtained. Available information indicates that the improvement which took place between the pre-war era and the present was apparently due to a more intensive utilization of industrial equipment and to a more systematic use of fixed capital in agriculture, particularly in coffee plantations.

In the case of Brazil, the best way of raising the productivity of the economy as a whole is by an increase in exportable production,<sup>9</sup> which almost always means the incorporation of unused natural resources into the economy. If, for example, there is an expansion of meat production, pastures are incorporated into the economy that were probably not utilized before. Similar considerations apply to increments in the production of wood, of bananas (in the coastal areas of Santos and Rio de Janeiro), of rice (in central Brazil), etc. Thus, a definite policy of stimulating exports may be one of the most effective methods of obtaining an increase in the average productivity of the economy.

The introduction of more efficient production techniques by means of small-scale investment is another way of increasing the average productivity of capital. The progress of agriculture achieved by the more widespread use of hybrid seeds, artificial insemination, insecticides and weed-killers, etc., provides the best example of technical improvements of this kind.

The most important measures likely to increase the average productivity of capital result from the adoption and implementation of a development programme. Sectorial disequilibria, manifest in so-called bottle-necks, are the principal causes of the periodic declines in the productivity of capital. Such declines are more clearly perceptible in the marginal ratio. Deficient transport and storage facilities may substantially reduce the productivity of capital employed in agriculture, just as an energy shortage may similarly affect industry. No less serious, although less apparent, is the over-investment that sometimes takes place in certain sectors. Studies undertaken on the São Paulo metallurgical and engineering industries bring to light numerous cases of over-investment, particularly in equipment. Sometimes this apparent excess of productive capacity is simply the counterpart of a shortage either of energy or of certain raw materials. At other times, it is a cloak for speculative activities, which are related to the uncertainty of the exchange situation or to other disturbing factors.

Up to a certain point, sectorial disequilibria are perfectly normal phenomena in a spontaneously developing economy. In those sectors in which the optimum size of the productive unit is large, it is usually impossible to avoid such disequilibria without incurring losses through the establishment of units of an uneconomic size. On the other hand, since the individual entrepreneur is not fully informed of market prospects or

of the plans of his fellow entrepreneurs, there is in many cases an inevitable duplication of effort, with the consequent waste of the community's resources.

The execution of a programme will tend to correct omissions and duplications, since it will help to provide entrepreneurs with a more precise idea of the future market and with a fuller knowledge of all the advances being made in the principal sectors. But it is mainly through the encouragement afforded by credit, complemented by direct state action, that a programme makes its decisive contribution to the prevention of sectorial disequilibria. The mere introduction of some discipline into an investment policy can therefore play a significant part in increasing the average productivity of capital.

(b) *The terms of trade*

The efforts made to improve the physical productivity of capital may be neutralized by a deterioration in the terms of trade, since this causes a decline in the economic productivity of the system as a whole. Generally, the fluctuations in the terms of trade are independent of any domestic measures adopted. A fall in cotton prices, due to action taken by the principal exporter, or a fall in wheat prices as a result of good harvests in the exporting countries, are factors that will influence Brazil's terms of trade in contrasting ways, without reference to any action or decision taken within the country.

Nevertheless, fluctuations in world coffee prices—the principal determinant of Brazil's terms of trade—are profoundly influenced by the country's economic policy. For this reason, Brazil is in a very special position as regards the possibilities of defending its own terms of trade. This problem will be examined in detail in one of the studies forming Part Two of the present report.<sup>10</sup> At this stage, the maintenance of the terms of trade at their 1952 level may be advanced as a favourable hypothesis, or rather as an objective to be reached.

(c) *The rate of saving*

The economy's real effort towards growth is reflected in the rate of saving. So long as there is no unemployment caused by an insufficiency of effective demand, this effort is relatively stable, since the community tends to consume a proportion of its income which varies only when there are substantial changes in income distribution. Nevertheless, it is in the possibility of increasing the rate of saving that a development programme finds its principal justification.

By increasing its share in income and by draining off a growing proportion of revenue for purposes of capital formation, the State can, within certain limits, raise the rate of saving. The same effect is obtained if the State, without enlarging its share in income, reduces its current expenditure in favour of investment. Heavier taxation is not in itself sufficient to raise the rate of saving. The revenue accruing from the additional taxes may be used to cover current expenditure. Moreover, an increase in the tax burden may result in a reduction of private saving. It is therefore conceivable that higher taxation may cause a decline in the rate of saving.

If an increased rate of saving is established as one of the objectives of a programme, it will be necessary to specify which population groups must reduce their consumption.

<sup>9</sup> In the case of coffee, this statement is valid only under certain conditions.

<sup>10</sup> See chapter II.

Broadly speaking, indirect taxation is the most effective instrument for reducing consumption in the lower income brackets. However, in the middle and upper income groups its effect is to reduce saving rather than consumption. This explains why an increase in the tax on essential goods, such as food and clothing, may lead to a falling-off in consumption, whereas the main consequences of a rise in the tax on luxury goods may be a curtailment of private saving. Direct taxation, whose incidence is almost exclusively on the middle and upper income groups, principally results in a reduction of private saving.

Thus, it may be concluded that it is no easy task to increase the rate of saving by the use of fiscal instruments. Direct taxes on enterprises constitute a special case. Apparently, such taxation is simply a method of transferring savings from the private to the public sector. However, it may prove a way of obliging firms to cut down the distribution of dividends in order to carry out their plans for expansion. The same may be said of fiscal instruments discouraging the transfer of profits to shareholders, since these profits, once retained, are transformed wholly into savings, while if distributed, they are partially consumed.

The foregoing observations give some idea of the difficulties encountered in practice in increasing the rate of saving, always provided that the possibility of a reduction in the consumption of the lower income groups is discarded. Such a reduction cannot be the aim of a development policy; in fact, if carried to certain extremes, it will tend actually to retard development.

The consumption of the upper income groups must be considered from two points of view: on the one hand, it constitutes the margin which may effectively be reduced without affecting the social aims of development; on the other, it represents an element exerting permanent pressure on the balance of payments. This second aspect is not, strictly speaking, linked with the problem of the rate of saving, but must be taken into account in the elaboration of a fiscal policy designed to raise that rate.

The difficulties which obstruct a policy with this objective arise, in the final instance, from the interdependence existing between the pattern of income distribution and the way in which the income in question is utilized. In those cases where the government participates in highly lucrative enterprises, it is possible to channel a large volume of resources towards investment without detriment to private saving. However, it is difficult to achieve the same objectives by taxing private sector income either directly in firms or once in the hands of the public.

The data relating to the period 1939-53 demonstrate that the rate of saving shows great stability, although with a slight upward trend. This latter was probably due to inflationary pressure and to the steady improvement in the terms of trade. It may also be assumed that the increase in the public sector's share in expenditure, noticeable in recent years, influenced the rise in the rate of saving. Unfortunately, data on this share are not available after 1947. It was less than 18 per cent in 1947-48, but exceeded 20 per cent in the period 1950-52. Moreover, in the same period government investment enlarged its share in the public sector, rising from 21.8 to 25.8 per cent. Perhaps a combination of these two trends had something to do with the rise in the rate of saving from 8.1 per cent in 1947-48 to 10.9 in 1949-52.

The available information indicates that the rate of saving fluctuated in the post-war period between 8.1 and 13.1 per cent. Even when account is taken of the margin of error of this data, particularly as regards annual variations, it may be asserted that the present structure of the economy would be able to support a rate of saving higher than that prevailing today. If the system had already spontaneously reached a rate of 13 per cent, it is fairly certain that this rate would be compatible with present conditions. One of the central objectives of a development policy might therefore be the recovery and maintenance of this 13 per cent rate of saving.

As a first step in this direction, an effort should be made to increase investment within the public sector. If, by means of a strict development programme, the Government were to succeed in channelling towards investment a significant proportion, say two-thirds, of the increment in public revenue, its investments would grow more than proportionately. As an example, the assumption is made that 30 per cent of public expenditure is devoted to investment and that the volume of this expenditure is growing at an annual rate of 6 per cent. If two-thirds of this increment are destined for investment, the latter will increase at a rate of 12 per cent per annum. Meanwhile, current expenditure will have increased by 2.9 per cent, which signifies a more intensive growth than that of population. If, on the other hand, it is assumed that public investment constitutes 30 per cent of aggregate capital formation and that private investment is growing at an annual rate of 6 per cent, it may be inferred that the share of the public sector in investment will be 35 per cent at the end of five years. In this case, there will be an increase in the rate of saving from 11 to 12 per cent.

A definite fiscal policy can therefore raise the rate of saving without discouraging the private sector, as would occur if there were a persistent attempt to reduce popular consumption by increasing indirect taxation. However to appreciate the firmness and consistency required from governmental action in order to achieve such an increment in the rate of saving, it suffices to take into account the previous observations.

#### (d) *Net inflow of external resources*

The behaviour of this variable is of fundamental importance for development. The larger the volume of resources flowing abroad, the smaller will be the investment effected in the country. *Mutatis mutandis*, the greater the inflow of foreign capital, the greater will be the volume of investment. Historical experience in Brazil indicates that the contribution of foreign capital to a higher rate of investment has been small and intermittent. Balance-of-trade statistics show that the inflow of real goods and services has never exceeded the outflow in any one decade of the last half-century.<sup>11</sup> There is nothing to indicate that past trends will be reversed in the near future. On the contrary, the data on public financial commitments show that large sums will have to flow abroad in coming years. The earlier projection shows that the remittance of resources overseas absorbs 22.4 per cent of all savings in 1955, reaching an average of 14.4 per cent in the five-year period extending to 1959. For this reason, in no one year of the period does the rate of net investment reach

<sup>11</sup> The value of technical services rendered to the country by foreign companies is not known. But this value cannot easily offset, in a series of years, the deficit in the balance of trade.

10 per cent, even on the assumption of a rate of saving of 11 per cent.

The largest share of the resources to be remitted abroad consists of the servicing of government indebtedness or of debts guaranteed by the Government. This item cannot be modified by domestic exchange or taxation measures. The other item, interest and dividends on direct capital investment, is influenced to a certain extent by such measures. However, measures adopted in this sector may have contradictory effects, since, if they deter the remittance of interest and dividends on the capital, they often discourage an inflow of new capital. It is thus difficult to assume that this item will be useful in exerting a significant influence on the rate of growth.

The same reasoning does not apply to the first item. It is highly probable that the Government will reach an agreement with its creditors, such as occurred in 1954, and will thus postpone the effort that would otherwise have to be made *in toto* during the next five years. This hypothesis is perfectly conceivable, since much of the Brazilian public debt is on a medium-term basis. It is also possible that international credit organizations will provide Brazil with resources of real importance for its development. The adoption of a well-conceived programme will certainly contribute to this end.

#### 5. DEFINITION OF GENERAL AIMS

The projection of current trends indicated that a rate of growth, comparable with that of the recent past, could probably not be achieved during the period 1955–62. This conclusion was reached without the introduction of pessimistic hypotheses as to the behaviour of the factors determining growth. But, on the assumption that Brazil will lose, during the next five years, all the improvement in the terms of trade that characterized the previous five years (1949–54), the economy's rate of growth would be even slower. (See table 27.)

Table 27. Brazil : comparison of different hypotheses of growth during the period 1955–62

	Production (Annual per capita rates of growth)	Income	Consumption
1. Initial projection .....	1.7	1.5	1.2
2. Deterioration in the terms of trade .....	1.6	0.9	0.8
3. Inflow of \$500 million* ....	1.9	1.8	1.6
4. Combination of 2 and 3 ....	1.8	1.3	1.2
5. Rise in the rate of saving to 13 per cent .....	2.0	2.0	1.6
6. Rise in the product-capital ratio to 0.57 .....	3.1	2.8	2.8
7. Combination of 5 and 6 ....	3.9	3.6	3.2
8. Combination of 3, 5 and 6 ..	4.0	3.8	3.4
9. Experience during the period 1939–53 .....	2.1	3.0	2.8
10. Experience during the period 1949–53 .....	3.1	4.1	3.8

\* Most favourable hypothesis (total reinvestment of the increase in income).

The adoption of a definite development programme may succeed in counteracting the effect of certain retarding elements which are at present manifest and in creating other stimuli

to growth. The action of these new encouragements must be expressed either by a rise in the rate of investment or by an improvement in the average productivity of capital.

As a beginning, it will be assumed that Brazil, with the aim of increasing its investment, will obtain aid to the value of \$500 million, from international credit institutions. The sum will be paid in annual instalments of \$100 million, as from 1955. This inflow of external resources will permit a rise in the rate of net investment, during the five-year period 1955–59, from 9.4 to 10.1 per cent. Consequently, the annual per capita rate of growth of income will increase from 1.5 to 1.7 and that of consumption from 1.2 to 1.5. A net inflow of \$500 million under these conditions—other factors being constant—would cause per capita consumption to increase by 12.5 per cent until 1962, or an increment of almost 30 per cent above that of the initial projection.

In the foregoing calculation, the same treatment was afforded to new foreign capital as that normally given to capital of domestic formation. However, it may be assumed that the entire increment in income brought about by this new capital will be reinvested. This hypothesis will be within the bounds of possibility if it deals with government-channelled capital. In this case, the increase in the rate of saving will be to 10.4 instead of 10.1 per cent and the increment in per capita consumption will reach 13.2 per cent in the period 1955–62, as against 12.5 per cent postulated previously.

The positive effect of this inflow of external resources may, however, be nullified by the negative action or other factors. Let it be assumed, for example, that, as these foreign resources enter the country, the terms of trade deteriorate in the manner already indicated—namely, that they return to the 1948 level. The two effects would then be counterbalanced. The annual rate of growth of per capita consumption will be about 1.2 per cent; exactly as in the initial projection.

It is now pertinent to examine the other factor determining the rate of investment—namely, the rate of saving. This entails the adoption of the previous hypothesis,<sup>12</sup> which assumes that the rate of saving will rise to 13 per cent and that the other factors will be treated in the same way as in the initial projection. In this case, there would be an appreciable rise in the rate of investment, from 8.5 in 1955 to 12.2 in 1962. The average for the period as a whole will be 11.1 per cent, comparable, therefore, with that of the period 1949–53 (11.7 per cent). The rate of growth of per capita income will reach 2 per cent and that of consumption 1.6 per cent. The effect will thus be identical to that of the inflow of \$500 million under the most favourable hypothesis, according to which the higher income caused by the inflow of external resources will be fully invested.

Once these various possibilities as to the rate of investment have been presented, the effects of possible changes in the average productivity of capital should be examined. One objective of a programme might perhaps be a rise in the average productivity of capital to 0.57, a level already spontaneously reached in the past. Even if this increase were obtained gradually between 1955 and 1959, it would have a considerable effect on the economy's rate of growth. The annual rate of growth of per capita consumption would reach 2.8 per cent—that is, more than double the rate anticipated in the initial projection and equal to that of the period 1939–53.

<sup>12</sup> See page 28.

These data emphasize the magnitude of the effort to rationalize the production process. In addition, they give an idea of the vital significance of a programme in accelerating development, since it seeks to co-ordinate investments in order to avoid the bottle-necks that reduce the average productivity of capital.

What are the possible effects of a combination of some of these hypotheses? In the first place, consideration should be given to the two hypotheses directly related to programming and strictly dependent on domestic decisions—a rise in the rate of saving and an improvement in the productivity of capital. A combination of the two most favourable hypotheses on these factors would raise the rate of growth of consumption to 3.2 per cent. If the effect of an inflow of \$500 million is added to these two hypotheses, the rate would rise to 3.4 per cent. In other words, it would approach the level reached during the period 1949–53, under the extremely favourable influence of an improvement in the terms of trade. Table 27 provides the data relating to these different hypotheses.

A series of possibilities therefore appear, representing different rates of development and calling for various degrees of effort on the part of the economy. It has been seen, for example, that the inflow of \$500 million of foreign capital would have a similar effect on the rate of growth as a rise in the rate of saving from 11 to 13 per cent. However, this rise could be achieved only through a reduction in the rate of growth of consumption during the period 1956–58. (See tables III and V of the annex to this chapter.) However, it is not by the effort implicit in this reduction of consumption that the major difficulties for this hypothesis can be assessed, but rather by the complexity and multiplicity of the measures required for such a reduction.

The elaboration of a programme pre-supposes far-reaching decisions of economic policy. It is evident that such decisions or directives must be based on hypotheses consistent with the possibilities of the economic system and with its institutional framework. Only after these guiding principles are set up can work begin on the formulation of the programme—that is, on the establishment of policies to be pursued by the various organs which guide and direct economic activity.

The aim of subsequent chapters is to explain how such a task of formulation can be carried out. An attempt will

be made to give a broad, general picture of the establishment, on the basis of certain directives, of the co-ordinated objectives for the development policies of various sectors of economic activity. The selection of general directives is outside the scope of the present study, which will consider the question fairly superficially.

Since present trends indicate that the annual rate of growth of per capita income will not exceed 1.5 per cent during the period 1955–62, as compared with a rate of 3.0 registered during 1939–53, a rate of 2 per cent may be considered as the minimum objective of a development programme (hypothesis 5 of table 27, developed in table V of the annex.) As a maximum hypothesis—disregarding the favourable action of other external factors, which are difficult to forecast—a rate of 3.8 per cent might be adopted (hypothesis 8 of table 27, developed in table VIII of the annex).

It is the highest authorities directing economic policy who must decide between the minimum and maximum objectives. Nevertheless, if a programme is to exist at all, at least a minimum objective should be established, since the present course of development tends to dispense with the guiding influence of a programme. It can thus be said that, if external contributions such as that indicated in hypothesis 3 of table 27 are assumed, the minimum objective must be raised. In this case, a figure of 2.3 per cent for income and of 2 per cent for consumption would be operative. Even so, it was considered preferable to ignore this mitigating factor and to maintain the earlier minimum objective.

To achieve this minimum objective, it is unnecessary to depend strictly upon an improvement in the rate of saving (as in hypothesis 5). The adoption of a programme would necessarily bring about an improvement in the productivity of capital, which would facilitate the attainment of such an objective through a smaller effort to increase the rate of saving. These differences of method are not, however, of any great significance when the task is carried out within such narrow limits. The rate of growth of consumption, which will serve as a guiding principle in forecasting structural changes in demand, would not easily undergo alteration, if the above-mentioned refinements were introduced into the hypothesis. Table V of the annex contains a development of the hypothesis chosen to serve as the basis for the general formulation of the programme in subsequent chapters.

## ANNEX

Table I. Brazil : most probable hypothesis of spontaneous development  
(Billions of cruzeiros at 1952 prices)

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)				(11)	(12)	(13)	(14)
	Repro- ducible capital	Product- capital ratio	Product	Effect of the terms of trade	Gross income	Depre- ciation	Net income	Rate of net saving	Net saving	Inflow or outflow of resources				Net invest- ment	Expen- diture	Con- sumption	Rate of invest- ment
										Servicing of the public debt (A)	Income from direct investments (B)	Foreign contri- bution (C)	Total (D)				
1950 .....	593	0.55	324.1	+5.5	329.6	17.2	312.4	13.1	40.8	—	—	—	— 6.3	34.5	323.3	271.6	11.0
1951 .....	627	0.55	346.5	+1.0	347.5	18.2	329.3	10.0	33.1	—	—	—	+ 8.7	41.8	356.2	296.2	12.7
1952 .....	667	0.54	360.9	—	360.9	19.3	341.6	8.7	29.7	—	—	—	+16.6	46.3	377.5	311.9	13.6
1953 .....	713	0.53	376.1	+3.3	379.4	20.5	358.9	11.8	42.5	—	—	—	— 5.3	37.2	374.1	316.4	10.4
1954 .....	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	— 3.0	37.2	413.9	354.9	9.4
1955 .....	789	0.53	418.1	+3.3	421.4	22.9	398.5	11.0	43.8	—7.7	—2.1	—	— 9.8	34.0	411.6	354.7	8.5
1956 .....	823	0.52	428.0	—	428.0	23.9	404.1	11.0	44.5	—3.5	—2.1	—	— 5.6	38.9	422.4	359.6	9.6
1957 .....	862	0.52	448.2	—	448.2	25.0	423.2	11.0	46.6	—3.3	—2.2	—	— 5.5	41.1	442.7	376.6	9.7
1958 .....	903	0.52	469.6	—	469.6	26.2	443.4	11.0	48.8	—3.1	—2.3	—	— 5.4	43.4	464.2	394.6	9.8
1959 .....	946	0.52	491.9	—	491.9	27.4	464.5	11.0	51.1	—4.8	—2.5	—	— 7.3	43.8	484.6	413.4	9.4
1960 .....	990	0.52	514.8	—	514.8	28.7	486.1	11.0	53.5	—6.2	—2.6	—	— 8.8	44.7	506.0	432.6	9.2
1961 .....	1,035	0.52	538.2	—	538.2	30.0	508.2	11.0	55.9	—2.4	—2.7	—	— 5.1	50.8	533.1	452.3	10.0
1962 .....	1,086	0.52	564.7	—	564.7	31.5	533.2	11.0	58.7	—1.1	—2.8	—	— 3.9	54.8	560.8	474.5	10.3

NOTE.—Column (1): reproducible capital for 1955 was obtained by adding net investment for that year to reproducible capital for 1954. Column (2): estimated as explained in the text. Column (3): calculated from cols. (1) and (2). Column (4): estimated as explained in the text. Column (5): calculated from cols. (3) and (4). Column (6): calculated from col. (1) (2.8 per cent). Column (7): calculated from cols. (5) and (6). Column (8): estimated as explained in the text. Column (9): calculated from cols. (7)

and (8). Column (10): subheading (A): known data; subheading (B): data calculated from col. (9) (4.8 per cent); subheading (C): estimated as explained in the text. Column (11): calculated from cols. (9) and (10). Column (12): calculated from cols. (6) and (10). Column (13): calculated from cols. (6), (7) and (12). Column (14): calculated from cols. (11) and (7).

Table II. Brazil : hypothesis of a deterioration in the terms of trade  
(Billions of cruzeiros at 1952 prices)

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Inflow or outflow of resources			(11)	(12)	(13)	(14)
										Servicing of the public debt (A)	Income from direct investments (B)	Foreign contribution (C)				
1954	752	0.54	409.2	+ 7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+ 3.7	421.9	22.9	399.0	11.0	43.9	-7.7	-2.1	—	34.1	412.1	355.1	8.5
1956	823	0.52	428.0	- 1.2	426.8	23.9	402.9	11.0	44.3	-3.5	-2.1	—	38.7	421.2	358.6	9.6
1957	861	0.52	447.7	- 7.1	440.6	25.0	415.6	11.0	45.7	-3.3	-2.2	—	40.2	435.1	369.9	9.7
1958	901	0.52	468.5	-13.2	455.3	26.1	429.2	11.0	47.2	-3.1	-2.3	—	41.8	449.9	382.0	9.7
1959	942	0.52	489.8	-13.5	473.3	27.3	446.0	11.0	49.1	-4.8	-2.4	—	41.9	466.1	396.9	9.4
1960	983	0.52	511.2	-13.8	497.4	28.5	468.9	11.0	51.6	-6.2	-2.5	—	42.9	488.7	417.3	9.1
1961	1,025	0.52	533.0	-14.1	518.9	29.7	489.2	11.0	53.8	-2.4	-2.6	—	48.8	513.9	435.4	10.0
1962	1,073	0.52	558.0	-14.4	543.6	31.1	512.5	11.0	56.4	-1.1	-2.7	—	52.6	539.8	456.1	10.3

NOTE.—See note to table I.

Table III-A. Brazil : hypothesis of an inflow of external resources  
(Billions of cruzeiros at 1952 prices)

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Inflow or outflow of resources			(11)	(12)	(13)	(14)
										Servicing of the public debt (A)	Income from direct investments (B)	Foreign contribution (C)				
1954	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+3.3	421.5	22.9	398.6	11.0	43.8	-7.7	-2.1	2.9	36.9	414.6	354.8	9.3
1956	826	0.52	429.5	—	429.5	23.9	405.6	11.0	44.6	-3.5	-2.1	2.9	41.9	426.8	361.0	10.3
1957	868	0.52	451.4	—	451.4	25.2	426.2	11.0	46.9	-3.3	-2.2	2.9	44.3	448.8	379.3	10.4
1958	912	0.52	474.2	—	474.2	26.4	447.8	11.0	49.3	-3.1	-2.4	2.9	46.7	471.6	398.5	10.4
1959	959	0.52	498.7	—	498.7	27.8	470.9	11.0	51.8	-4.8	-2.5	2.9	47.4	494.3	419.1	10.1
1960	1,006	0.52	523.1	—	523.1	29.2	493.9	11.0	54.3	-5.2	-2.6	—	45.5	514.3	439.6	9.2
1961	1,052	0.52	547.0	—	547.0	30.5	516.5	11.0	56.8	-2.4	-2.7	—	51.7	541.9	459.7	10.0
1962	1,104	0.52	574.1	—	574.1	32.0	542.1	11.0	59.6	-1.1	-2.9	—	55.6	570.1	482.5	10.3

NOTE.—See note to table I.

Table III-B. Brazil: hypothesis of an inflow of external resources with total reinvestment  
(Billions of cruzeiros at 1952 prices)

Year	Reproductive capital	Productive capital	Product	Effect of the terms of trade	Gross income	Depreciation	Net income	Rate of net saving	Net saving	Inflow or outflow of resources				Net investment	Export-earnings	Consumption	Rate of investment
										Saving of the public debt (A)	Income from direct investments (B)	Foreign contribution (C)	Total (D)				
1954	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	-3.0	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+3.3	421.5	22.9	398.6	11.0	43.8	-7.7	-2.1	2.9	-6.9	36.9	414.6	354.8	9.3
1956	826	0.52	429.5	—	429.5	23.9	405.6	11.3	46.0	-3.5	-2.2	2.9	-2.8	43.2	426.7	359.6	10.6
1957	869	0.52	451.9	—	451.9	25.2	426.7	11.3	48.3	-3.3	-2.3	2.9	-2.7	45.6	449.2	378.4	10.7
1958	915	0.52	475.8	—	475.8	26.5	449.3	11.3	50.8	-3.1	-2.4	2.9	-2.6	48.2	473.2	398.5	10.7
1959	963	0.52	500.8	—	500.8	27.9	472.9	11.3	53.4	-4.8	-2.5	2.9	-4.4	49.0	496.4	419.5	10.4
1960	1,012	0.52	526.2	—	526.2	29.3	496.9	11.3	56.1	-6.2	-2.7	—	-8.9	47.2	517.3	440.8	9.5
1961	1,059	0.52	550.7	—	550.7	30.7	520.0	11.0	57.2	-2.4	-2.7	—	-5.1	52.1	545.6	462.8	10.0
1962	1,111	0.52	577.7	—	577.7	32.2	545.5	11.0	60.0	-1.1	-2.9	—	-4.0	56.0	573.7	485.5	10.3

NOTE.—See note to table I.

Table IV. Brazil: combination of the hypotheses appearing in tables II and III-A  
(Billions of cruzeiros at 1952 prices)

Year	Reproductive capital	Productive capital	Product	Effect of the terms of trade	Gross income	Depreciation	Net income	Rate of net saving	Net saving	Inflow or outflow of resources				Net investment	Export-earnings	Consumption	Rate of investment
										Saving of the public debt (A)	Income from direct investments (B)	Foreign contribution (C)	Total (D)				
1954	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	-3.0	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+3.7	421.9	22.9	399.0	11.0	43.9	-7.7	-2.1	2.9	-6.9	37.0	415.0	355.1	9.3
1956	826	0.52	429.5	-1.2	428.3	23.9	404.4	11.0	44.5	-3.5	-2.1	2.9	-2.7	41.8	425.6	359.9	10.3
1957	868	0.52	451.4	-7.1	444.3	25.2	419.1	11.0	46.1	-3.3	-2.2	2.9	-2.6	43.5	441.7	373.0	10.4
1958	911	0.52	473.7	-13.2	460.5	26.4	434.1	11.0	47.7	-3.1	-2.3	2.9	-2.5	45.2	458.0	386.4	10.4
1959	956	0.52	497.1	-13.5	483.6	27.7	455.9	11.0	50.1	-4.8	-2.4	2.9	-4.3	45.8	479.3	405.8	10.0
1960	1,002	0.52	521.0	-13.8	507.2	29.1	478.1	11.0	52.6	-6.2	-2.5	—	-8.7	43.9	498.5	425.5	9.2
1961	1,051	0.52	546.5	-14.1	532.4	30.5	501.9	11.0	55.2	-2.4	-2.6	—	-5.0	50.2	527.4	446.7	10.0
1962	1,101	0.52	572.5	-14.4	558.1	31.9	526.2	11.0	57.9	-1.1	-2.8	—	-3.9	54.0	554.2	468.3	10.3

NOTE.—See note to table I.

Table V. Brazil : hypothesis of a rise in the rate of saving  
(Billions of cruzeiros at 1952 prices)

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Inflow or outflow of resources			(11)	(12)	(13)	(14)
										Servicing of the public debt (A)	Income from direct investments (B)	Foreign contribution (C)				
1954	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+3.3	421.5	22.9	398.6	11.0	43.8	-7.7	-2.1	—	34.0	411.7	354.8	8.5
1956	823	0.52	428.0	—	428.0	23.9	404.1	12.0	48.5	-3.5	-2.3	—	42.7	422.2	355.6	10.6
1957	866	0.52	450.3	—	450.3	25.1	425.2	13.0	55.3	-3.3	-2.7	—	49.3	444.3	369.9	11.6
1958	915	0.52	475.8	—	475.8	26.5	449.3	13.0	58.4	-3.1	-2.8	—	52.5	469.9	390.9	11.7
1959	967	0.52	502.8	—	502.8	28.0	474.8	13.0	61.7	-4.8	-3.0	—	55.9	495.0	413.1	11.4
1960	1,021	0.52	530.9	—	530.9	29.6	501.3	13.0	65.2	-6.2	-3.1	—	59.3	521.6	436.1	11.2
1961	1,077	0.52	560.0	—	560.0	31.2	528.8	13.0	68.7	-2.4	-3.3	—	63.0	554.3	460.1	11.9
1962	1,140	0.52	592.8	—	592.8	33.1	559.7	13.0	72.8	-1.1	-3.5	—	68.2	588.2	486.9	12.2

NOTE.—See note to table I.

Table VI. Brazil : hypothesis of a rise in the productivity of capital  
(Billions of cruzeiros at 1952 prices)

Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Inflow or outflow of resources			(11)	(12)	(13)	(14)
										Servicing of the public debt (A)	Income from direct investment (B)	Foreign contribution (C)				
1954	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+3.3	421.5	22.9	398.6	11.0	43.8	-7.7	-2.1	—	34.0	411.7	354.8	8.8
1956	823	0.54	444.4	—	444.4	23.9	420.5	11.0	46.2	-3.5	-2.2	—	40.5	438.7	374.3	9.6
1957	863	0.55	474.6	—	474.6	25.0	449.6	11.0	49.5	-3.3	-2.4	—	43.8	468.9	400.1	9.7
1958	907	0.56	507.9	—	507.9	26.3	481.6	11.0	53.0	-3.1	-2.5	—	47.4	502.3	428.6	9.8
1959	954	0.57	543.8	—	543.8	27.7	516.1	11.0	56.8	-4.8	-2.7	—	49.3	536.3	459.3	9.5
1960	1,003	0.57	571.7	—	571.7	29.1	542.6	11.0	59.7	-6.2	-2.9	—	50.6	562.6	482.9	9.3
1961	1,054	0.57	600.8	—	600.8	30.6	570.2	11.0	62.7	-2.4	-3.0	—	57.3	595.4	507.5	10.0
1962	1,111	0.57	633.3	—	633.3	32.2	601.1	11.0	66.1	-1.1	-3.2	—	61.8	629.0	535.0	10.3

NOTE.—See note to table I.



Table VII. Brazil : combination of the hypotheses appearing in tables V and VI  
(Billions of cruzeiros at 1952 prices)

Year	(1) Reproducible capital	(2) Product- capital ratio	(3) Product	(4) Effect of the terms of trade	(5) Gross income	(6) Depreci- ation	(7) Net income	(8) Rate of net saving	(9) Net saving	(10) Inflow or outflow of resources			(11) Net invest- ment	(12) Expendi- ture	(13) Consump- tion	(14) Rate of invest- ment
										(A) Servicing of the public debt	(B) Income from direct investments	(C) Foreign contribu- tion				
1954	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+3.3	421.5	22.9	398.6	11.0	43.8	-7.7	-2.1	—	34.0	411.7	354.8	8.5
1956	823	0.54	444.4	—	441.4	23.9	420.5	12.0	50.5	-3.5	-2.4	—	44.6	438.5	370.0	10.6
1957	870	0.55	478.5	—	478.5	25.2	453.3	13.0	58.9	-3.3	-2.8	—	52.8	472.4	394.4	11.6
1958	923	0.56	516.9	—	516.9	26.8	490.1	13.0	63.7	-3.1	-3.0	—	57.6	510.8	426.4	11.7
1959	981	0.57	559.2	—	559.2	28.4	530.8	13.0	69.0	-4.8	-3.3	—	60.9	551.1	461.8	11.5
1960	1,042	0.57	593.9	—	593.9	30.2	563.7	13.0	73.3	-6.2	-3.5	—	63.6	584.2	490.4	11.3
1961	1,106	0.57	630.4	—	630.4	32.1	598.3	13.0	77.8	-2.4	-3.7	—	71.7	624.3	520.5	12.0
1962	1,178	0.57	671.5	—	671.5	34.2	637.3	13.0	82.8	-1.1	-4.0	—	77.7	666.4	554.5	12.2

NOTE.—See note to table I.

Table VIII. Brazil : combination of the hypotheses appearing in tables III-B, V and VI  
(Billions of cruzeiros at 1952 prices)

Year	(1) Reproducible capital	(2) Product- capital ratio	(3) Product	(4) Effect of the terms of trade	(5) Gross income	(6) Depreci- ation	(7) Net income	(8) Rate of net saving	(9) Net saving	(10) Inflow or outflow of resources			(11) Net invest- ment	(12) Expendi- ture	(13) Consump- tion	(14) Rate of invest- ment
										(A) Servicing of the public debt	(B) Income from direct investments	(C) Foreign contribu- tion				
1954	752	0.54	409.2	+7.7	416.9	21.8	395.1	10.2	40.2	—	—	—	37.2	413.9	354.9	9.4
1955	789	0.53	418.2	+3.3	421.5	22.9	398.6	11.0	43.8	-7.7	-2.1	2.9	36.9	414.6	354.8	9.3
1956	826	0.54	446.0	—	446.0	23.9	422.1	12.0	50.6	-3.5	-2.4	2.9	47.6	443.0	371.5	11.3
1957	874	0.55	480.7	—	480.7	25.3	455.4	13.0	59.2	-3.3	-2.8	2.9	56.0	477.5	396.2	12.3
1958	930	0.56	520.8	—	520.8	27.0	493.8	13.0	64.1	-3.1	-3.1	2.9	60.8	517.5	429.7	12.3
1959	991	0.57	564.9	—	564.9	28.7	536.2	13.0	69.7	-4.8	-3.3	2.9	64.5	559.7	466.5	12.0
1960	1,055	0.57	601.3	—	601.3	30.6	570.7	13.0	74.2	-6.2	-3.6	—	64.4	591.5	496.5	11.3
1961	1,119	0.57	637.8	—	637.8	32.4	605.4	13.0	78.7	-2.4	-3.8	—	72.5	631.6	526.7	12.0
1962	1,191	0.57	678.9	—	678.9	34.5	644.4	13.0	83.8	-1.1	-4.0	—	78.7	673.8	560.5	12.2

NOTE.—See note to table I.

## PROJECTIONS OF DEMAND FOR FINAL PRODUCTS

### 1. INTRODUCTION

Once the guiding principles of a development policy are established, it is possible, with the aid of the programming technique, to anticipate the changes and adjustments that must be made if the economy is to reach and maintain the rate of growth implicit in such directives.

As economic development advances, changes will be required in the structural mechanism of production and in the system of income distribution; but, as a general rule, these changes take place *a posteriori*. The first corrective measures are adopted when bottle-necks and a waste of factors begin to be evident. In the majority of cases, it is possible, by means of economic analysis, to forecast the most significant of these maladjustments. Consideration will now be given to the all too frequent problem of a disequilibrium between the capacity to import and the demand for imported goods. Whenever a relatively high rate of growth is postulated in a development policy, the following proposition must be formulated: unless the capacity to import and income grow with equal intensity, production for the domestic market will have to increase more rapidly than income.

If it is assumed that the coefficient of imports remains stable, i.e., that there is a parallel growth of income and imports, does this hypothesis imply an intensification of either the historical or the recent rate of expansion in exports? Could such a rate of growth be achieved, given the existing domestic supply and foreign market conditions? If overseas demand for export products is not growing at the required pace, what price reductions will be necessary to obtain an increase in exports?

If the conclusion is reached that the capacity to import cannot expand at the rate postulated for income, a higher rate of growth will have to be assumed for production destined for the domestic market than for income. In this case, and according to the income-elasticity of demand for the commodities imported, a series of structural adjustments will have to be made in the economy to permit the substitution of domestically produced goods for imports. Under present conditions, such changes take place after the inadequacy of the capacity to import has been ascertained. That is why some sectors are more backward than others and why idle capacity in certain sectors exists side by side with a deficient capacity in others. These are the distortions that slow down the rate of growth.

There are other aspects of this problem which must be taken into account. As a general rule, export activities are characterized by a comparatively low capital intensity. Therefore, an expansion of exports requires relatively less capital than import replacement. But since most equipment is purchased abroad, if production for the domestic market is to grow more rapidly than income, capital-goods imports must increase even more intensively. In other words, either the replacement

of consumer-goods imports is accelerated, or effort is concentrated on the domestic production of capital goods. Whatever the solution, major structural changes must be introduced. Given a particular hypothetical growth-pattern, these changes both in over-all demand and in demand for goods at present imported may be estimated. Only in this way is it possible to adopt opportune measures aimed at facilitating adjustments in the productive mechanism and at maintaining an intensive rate of growth over a prolonged period.

A development policy is implicit in the aggregate projections presented in the previous chapter. However, for this policy to shape itself into a programme, the elaboration of sector-by-sector projections is indispensable; that is, the rate of growth of each group of economic activities compatible with the hypothetical growth-pattern of the economy as a whole must be determined with some degree of accuracy. Without analysis at the sectorial level, the aggregate projections will lack normative value, since only by such analysis can the structural changes required by a definite rate of growth be brought to light. As noted earlier, an anticipation of these structural changes enables opportune safeguards to be adopted, so that a disturbance of economic growth by sectorial disequilibria may be avoided.

### 2. CONCISE ACCOUNT OF THE METHOD FOLLOWED

Projections by sector are based partly on the aggregate projections and partly on a meticulous analysis of both the dynamics of demand and the interrelationship between economic activities. Once a hypothesis is formulated on the growth of the economy—of the product, of income, of consumption, etc.—an analysis by sector within the limits of that hypothesis can be carried out. The aggregate projections give an indication of the probable volume of consumption, but do not explain how the community will distribute its consumption expenditure. However, it is the composition of this expenditure which, in the final instance, determines the structure of the product and of imports.

The programming of development does not necessarily imply any interference with the composition of consumption beyond the limits usually admitted as normal in a free-market economy. It is understood that the consumer will enjoy complete autonomy in determining the structure of his expenditure. The limitations that may exist on the supply side are those which are determined by balance-of-payments or other motives common to free-market economies. In fact, the autonomy of the consumer is an essential mechanism in programming development, whose disappearance would require the creation of a whole new superstructure for determining the distribution of resources according to some criterion which would also have to be defined.

From the macro-economic point of view, the pattern of consumption is a function of the level of per capita income

and of the way in which it is distributed. Since it is possible to influence these two factors without encroaching on the freedom of the consumer to decide his own pattern of expenditure, there is no reason to introduce elements of rigidity into the economic system.<sup>1</sup>

If a programme is based on freedom of the consumer, it can also anticipate his conduct. In other words, it presupposes the possibility of foreseeing future changes in the pattern of consumption, given certain hypotheses on the volume and distribution of income. If it is known, for example that the volume of income to be consumed directly by the population will grow by approximately 50 per cent per capita during a given number of years and that the way in which this income is distributed will not undergo fundamental modification, the major alterations that must occur in the pattern of consumption should be indicated on the basis of an analysis of the dynamics of demand. As this problem can be resolved with an objective criterion, it is also possible to set up projections by sector which would be compatible with the directives of a development policy.

It is not sufficient, however, to forecast the structural changes in consumption. By this means, a projection can be made of the demand for those goods and services which reach the hands of the final consumer, but not of the demand for intermediate goods and services and for capital goods. The way to attain this second objective should now be examined.

Producer goods in general (raw materials and equipment) are destined, in the final instance, for transformation into consumer goods and services. Production of an intermediate or capital commodity today is thus a stage in the production of a consumer commodity or service, since the economic system is nothing more than the process whereby the community meets its needs, and these needs are satisfied by consumption. Once the probable growth in the production of consumer goods is known, an estimate of the demand for the intermediate products embodied in such consumer goods is not difficult, provided that the interrelationships of the productive system are known. The establishment of these interrelationships permits a table of coefficients to be drawn up by means of which the demand for intermediate goods can be approximately deduced from the demand for the final goods in which they are incorporated.

From the point of view of programming, the demand for capital goods is likewise considered as derived demand. Once the growth of final and intermediate goods industries is projected, the volume of equipment and building materials required for their expansion can be estimated.

The first stage in the elaboration of a programme consists in forecasting the structural changes in consumption which are likely to result from the rise in per capita income. To this end, a detailed appraisal is made of the consumption pattern in the base period, and as accurate a study as possible undertaken of the situation regarding relative prices and the income elasticity of demand for the principal groups of consumer goods. After this analytical work has been carried out, a projection of consumer expenditure will be made, by combining the income-effect with the estimated increase in per capita

income. Thus, if the income-elasticity coefficient of demand for unprocessed foodstuffs is 0.6<sup>2</sup> and if a 37-per-cent increase in consumer income is foreseen over a period of eight years, it may be inferred that the total demand for unprocessed foodstuffs will grow by 31 per cent. As soon as this calculation is made for the different groups of consumer goods, an approximate idea may be obtained of modifications which the pattern of consumption will undergo during the course of development.

The second problem is as follows: what share of the demand for consumer goods will be satisfied by domestic production and what share by imports? The starting-point must obviously be an analysis of the situation during the base period and of trends in the process of substituting domestic production for imported consumer goods.

This substitution problem will be considered in detail later.<sup>3</sup> For the moment, it is sufficient to recall that the intensity of the substitution process will be determined by the prospects for the capacity to import, another problem to be dealt with at a subsequent stage.<sup>4</sup>

The proportion of the demand to be met by domestic production will be assessed on the basis of the preliminary estimate of the probable volume of substitution in the consumer-goods sector. This will provide a new point of departure for projecting the activities normally associated with the production of consumer goods. These projections, in turn, constitute a new starting-point for estimating the demand for intermediate goods—that is, for the commodities incorporated in consumer goods.

As regards intermediate products, it will be necessary to undertake an analysis identical with that of consumer goods representing an appraisal of the way in which demand is being satisfied, the share of imports, trends in the process of substituting domestic production for imported articles, and so on. As in the case of final consumer goods, the analysis of the trend towards substitution will enable a preliminary assessment of the probable volume of indispensable imports to be made. The demand to be satisfied by domestic production will be estimated by comparing aggregate demand with anticipated imports.

If the sum total of all the imports forecast in these projections is compared with the volume of the capacity to import, the capacity for external payment available for capital-goods imports—in other words, the capacity to import capital goods—will result as the difference.

The projections of the growth of activities associated with the production of consumer goods will serve as the basis for calculating the demand for capital goods. This calculation is not difficult if each branch of industry is treated separately. However, it is not always advisable—or even possible—to enter into detail in these projections. The type of programming considered here necessitates a simple method of

<sup>1</sup> The problem would obviously be different if there were a major disequilibrium between real supply and monetary demand; to avoid hardship for certain groups, this would involve the introduction of direct controls on the price system and on the allocation of consumer goods.

<sup>2</sup> An income-elasticity coefficient of 0.6 implies that if the growth in per capita income were 1 per cent, that of demand for the consumer commodity in question would be 0.6 per cent. It must be borne in mind that this is a question of a ratio between two rates of variation, one of income and the other of consumption (both in per capita values). In the calculation appearing in the text, an annual rate of demographic growth of 2.4 per cent was assumed.

<sup>3</sup> See chapter V of Part One.

<sup>4</sup> See chapter IV of Part One.

estimating the demand for capital goods which exempts the economist from making a direct study of each project. This method is based on the average product capital ratios for each group of activities. Given a certain structure of relative prices, such ratios indicate how far each unit of capital invested in a branch of industry increases the productive capacity of that industry. If the value of the increase in production is divided by that of investment, a coefficient will be obtained which expresses the product capital ratio. This ratio reflects a given price structure, which is necessarily subject to modification, since productivity in the various industries will evolve in different ways. This, however, does not invalidate the use of the above-mentioned coefficients, since they are applied to groups of affiliated industries and not to highly specialized branches. In addition, they claim only to give an idea of the volume of the resources required. At all events, it will be necessary to revise these calculations from year to year in order to introduce the effects of the more important changes occurring in cost and price structures.

Once the demand for capital goods has been projected, an estimate should be made of the manner in which this demand must be satisfied. Because a calculation of the capacity to import capital goods is already available, the volume of the demand for these goods to be met from domestic production is determined by subtraction. Finally, if the rate of growth of capital goods industries is known, it will be possible to calculate the investment required for this growth. Thus, a second estimate can be obtained of the total demand for capital goods and, indirectly, of the proportion of this demand to be satisfied by domestic production.

### 3. INCOME DISTRIBUTION AND RELATIVE PRICES

As is well known, changes in the pattern of demand for final products are a fundamental reflection of alterations in the average level of consumer income, in the distribution of this income and in the relative prices of final products. It is now pertinent to give more detailed consideration to the possible importance of these last two factors.

The problem of income distribution will be considered first. The effect of an increase of 10 per cent in per capita income upon the pattern of consumption is entirely different according to whether it arises from a higher level of wages, whether it is caused by an increase in the profits distributed by enterprises or whether the higher remuneration affects urban or rural workers. Should a good system of national accounts be available, the origin of consumer income may be observed at the end of each period. This will show what proportion is derived from the payment of labour, what share results from distributed profits and what part originates in other factor payments. On the basis of the projections of the different sectors of production, of wage policy and of some elements of fiscal policy, it is possible to project the structure of income available for consumption. However, these projections are valid only when they refer to relatively short periods. The five-or-ten-year projections of the pattern of consumption must be based on broad and flexible hypotheses subject to annual revision in accordance with the findings of short-term studies of the type previously mentioned.

The problem of relative prices assumes a similar form. It is practically impossible to forecast changes in such prices very far ahead. In addition to reflecting the immediate

market situation for each product, these changes bring to light alterations in the cost structure and in the exchange situation. Bad weather in an agricultural area, the appearance of a particular disease, or some other factor of this nature can, from time to time, reduce the supply of a consumer commodity. As a result, and according to the dynamics of demand for the product concerned, its price—as well as those of other rival products—may rise sharply. Since their effects are more permanent, changes in relative price determined by an unbalanced increase in productivity are even more important.

Their significance lies in the fact that consumers react in a specific way according to the commodity whose price changes in relation to the general level. Sometimes a fall in the relative price of a product implies the ousting of others from the market. Conversely, it may provoke an increase in the consumption of other products or a rise in the level of saving of certain groups of consumers. It is obvious that, if the relative price of a cereal or a fruit is reduced, consumption of this particular foodstuff will tend to increase at the expense of other cereals or fruits. But what influence will a fall in the price of a foodstuff exert on the demand for garments and footwear? Probably, it will be impossible to forecast this influence without considering each consumer group separately. In the higher income groups, a fall in relative prices for foodstuffs will probably bring about an increase in saving. In the lower income groups, it will perhaps cause a rise in food consumption. In the middle income groups, the consequence will most probably be heavier consumption of other goods.

Changes in relative prices among groups of consumer goods—that is, among products with a low substitution-elasticity—provoke reactions similar to those resulting from variations in the level of personal income. For this reason, forecasts of alterations in relative prices are of secondary importance if the projections of consumption are based on an analysis of relatively large groups of products.

However, their importance is greater at the level of projections within each group, as in the case of foodstuffs. Thus, the necessity arises for annual revision of longer-term projections. For long-term projections, the revision must incorporate the changes imposed by the operation of the aforementioned factors—unequal technological progress, disparities in the level of investment, losses in crops, etc.<sup>5</sup>

<sup>5</sup> The effects on relative prices of advances in technology and of the partial loss of a harvest are fundamentally distinct phenomena, and must be considered differently in correcting projections of demand. The impact of the loss of a harvest is temporary, and the change in relative prices thereby provoked represents the prejudiced sector's attempt to transfer part or all of the loss to the community as a whole. What is important to bear in mind, in this instance, is the loss in real income and its effect on the pattern of consumption. A technological improvement results in a basic reduction of production costs, the benefit of which may be retained by the producer, who will thus widen his profit margin. If, however, the producer considers that by transferring this gain to the consumer, through the lowering of the sales prices, he can enlarge his market and earn more by increasing the scale of production, there will be a change in relative prices. In this case, it must be borne in mind that a concomitant increment in real income is produced. Should the phenomenon occur simultaneously in various sectors, it is possible that the heavier consumption of those products whose prices have fallen will not mean that the consumption of other commodities declines, but that it expands less or remains stationary. There are instances, however, in which an advance in a sector's production technique leads to the total exclusion of competing products.

## 4. PROJECTION OF DEMAND FOR FINAL PRODUCTS

Given the relative stability in income distribution and the slow effect of changes in relative prices—an effect virtually felt only within each commodity group—modifications in the level of per capita income figure as the major determinant of changes in the composition of consumption. It is common knowledge that the pattern of consumption of persons enjoying the same level of income shows many points of similarity. Broadly speaking, these persons react to an increase in income in a far more uniform way than those with different income levels.

Projections of consumption covering periods of five or ten years must therefore be based on an income-elasticity analysis, with a correction of the annual projections in terms of the changes in relative prices. Some over-all data on the income-elasticity of demand for certain important groups of consumer goods will now be given. On the basis of these coefficients, an attempt will be made to determine the principal changes which may occur in the structure of consumption, assuming that the economy will grow according to the so-called minimum programme.

(a) *Agricultural products*

To analyse the dynamics of demand, the agricultural sector will be divided into three groups: foodstuffs for the domestic market; raw materials for the domestic market; and export products. The third group will be considered in detail elsewhere.<sup>6</sup> Raw materials for the domestic market do not

<sup>6</sup> See chapters I and II of Part two.

constitute an independent sector for purposes of the analysis of demand, but should be considered jointly with the manufacturing sector which uses them. For the moment, attention will be devoted solely to foodstuffs for the domestic market.

Food absorbs a major share of the expenditure of the population, as a whole and of that of the large majority of social groups, the higher-income brackets being the sole exception. Nevertheless, only some of this expenditure on foodstuffs reaches the agricultural sector. A considerable proportion is absorbed by services, the value of which is added to that of the foodstuffs, by the manufacturing activities associated with food processing and by taxation.

A direct estimate of the pattern of consumers' expenditure would be necessary in order to assess the share of foodstuffs within the aggregate expenditure on consumption. Inquiries made in 1952 by the Comissão Nacional da Bem-Estar Social among working-class families in many Brazilian cities, reveal that foodstuffs absorbed almost 50 per cent of the total expenditure of such families. In the city of São Paulo, the corresponding percentage appeared to be 41.1 per cent, and in the Federal District 47.3 per cent. According to general experience, the proportion of expenditure on foodstuffs tends to decrease as real income rises. In the middle classes, it is already substantially lower (30 per cent or less, as a rule) and in the more privileged groups it undergoes an even greater reduction. A rapid calculation, for which 1949 was taken as the base year, revealed that foodstuffs absorbed approximately 41.2 per cent of Brazil's total consumer expenditure during the period 1947-54. Table 28 gives an approximate idea of the relative importance of this expenditure since 1947.

Table 28. Brazil: share of foodstuffs in total popular expenditure

(Billions of cruzeiros at 1952 prices)

	1947	1948	1949	1950	1951	1952	1953	1954
Expenditure on foodstuffs .....	96.7	100.4	109.4	117.9	123.6	122.3	132.1	135.5
Total consumer expenditure ...	236.9	245.9	248.0	271.6	296.3	311.9	316.4	354.9
Foodstuffs as a percentage of the total .....	40.8	40.8	44.1	43.4	41.7	39.2	41.8	38.2

NOTE.—A calculation was made of the volume of expenditure in 1949; for the remaining years an estimate was made on the basis of indices of the physical volume of apparent consumption of foodstuffs.

These data obviously constitute a preliminary estimate, since they are based on the approximate supply and exclude possible movements in the level of stocks from one year to another. They indicate that the share of expenditure on foodstuffs in total expenditure is highly stable, a fact which can easily be explained if the relatively short duration of the period concerned is recalled. However, this stability conceals a state of flux in the pattern of consumer expenditure on foodstuffs, the share of processed commodities in the total tending to rise.

The specific way in which the Brazilian economy is developing—with little or no increase in the average real urban wage, but with a substantial rise in the average national wage as a result of the population shift from country to town—is responsible in large measure for this rapid change in the composition of expenditure on foodstuffs. The expenditure on unprocessed food, calculated at constant prices, increased

by 25.5 per cent between 1947 and 1953. An increment of this size represents an income-elasticity coefficient of 0.5. If imported wheat is added, this coefficient rises to 0.7. But it should be recalled that the rapid rise in wheat consumption is partly a consequence of the artificially low levels prevailing during the base period (1947). By way of illustration, unprocessed foodstuffs in table 29 were grouped as articles of lower income-elasticity (cereals, tubers and pulses) and higher income-elasticity (meat, fruit and sugar). Coefficients of 0.39 and 0.61 were obtained for the first and second groups, respectively.

The data relating to food processing are not strictly representative of the dynamics of demand, owing to the strong influence of fluctuations in wheat imports during the period in question. If the analysis is extended to cover a longer period, the income-elasticity coefficient obtained will be substantially lower than that which can be inferred from

Table 29. Brazil : increment of consumer expenditure on foodstuffs during the period 1947-53

(1947 = 100)

	1948	1949	1950	1951	1952	1953
I. Unprocessed foodstuffs .....	104.2	113.2	118.8	120.6	119.6	125.5
(a) Low income-elasticity group <sup>a</sup> .....	102.8	112.0	119.7	117.5	117.3	123.9
(b) High income-elasticity group <sup>b</sup> .....	106.2	115.2	117.4	125.3	123.0	127.9
II. Imports .....	87.6	94.2	123.8	143.9	125.4	142.1
(a) Wheat .....	86.4	99.8	125.8	141.4	128.2	165.7
(b) Others .....	90.4	82.3	119.3	149.3	119.5	91.6
III. Foodstuff processing .....	109.1	119.9	129.8	141.4	145.6	164.5
IV. Total of I and II .....	102.2	111.0	119.4	123.4	120.3	127.5
V. Total of I and II (a) .....	102.6	112.1	119.4	122.4	120.3	128.9
VI. Total of I, II and III .....	103.9	113.2	122.0	127.9	126.6	136.7
TOTAL CONSUMER EXPENDITURE .....	103.8	104.7	114.6	125.1	131.6	133.6

Sources : Basic data from official Brazilian statistics and the Fundação Getúlio Vargas.

<sup>a</sup> Cereals, tubers and pulses.<sup>b</sup> Meat, fruit and sugar.

table 29. In the period 1939-53 as a whole, the supply of industrially processed foodstuffs (including beverages) increased at an annual rate of about 6 per cent, which implies an income-elasticity coefficient of demand of 1.2. This coefficient seems to be higher in times of rapid development, that is, when urbanization is more intensive.

The data in table 30 constitute a projection of expenditure on foodstuffs based on income-elasticity coefficients of 0.6 and 1.2 for unprocessed and processed foodstuffs, respectively, and on an increase in per capita consumption at an average annual rate of 1.6 per cent. This hypothesis corresponds to what may be assumed as the minimum objective of a programme.<sup>7</sup>

Table 30. Brazil : projection of expenditure on foodstuffs (Billions of cruzeiros at 1952 prices)

Sectors of production	1949	1954	Projections for 1953
Agriculture .....	52.9	63	82
Industry .....	15.9	22	31
Services <sup>a</sup> .....	40.6	51	68
TOTAL ...	109.4	136	181
Expenditure on foodstuffs as a percentage of total consumer expenditure .....	44.1	38.2	37.2

<sup>a</sup> Including taxes.

## (b) Manufactured consumer goods

With the aim of providing a rough idea of the relative importance of manufactures in popular consumption, an estimate was made of the total domestic supply of these goods. Table 31 shows the results of this estimate in relation to aggregate consumption.

These data reflect the net contribution of the manufacturing sector, excluding both the value of agricultural raw materials and that of services, which is added to the value of the commodities during and after the manufacturing process.

In the period 1949-54, relative stability is observed in the share of manufactured goods in total consumption. In comparison with the pre-war period, a rise—albeit relatively

<sup>7</sup> See Chapter II above.

Table 31. Brazil : domestic supply of consumer manufactures (Billions of cruzeiros at 1952 prices)

Year	Total consumption	Consumer manufactures	Consumer manufactures excluding foodstuffs, beverages and tobacco	Percentage	
				(B) to (A)	(C) to (A)
	(A)	(B)	(C)		
1939 ....	154	31.7	21.4	20.6	13.9
1949 ....	248	55.5	39.8	22.4	16.0
1950 ....	272	61.4	43.8	22.6	16.1
1951 ....	296	68.8	49.9	23.2	16.9
1952 ....	312	67.8	47.4	21.8	15.2
1953 ....	316	68.0	47.5	21.5	15.0
1954 ....	354	76.7	55.4	21.5	15.6

NOTE.—The data in this table are based on an index of the domestic production of consumer manufactures (calculated by the Fundação Getúlio Vargas) and on another of the imports of these commodities (calculated by the Economic Commission for Latin America). The aggregation was made on the basis of 1949 census data.

insignificant—can be noted. If these data are valid, an income-elasticity coefficient of approximately 1.2 will be obtained for the demand for manufactured goods as a whole. This coefficient remains virtually unaltered if processed foodstuffs are excluded from the group.

During the period 1939-54, per capita consumption of manufactured goods increased at an annual rate of 3.5 per cent. More recently (1949-54), it rose to 4 per cent. However, if these rates are suitably related to the increase in income, a slight fall can be noticed in the elasticity coefficient. It may be assumed that, in periods when consumption increases more rapidly, the income-elasticity coefficient of demand for foodstuffs undergoes a relative reduction, particularly if a redistribution of income takes place at the expense of the wage-earning sector. Nevertheless, although it is possible to observe this trend, it can be measured only with difficulty, owing to the unreliability of the data used.

The task of projection in this sector comprises two stages : an estimate of the income-elasticity coefficients for the principal commodities groups and an appraisal of the pattern of consumption during the base period selected.

The first difficulty to be faced arises from the manner in which industrial statistics are classified, because the classification is linked with the nature of the production process and

not with the ultimate use of the article produced. Even if detailed figures relating to consumer expenditure on manufactured goods were available, it would be difficult to establish any exact connexion between these data and statistics of industrial production.

To calculate elasticities, estimates are required of the quantity of manufactured goods that reach the hands of the consumer. These data must refer to the gross value of the articles at constant prices as purchased by the consumer and are generally derived from analyses of typical family budgets. Since adequate studies on consumer expenditure are not yet available in Brazil, an appraisal of the supply of manufactured consumer goods based on production and import data will have to suffice.

The income-elasticity coefficients were calculated on the basis of the trends in real consumption of the principal commodity groups and in income available for consumption. As regards some of the former, this calculation cannot yet be made in practice. However, the gaps may be partially filled with the aid of indirect information and by resorting to data from countries with a similar economic structure. It must not be forgotten that these estimates aim only at affording an idea of volume and that the margin of error for one industrial group may be offset by other errors in the opposite direction.

Table 32 presents two calculations of income-elasticity coefficients: one refers to the trend during the period 1937-39 to 1947-49; the other is based on the trend in 1949-54. The data on durable goods are less accurate and their trend more erratic than that of the remainder. Broadly speaking, a comparison of the two columns of coefficients reveals that the rate of relative increase of basic consumer goods underwent a reduction.

Table 32. Brazil: income-elasticity coefficients of demand for consumer manufactures

Commodity groups	Trends	
	1937-39 to 1947-49	1949-54
Foodstuffs .....	1.2	1.0
Textiles .....	0.9	0.6
Garments .....	1.0	0.9
Footwear .....	1.0	0.5
Pharmaceutical products .....	1.9	1.9
Paper .....	1.2	2.1
Printed matter .....	1.0	1.4
Tobacco and matches .....	2.0	2.3
China .....	2.0	2.4
Furniture .....	2.0	2.5
Automobiles .....	2.5	—
Electrical apparatus .....	2.0	3.7
Other goods .....	2.0	2.1

Note.—These coefficients express the relation between the average annual per capita rates of growth of consumption of the commodity in question and of the total income available for consumption. As an illustration, in the latter series, *ex-post* data on total consumption were used. In reality the results do not vary greatly, given the reduction in voluntary personal saving.

Since the rate of growth of consumption forecast here for the period 1954-62 is even lower than that registered during the years 1937-39 to 1947-49, it was felt more suitable to use the elasticity coefficients for the former period in the projections.

To establish these projections, the consumption behaviour of manufactured goods during the base period must be known. It will have to be assessed on the basis of data relating to the value added during the manufacturing process, so that the exact share of each industry in the production of the final goods may be ascertained.

In the study on the dynamics of demand, it was necessary to group commodities according to the form in which they reach the hands of the final consumer, since it is his freedom of choice in the matter that operates as a strategic variable. But it so happens that this grouping does not necessarily correspond to the organization of production. Since demand must be projected in such a way that the objectives of domestic production and of import replacement can be established, a reclassification must be attempted which will also satisfy the aims of an investment programme.

In the case of domestic production, the break-down presents no great difficulty, since it is sufficient to compute the value added by the various industries instead of the gross value of production. For imports, the problem is more complex, since statistics refer to gross c.i.f. values. In order to obtain a preliminary break-down of these values, a simplified scheme of inter-industry relations was worked out on the basis of the input-output matrix of the United States economy. (See table 34.)

Table 33 appraises the consumption of manufactured goods in 1949 and 1954, in the manner described, and presents the projection for 1962. These projections are based on the income-elasticity coefficients appearing in the first column of table 32, which correspond to the working hypothesis that an average annual rate of increase of 1.6 per cent will occur for per capita consumption. This table also shows the estimated expansion in the per capita consumption of each commodity group during the period in question.

Table 33. Brazil: projection of demand for consumer manufactures\*  
(Billions of cruzados at 1952 prices)

Commodity groups	Consumption in		Projection for 1962	Per capita increase 1954-62
	1949	1954		
<i>Non-durable goods</i> .....	43.8	59.1	82.6	15.6
Foodstuffs .....	15.8	21.3	30.0	16.5
Textiles .....	12.8	15.9	21.4	11.3
Garments .....	3.8	5.1	7.0	13.5
Footwear .....	2.4	2.9	4.0	14.1
Pharmaceutical products and toilet articles .....	3.3	5.1	7.8	26.5
Paper .....	2.0	3.2	4.5	16.3
Printed matter .....	2.6	3.7	5.1	14.0
Tobacco and matches .....	1.1	1.8	2.8	28.6
<i>Durable goods</i> .....	6.4	9.7	15.3	30.4
China and table-ware .....	1.0	1.7	2.6	26.5
Furniture .....	1.4	2.4	3.7	27.5
Motor vehicles .....	1.6	1.4	2.3	35.9
Electrical apparatus .....	1.0	2.1	3.3	29.9
Others .....	1.4	2.2	3.4	27.8
<i>Industrial chemical products</i> .....	3.3	5.3	8.4	31.1
<i>Unclassified</i> .....	2.0	2.6	3.5	11.3
TOTAL ...	55.5	76.7	109.8	18.4

Sources: Basic data from official Brazilian statistics and the Fundação Getúlio Vargas.

\* The data express the value added by industry group.

Table 34. Brazil : break-down

	Freight and insurance	Other services rendered in country of origin	Agriculture and livestock	Foodstuffs	Textiles	Paper	Printed matter	Pharmaceutical products	Leather	China and table-ware	Furniture	Automobiles
<i>Non-durable consumer goods</i>												
Foodstuffs .....	194	68	512	348								
Textiles .....	56	74	234		671							
Paper .....	127	62				405						
Printed matter .....	31	3				9	42					
Pharmaceutical products .....	12	63						447				
Leather .....	12	3	6						43			
<i>Durable goods</i>												
China and table-ware .....	13	7								54		
Furniture .....	—										3	
Automobiles .....	213	39										672
Electrical apparatus .....	33	31										
Others .....	134	45										
Industrial chemical products .....	301	120	169									
Unclassified .....	82											
<i>Capital goods</i>												
Iron and steel .....	145	106										
Other industrial metals .....	40	38										
Machinery .....	494	181										
Transport equipment .....	243	87										
Electrical equipment .....	102	45										
Others .....	63	34										
Cement .....	182	15				5						
Glass .....	4	4										
Wood .....	3											
Others .....	17	8										
GRAND TOTAL ...	2,501	1,033	921	348	671	419	42	447	43	54	3	672

NOTE.—The values given at the foot of each column correspond to the share of the industry-group indicated above. C.I.F. values are shown at the end of each horizontal line.

### 5. INTERMEDIATE PRODUCTS

Intermediate products consist mainly of raw materials of agricultural or mineral origin and of semi-manufactured goods derived from them. Some intermediate products are directly absorbed by capital goods industries, building materials and metals for engineering industries, for example. Consideration will be given here only to the intermediate products directly incorporated in consumer goods, even when this distinction can be made only in a very arbitrary manner. Industrial chemical products, for instance, are partly absorbed by consumer-goods industries and partly by capital-goods industries. The same may be said of aluminium, tin and, to a lesser degree, iron and copper. In these cases, as in many others an arbitrary decision is indispensable, owing to the limited nature of the information available.

Some intermediate products, such as textile fibres, leather and rubber, present no special difficulties, since the demand for them closely follows that of the final products in which they are incorporated. Once the demand for the latter is projected, there is a good point of reference for formulating a preliminary hypothesis of the future demand for the intermediate product. Occasionally, as in the case of pulp and paper, it is more suitable to group them in a single industry for purposes of projection. At other times the difficulties are

greater, owing to the possibility of substituting one type of raw material for another. The textile industry affords a good example. The replacement of one type of fibre by another is to a large extent a problem of the influence of technological change upon demand through relative prices. As noted earlier, the five- or ten-year projections in such cases are of a very general character and must be revised each year.

The projection of demand for industrial chemical products requires a detailed knowledge of the present use of these products. If the pattern of consumption and the probable development of each of the activities utilizing these products were known, it would not be difficult to project their demand. However, given the frequent changes that technical progress causes in this sector, the projections in question would be nothing more than a preliminary estimate subject to periodic revision. Since available data do not permit the establishment in sufficient detail of the way in which chemical products are at present utilized, the projection must be confined to assuming a correlation between the growth of demand for these products and of that recorded for manufactured consumer goods as a whole.

The projection of the demand for fuels\* in principle presents the same difficulties as were noted for industrial

\* See chapter IV of Part Two.



Imports of manufactured goods <sup>a</sup>(os) <sup>b</sup>

Chemical products	Unclassified (consumer goods)	Iron and steel	Other metals	Machinery	Transport equipment	Electrical equipment	Other equipment	Cement	Glass	Wood	Other building materials	Total non-durable consumer goods	Total durable consumer goods	Total consumer goods	Total capital goods	Grand total
39																1,161
35																1,120
9																603
1																86
119																641
2																66
1																75
9		87	9			39	116									3
15		159	10			15	21									1,184
915			31													552
435																893
10		828	32				85									1,505
5			494													517
		326	145	2,353		181	434									1,206
22		175	22		1,531	87	262									577
9		101	37			649	73									4,114
11		117	23			11	364									2,429
3								108								1,016
1									30							623
										7						313
1											59					39
1,257	435	1,793	803	2,353	1,531	982	1,355	108	30	7	59	1,970	1,680	5,342	9,021	18,818

<sup>a</sup> Calculated on the basis of the input-output matrix of the United States economy.<sup>b</sup> Rate of exchange: 1 dollar = 24.8 cruzeiros.

chemical products. Nevertheless, the data are more abundant, and the projection of demand could be made directly, avoiding the necessity of a general hypothesis such as that postulated on the behaviour of demand for chemical products.

## 6. PROJECTION OF AGGREGATE DEMAND FOR FINAL PRODUCTS

Table 35 presents all the data relating to the demand for final products. In addition to unprocessed foodstuffs, the "primary sector" includes textile fibres, leather, rubber and mineral fuels. In this preliminary estimate, it is assumed that the demand for fibres will grow with the textile industry, that of leather with the boot and shoe industry, and that of rubber with the number of motor vehicles. Mineral fuels, as well as the increase in motor vehicles, are the object of a special study appearing in Part Two.<sup>9</sup> The group "Others" includes unspecified raw materials. It is assumed that demand for them will keep pace with the average growth of demand for the other raw materials.

In the "secondary sector" are to be found the data already shown in the preceding section. The "tertiary sector" comprises services as a whole—whether rendered directly

Table 35. Brazil: projection of total consumer expenditure (Billions of cruzeiros at 1952 prices)

Commodity groups	Consumption in		Projection for 1962 <sup>a</sup>	Annual per capita rate of growth	
	1959	1964		1949-64	1964-62
Primary sector .....	66.3	82.1	114.0	2.0	1.7
Unprocessed foodstuffs	52.9	63.0	82.0	1.2	0.9
Textile fibres .....	3.4	5.1	6.9	5.8	1.4
Leather .....	0.4	0.5	0.7	2.0	1.8
Rubber .....	0.4	0.6	1.0	5.8	4.0
Mineral fuels .....	3.0	5.3	12.8	9.5	9.0
Others .....	6.2	7.6	10.6	1.7	1.8
Secondary sector .....	55.5	76.7	109.8	4.2	2.1
Non-durable goods ..	43.9	59.1	82.6	3.6	1.8
Durable goods .....	6.3	9.7	15.3	6.4	3.4
Chemical products ..	3.3	5.3	8.4	7.3	3.5
Unclassified .....	2.0	2.6	3.5	2.9	1.4
Tertiary sector .....	126.2	196.1	263.1	6.6	1.3
Total consumption expenditure .....	248.0	354.9	486.9	4.9	1.6

<sup>a</sup> The projection for 1962 is made on the basis of the income-elasticity coefficients appearing in the first column of table 32, on the assumption that income available for consumption will grow at an annual rate of 1.6 per cent per capita and that the growth rate of the population will be 2.4 per cent per annum.

<sup>9</sup> See chapter III of Part Two.

to consumers or rendered to enterprises—including those of governmental origin. No great validity can be attached to the large increase in the share of this sector registered between 1949 and 1954, given the unreliability of the over-all data.

The projection of the probable pattern of consumption—that is, the forecast of the principal changes in its structure

—is the corner-stone of a programme. This is apparent when it is borne in mind that the central objective of programming is to guide productive activity, so that it may satisfy, directly or indirectly, a given pattern of consumption known to correspond organically with the rate of growth accepted as the target of a development policy.

## Chapter IV

# INTEGRATION OF FOREIGN TRADE WITH THE PRODUCT AND EXPENDITURE

### 1. THE SUBSTITUTION PROBLEM

The previous chapter attempted to show how an objective forecast could be made of the principal changes caused in the pattern of demand for final products by a given rate of economic growth. Once these changes are known, the basic task of formulating a programme may begin, involving a detailed appraisal of the productive mechanism. Only then can the changes to be introduced into the various sectors of production be determined, so that such modifications may meet a demand whose broad outlines are known in advance.

The analysis of demand therefore precedes that of supply. If the future pattern of demand is unknown, it is impossible to give a systematic orientation to the sectors whose production contributes to supply. However, it is in this second stage of the work that a programme begins to take shape. Programming cannot strictly so be termed unless guiding principles exist in the different sectors of production. These are the criteria upon which fiscal, trade and credit policies and—when necessary—direct state action can be based.

The present chapter includes only the more general aspects of formulating a programme. The projections in chapter II have provided an idea of the levels which expenditure, outlay on consumption and investment will probably reach under the hypothesis of growth postulated in the minimum programme. In order to pursue the analysis, the following question must be answered: what proportion of total demand will be directly satisfied by domestic production and what proportion indirectly met from imports? As soon as this problem is elucidated, the time will be ripe to study how best the productive mechanism may be adapted to the pattern of demand.

By definition, imports are the least rigid element in supply. Whereas domestic production is more or less governed by the structure of the productive mechanism, the capacity to import can be utilized with great flexibility.<sup>1</sup> Because this is so, when development is accompanied by an equally intensive increase in the capacity to import, adjustments between demand and supply are made with much greater ease. In this case, whenever demand for a certain product outstrips the forecasts of domestic producers, availabilities are supplemented by imports. This is one of the reasons why stagnation in the capacity to import strongly inhibits development, at least in its preliminary stages.

As noted in chapter I, the period 1939–53 was characterized by a substantial rise in the capacity to import. Calculated at 1952 prices, imports represented 13.4 per cent of expenditure in 1939 and 14 per cent during the period 1947–53. If the years 1951–52, when the volume of imports was abnormally large, are eliminated from the period 1947–53, the average

stands at 13.3 per cent, a figure practically identical with that of 1939. The intensive development of Brazil's economy during the post-war period was therefore favoured by a parallel increase in the capacity to import.

Even when the capacity to import grows proportionately with expenditure, the composition of imports must undergo persistent variation. Moreover, the faster the rate of development, the more rapid are the changes in the pattern of demand. These changes appear magnified in the import sector, the focal point for all commodities which are permanent or occasionally in short supply. On the other hand, there are factors peculiar to under-developed countries which help to increase the pressure on the import sector.

Knowledge of the market, production experience accumulated in a particular branch, the desire to control subsidiary sectors and other similar elements are recognized to be of fundamental practical importance for the entrepreneur. For this reason, he is always inclined to expand his activities in the branch he knows. To enter a sector traditionally dominated by imports is to incur new risks.<sup>2</sup>

The unwillingness of entrepreneurs to enter other sectors than their own, particularly those in which the market is traditionally supplied by importers, causes an even greater pressure on imports and creates new difficulties for development. The fear exists among domestic entrepreneurs that their productivity is inferior to that of a foreign competitor, or that the latter, at one stage or another, may artificially reduce his prices in order to recapture the market. The domestic entrepreneur knows that he must compete with financially powerful groups, with highly efficient foreign manufacturers or with those enjoying optimum market conditions, ready access to raw materials, and low external costs. These reasons, and others peculiar to each specific case, often cause the entrepreneur in an under-developed country to concentrate his resources in sectors where he is already active and to abstain from channelling resources to those branches where an actual or potential danger of foreign competition exists. It may thus lead to over-investment in the sectors controlled by domestic entrepreneurs and hence to a growth of the demand for imported commodities which would have been less intensive had investment been distributed among all branches of production in accordance with a single criterion for the prospective increase in demand.<sup>3</sup>

After a period of over-investment in the domestic sector, the pressure on imports tends to increase until it becomes

<sup>1</sup> An abrupt suspension of imports, such as took place during the war, or a relatively substantial rise in the price of imported products—as during a crisis or after a monetary devaluation—obviously provides new stimuli which nullify or offset the disadvantages in question.

<sup>2</sup> These phenomena of over-investment appear to be inseparably linked with inflation. It should be emphasized that such disequilibria accompany development partly because of specific elements in under-developed economies.

<sup>3</sup> The limitations that bilateralism imposes on this flexibility will receive due consideration in section 4 of this chapter.

intolerable. By extending the incubation period of disequilibrium, the liquidation of foreign exchange reserves, the contracting of trade debts and the opening of credit lines all tend to aggravate the imbalance. The solution has almost always been sought in devaluation in one form or another, accompanied by a reduction in the real value of investors' net resources<sup>4</sup> and in the demand for imported consumer goods. During the readjustment phase which follows, there is always the risk that part of the productive capacity of those sectors which experienced over-investment will be under-utilized.

The foregoing observations demonstrate that, at the present stage of development of Brazil's economy, external disequilibria and the under-employment of fixed capital can be avoided only if a decided stimulus is given to investment in order to replace imports. Such stimulus finds long-range instruments in an over-all analysis and system of projections of economic activity. Without the co-ordinating influence of a programme, balance-of-payments disequilibria will almost inevitably accompany development in its initial stages, subjecting it to periodic readjustments that do not allow a high rate of growth to be maintained.

The substitution problem has aroused much theoretical discussion and on repeated occasions has been unsatisfactorily presented. It is usually said that, by guiding investments in a given direction, resources are being transferred from one sector to another and that imports will decline in the first sector but will rise in the second. This approach overlooks the fact that some proportion of investment is often mis-directed and that each unit of investment may have a different substitution intensity according to the sector where it is applied. Thus, one unit of capital invested in the wheat crop may represent the incorporation of land previously unused; in the paper industry it may cause forest resources to be exploited which were formerly unproductive from the economic point of view, etc. In such cases, one unit of investment replaces more than the value represented by the remuneration of the capital and labour employed. The same is true of the textile industry when it utilizes fibres whose domestic production does not absorb factors with an alternative use. Following the argument one stage further, consideration should also be given to the problem of the elasticity of the labour supply. This elasticity—a characteristic of under-developed economies—increases the intensity of substitution in certain industries. For this reason, the textile industry,

where the labour-absorption capacity is notoriously high, has become an economic proposition in almost all under-developed countries. Thus, it may be accepted as an easily verified principle that the greater the absorption of factors without alternative use (natural resources and labour) per unit of capital invested in a productive activity, the higher will be the substitution intensity of that activity.

Given this premise, it may be assumed that suitable guidance of investment can help to reduce the pressure which economic development exerts upon the balance of payments.

## 2. AGGREGATE FOREIGN TRADE PROJECTIONS

Since imports constitute the most flexible sector of supply, it is obvious that a relative contraction in the capacity to import will enhance the difficulties of spontaneous adjustments between the structure of total supply and the changing pattern of demand. The waste of resources tends to be greater. For this reason it would be difficult—even in the presence of stimuli to raise the rate of investment—to avoid a fall in the average productivity of capital during the transition from one stage of development, which is accompanied by an expansion of the capacity to import, to another, which is characterized by a relative stagnation of this capacity. This is in fact the present situation of the Brazilian economy.

It would be advisable first to consider the prospects of the capacity to import. The hypothesis formulated in chapter II, namely the assumption of a return to the 1952 terms of trade, will continue to be used. This return virtually came to an end with the fall in the price of coffee registered between the last quarter of 1954 and the first few months of 1955. A hypothesis of the quantum of exports, the principal determinant of the capacity to import, must thus be formulated.

The first observation to be made with respect to Brazilian exports is their decline in world trade. At no time since 1949 have exports reached their 1938 volume. On the other hand, in 1948 the quantum of world exports was already higher than in 1938 and has since continued to rise steadily. These data are of particular significance, since they demonstrate that, in a period of substantial expansion in international trade, Brazil could not retain its previous markets. As competition is much keener during periods of decline or stagnation in world trade, it is easily understandable that a recovery of the position lost in recent years will not be easy for Brazil.

Nevertheless, the relative fall in the quantum of its exports does not imply that Brazil's share in the value of world trade has decreased. The fairly substantial rise in the average prices of exports fully offset the loss in quantum. Thus, in any one of the years between 1948 and 1953, the share of Brazil was higher than in 1937-38. (See table 36.)

Table 36. Brazil : share of the value of exports in the world total

(Billions of dollars)

	1937-38	1948	1949	1950	1951	1952	1953
(A) World trade .....	22.2	52.8	53.7	55.4	75.4	72.5	73.4
(B) Brazilian exports .....	0.320	1.173	1.089	1.347	1.757	1.409	1.539
(B) as a percentage of (A) .	1.44	2.22	2.03	2.43	2.33	1.94	2.10

Source : United Nations, *Direction of International Trade*.

<sup>4</sup> Since a substantial share of investment can be effected only by means of industrial equipment imports, devaluation reduces the volume of investment and also causes less pressure on the balance of payments in this sector.

It is interesting to note that in 1948, when the quantum of world trade returned to its pre-war level, the Brazilian share rose significantly. This increase reflected a relative increment both in quantum and in prices. During the following years, relative prices rose substantially, but this movement was practically nullified by the fall in quantum, for, having reached a peak in 1950, the Brazilian share in world trade was lower in 1952-53 than it had been in 1948. If the phenomenon is viewed from this angle, it can be seen that the rise in coffee prices merely helped Brazil to maintain its share in the total value of world exports. From another standpoint, the phenomenon is more complex, for the rise in coffee prices was partly a reflection of the decline or anticipated decline in the exportable quantum. But the decline in the quantum of the other Brazilian exports was even greater. Between 1948 and 1953, coffee exports declined by only 11 per cent, while the total of all other exports fell by 60 per

cent. Thus, if the phenomenon is analysed with a dynamic criterion—that is, with due regard to the growth of world trade—it becomes apparent that Brazil lost<sup>5</sup> more through the reduction in the quantum of exports than was gained from the improvement in the terms of trade. Table 37 shows Brazilian exports, at current dollar values, from 1948 onwards, and the hypothetical value of these exports had the Brazilian share in world trade remained at the 1948 level, that is, at the level attained before the rise in coffee prices. It can be seen that, for the five-year period 1949-53 as a whole, the total value of exports is greater in the hypothetical case than in real terms.

<sup>5</sup> More explicitly, lost in terms of the capacity to import. From the point of view of generating income, the problem may assume a different form, since the factors not utilized in export production may have been absorbed in production for the domestic market.

Table 37. Brazil : value of exports

(Millions of dollars)

	1948	1949	1950	1951	1952	1953	Total
(A) Actual exports .....	1,173	1,089	1,347	1,757	1,409	1,539	8,314
(B) Hypothetical exports <sup>a</sup> .....	1,173	1,192	1,230	1,674	1,610	1,629	8,508
Difference between (B) and (A) .....	—	103	—117	—83	201	90	194

<sup>a</sup> Assuming a constant share of 2.22 per cent (observed in 1948) in the current value of world trade.

It is easy to see that if Brazil had succeeded in maintaining its share in the quantum of world trade, even given a decline in the volume of coffee exports, the increase in the capacity to import would have been very substantial. If the quantum of all exports had remained at the 1948 level until 1953, with a reduction corresponding to the decline in the volume of coffee exports, the aggregate value of exports in the period 1948-53 would have reached \$10,105 million. On the other hand, if the quantum of exports—excluding coffee—had increased with the quantum of world exports, total Brazilian sales abroad would have risen to \$11,299 million during the same period. Since the value of exports in fact stood at \$8,314 million it is clear that there was a loss of \$1,791 million under the terms of the first hypothesis, and of \$2,985 million

under those of the second. The relative decline in the quantum—excluding coffee—represented a loss for Brazil of \$1,194 million during this five-year period. (See table 38.)

In a period of expanding world trade, the mere maintenance of the 1948 quantum of exports—always excluding coffee—would have been sufficient to cover the deficit of nearly \$1.2 billion in the balance of payments on current account during the period 1949-53. If this quantum had grown with that of world trade, the gain would have been nearly \$3 billion, thus exceeding the profit of approximately \$2.5 billion obtained by Brazil during the same period through higher coffee prices.

The recovery of the export quantum is undoubtedly one of the most important objectives to be established in a development programme for Brazil. The increase in the capacity to import during the post-war period was caused exclusively by the improved terms of trade, since the quantum of exports decreased steadily throughout this period. Between 1946—the peak year for exports during the last decade—and 1954, a 31.3 per cent reduction in the quantum of exports and a 158 per cent improvement in the terms of trade were apparent. The assumption that the terms of trade will be re-established at the 1952 level implies a loss of rather more than half this improvement. In the meanwhile, what can be forecast for the quantum of exports, the reduction of which to a large extent reflected the exchange policy pursued until the end of 1953? The answer is that part, if not all, of the ground lost will be recovered. There is no reason for Brazilian exports to decline when world trade is expanding, unless the application of domestic measures is the cause.

The quantum of Brazilian exports declined in 1952 to its lowest point, which almost equalled the nadir reached during

Table 38. Brazil : estimate of the loss in foreign exchange resulting from the reduction in the export quantum

(Millions of dollars)

Year	Value of exports (f.o.b.)	Value of imports <sup>2</sup> (c.i.f.)	Exports	
			(Hypothesis A)	(Hypothesis B)
1948 .....	1,173	1,134	1,173	1,173
1949 .....	1,089	1,116	1,329	1,383
1950 .....	1,347	1,098	1,577	1,727
1951 .....	1,757	2,011	2,105	2,469
1952 .....	1,409	2,010	1,966	2,268
1953 .....	1,539	1,320	1,955	2,279
TOTAL ...	8,314	8,689	10,105	11,299

Hypothesis A : Maintenance of the quantum of exports (except coffee) at the 1948 level. Current prices.

Hypothesis B : Increase in the quantum of exports (except coffee) parallel with world exports. Current prices.

the war. In 1953, there was a recovery of 18.5 per cent in relation to the preceding year, while in 1954, despite the serious drop in coffee exports, the quantum was still 11 per cent above that of 1952. It may therefore be said that a tendency towards recovery exists as a consequence of exchange reform. In reality, if 1954 coffee exports had reached the 1953 level, the aggregate quantum for that year would have increased by 26 per cent above that of 1952. On the basis of these data, it may be assumed that Brazil's quantum of exports will tend to recover the 1951 level spontaneously, as long as there is no fundamental modification of exchange policy. This level—33.8 per cent above that of 1952—was the peak for the last five years. It is reasonable to assume that the process of recovery will take at least three years, as from 1955.

Given this hypothesis of the probable future growth of the quantum of exports, the minimum objective of a programme should now be indicated. The recovery of the peak registered by Brazil's quantum of exports in the period 1939-54 will be set as the target. This level was reached in 1946 and is 21.7 per cent above that of 1951, which was referred to earlier as the limit of spontaneous recovery. This should not be considered an exceptionally ambitious target, since it barely exceeds the 1939 level. However, it represents an increase of 45.8 per cent in relation to 1954. Provided that spontaneous recovery can continue at the same rate after 1957, the target of the programme will be reached in 1960.<sup>6</sup> Thus, the programme's objective would consist purely and simply in extending the period of recovery from three to six years. In this way there would be an annual average rate of growth of 6.5 per cent until 1957 in the case of the spontaneous recovery, and until 1960 in that of the programme. In both it will be assumed that, once the phase is concluded, the quantum of exports will grow at 2 per cent per annum.<sup>7</sup>

Table 39. Brazil : initial hypothesis : production for export and for the domestic market  
(Billions of cruzeiros at 1952 prices)

Year	Gross product	Exports*	Production for domestic market	Exports as a percentage of the product
1950 .....	324.1	43.9	280.2	13.5
1951 .....	346.5	51.6	294.9	14.9
1952 .....	360.9	38.4	322.5	10.6
1953 .....	376.1	46.8	329.3	12.4
1954 .....	409.2	42.0	367.2	10.3
1955 .....	418.1	44.7	373.4	10.7
1956 .....	428.0	47.6	380.4	11.1
1957 .....	448.2	50.7	397.5	11.3
1958 .....	469.6	51.7	417.9	11.0
1959 .....	491.9	52.7	439.2	10.7
1960 .....	514.8	53.8	461.0	10.5
1961 .....	538.2	54.9	483.3	10.2
1962 .....	564.7	56.0	508.7	9.9

\* Including the effect of fluctuations in the terms of trade.

Tables 39 and 40 present two hypotheses of the growth of exports, comparing them with the projections of the

<sup>6</sup> Even if world trade remained stationary during this period and the above-mentioned target were reached, Brazil would not regain its 1948 share in the quantum of world exports.

<sup>7</sup> Two per cent is the historical rate of growth registered during the period 1901-50 for the quantum of Brazil's exports.

product given in chapter II for the initial hypothesis and the minimum programme. In either event, the share of exports in total production will remain practically stable at the 1952-54 level. In other words, the relative decline in export production between 1939 and 1952 will have come to an end, and a period of parallel expansion in production for the domestic and foreign markets will have ensued.

Table 40. Brazil : hypothesis of a minimum programme : production for export and for the domestic market  
(Billions of cruzeiros at 1952 prices)

Year	Gross product	Exports*	Production for domestic market	Exports as a percentage of the product
1950 .....	324.1	43.9	280.2	13.5
1951 .....	346.5	51.6	294.9	14.9
1952 .....	360.9	38.4	322.5	10.6
1953 .....	376.1	46.8	329.3	12.4
1954 .....	409.2	42.0	367.2	10.3
1955 .....	418.2	44.7	373.5	10.7
1956 .....	428.0	47.6	380.4	11.1
1957 .....	450.3	50.7	399.6	11.2
1958 .....	475.8	54.0	421.8	11.3
1959 .....	502.8	57.5	445.3	11.4
1960 .....	530.9	61.2	469.7	11.5
1961 .....	560.0	62.4	497.6	11.1
1962 .....	592.8	63.6	529.2	10.7

\* Including the effect of fluctuations in the terms of trade.

Given a hypothesis of the growth of the capacity to import—resulting from the quantum of exports, the index of the terms of trade and the net outflow of resources—it is possible to calculate the probable volume of imports. This estimate appears in tables 41 and 42. The first of these tables presents the initial hypothesis and the second the minimum programme. In both cases, the process of substituting domestic production for imports must be continued. The share of imports in total expenditure, which rose to 14 per cent in 1947-53, will have to be reduced to 10 per cent in the minimum programme hypothesis. Imports will have to be about 30 per cent less than if their share in expenditure could be maintained. It is,

Table 41. Brazil : initial hypothesis : share of domestic production and of imports in available goods and services  
(Billions of cruzeiros at 1952 prices)

Year	Available goods and services	Production for the domestic market	Imports	Imports as percentage of available goods and services
1950 .....	323.3	280.2	43.1	13.3
1951 .....	356.2	294.9	61.3	17.2
1952 .....	377.5	322.5	55.0	14.6
1953 .....	374.1	329.3	44.8	12.0
1954 .....	413.9	367.2	46.7	11.3
1955 .....	411.6	373.4	38.2	9.3
1956 .....	422.4	380.4	42.0	9.9
1957 .....	442.7	397.5	45.2	10.2
1958 .....	464.2	417.9	46.3	10.0
1959 .....	484.6	439.2	45.4	9.4
1960 .....	506.0	461.0	45.0	8.9
1961 .....	533.1	483.3	49.8	9.3
1962 .....	560.8	508.7	52.1	9.3

therefore, a question of substituting domestic production for imports on a relatively large scale, but this will be difficult to achieve in the period envisaged without a definite policy for the encouragement and guidance of domestic producers.

Table 42. Brazil : hypothesis of a minimum programme : share of domestic production and of imports in available goods and services

(Billions of cruzeiros at 1952 prices)

Year	Available goods and services	Production for the domestic market	Imports	Imports as percentage of available goods and services
1950 .....	323.3	280.2	43.1	13.3
1951 .....	356.2	294.9	61.3	17.2
1952 .....	377.5	322.5	55.0	14.6
1953 .....	374.1	329.3	44.8	12.0
1954 .....	413.9	367.2	46.7	12.7
1955 .....	411.7	373.5	38.2	10.2
1956 .....	422.2	380.4	41.8	9.9
1957 .....	444.3	399.6	44.7	10.1
1958 .....	469.9	421.8	48.1	10.2
1959 .....	495.0	445.3	49.7	10.0
1960 .....	521.6	469.7	51.9	9.9
1961 .....	554.3	497.6	56.7	10.2
1962 .....	588.2	529.2	59.0	10.0

This estimate of the total volume of substitution is based on the probably unrealistic hypothesis that the dynamics of demand for imported goods are identical with those of aggregate demand. From a sample of the principal goods imported, it can be seen that the demand for them grows more than proportionately to an increase in aggregate expenditure. Assuming that the disparity between the two rates of growth ranges from 1 to 1.5, the substitution process would have to cover 52 per cent of the imports with a potential demand. These data bring to light the far-reaching changes imposed by development on the structure of the productive mechanism, given a relative stagnation in the capacity to import.

### 3. LIMITING FACTORS OF A QUALITATIVE AND PHYSICAL NATURE

The probable future level of the quantum of imports having been defined, attention should now be directed to their composition. What changes will be necessary in the composition of imports to ensure that a relative shortage of foreign exchange creates the minimum difficulties for development? As noted in the previous section, there is every indication that in the near future the rate of increase in the capacity to import will not keep pace with the growth of expenditure. Under such conditions, it is obvious that development can take place only if some imported goods are replaced by similar commodities produced domestically.

However, substitution cannot be effected with equal intensity in all sectors. Limiting factors of different kinds create difficulties for the process in some sectors and indirectly encourage it in others. Strictly speaking, these factors are of a physical, qualitative and economic nature.

The physical factors will be examined first. Climatic conditions and a lack of adequate natural resources can be

serious obstacles to the development of certain lines of production. This is true of coffee and cacao in the United States and Europe, of manganese in the United States, of cotton in Japan, and of innumerable other examples. From this point of view, Brazil, with its extensive territory and variety of climates, is an exceptionally well-endowed country.

It is not always easy to isolate a limiting factor of a physical nature from others of a strictly economic character, since technology is constantly changing the facts of the case. Illustrative examples are provided by beet sugar, synthetic rubber, synthetic gasoline, the utilization of low-grade ores and synthetic nitrogenous fertilizers. Notwithstanding this persistent expansion of natural resources through technological progress, a substitution policy must begin by identifying those goods whose domestic production at one time or another encounters obstacles of a physical nature. In Brazil, sulphur is a case in point, although the possibility of its replacement by carbon pyrites has given the economic aspect of the problem precedence over the physical. Tin, lead and copper, whose proven deposits are of a relatively low grade, are in an almost identical situation.

Physical and economic factors play an equal part in the problem of petroleum. If petroleum production were absolutely sure to increase as a result of higher investment in this sector, the problem would be purely economic, and would consist in obtaining the required financial resources and technical knowledge. But such an increase, although highly probable, is hypothetical, and there is thus a limiting factor of a physical nature which must be taken into account. This conclusion applies only to the value of crude petroleum in the port of embarkation, since refining and transport meet merely with limitations of an economic nature.<sup>6</sup>

The second group of factors to be considered are those which have been termed "qualitative". There exist certain products that can be replaced only with difficulty, owing to their intrinsic quality. Works of art and science are an extreme instance. Imports of technical journals and books, or fellowships in foreign universities and research institutes, are the easiest means of gaining access to the knowledge being accumulated in countries in the vanguard of scientific research. The same may be said of certain forms of art regularly imported as services. The cinema provides an outstanding example. Although the development of the domestic film industry can progressively reduce the number of imported films in national cinema programmes, the term "substitution" lacks meaning in this context, since a work of art—if such it can justly be called—cannot really be replaced. The limits of this group are therefore to a certain point arbitrary. Specific beverages, ornaments, china-ware and other objects whose trademark is an integral part of the quality must also be considered. The problem is not so much one of "substitution" as of the criterion to be followed by the authorities. In such cases, it may be assumed that the solutions to be adopted in the future will not differ greatly from those which have prevailed in the past.

Once the limiting factors of a physical or qualitative order have been listed and the total of essential or desirable imports evaluated, some idea can be obtained of the volume of substi-

<sup>6</sup> If current expectations as regards the recently-discovered reserves in the Amazon area are confirmed, the petroleum problem will become strictly economic in nature.

tution to be carried out in accordance with a strictly economic criterion. At this stage, the problem takes the following form: what would be most useful for the Brazilian economy at present—the replacement of imports of pharmaceutical products or of paper; of mechanical or of chemical products? But, before this problem is broached directly in chapter V, another general question must be discussed—that of the division of the world market.

#### 4. PECULIARITIES OF BILATERAL TRADE

The break-down of international trade into monetary compartments increases the complexity of the substitution problem. However, in the particular case of Brazil, this division has less importance than is commonly attributed to it.

Because most of Brazil's foreign trade is carried on with industrialized countries, a high degree of substitution exists among the different markets supplying the country. Since exports are largely paid for in dollars, payment for imports from outside the dollar area which must be purchased with dollars should not, strictly speaking, present serious problems. Another large share of exports is paid for in the currencies of Western European countries—France, Germany, Italy, Sweden, the United Kingdom and the Benelux States—which supply the manufactured and semi-manufactured goods forming the bulk of Brazilian imports.

Separate consideration should, however, be given to the problem of trade with neighbouring countries—in particular, Argentina. In contrast with other trade flows, the exports of neighbouring countries to Brazil are in the form of primary products. Thus, there is an exchange of primary products which is realized on a strictly bilateral basis. In such circumstances, the substitution problem assumes a completely different aspect. For example, the replacement of a manufactured commodity or any imported article from the United States leaves room for another commodity which it would be relatively advantageous to import. This does not occur, however, in the case of imports from Argentina, because the number of Argentine products which can be exported to Brazil is limited. In reducing its purchases of Argentine wheat, Brazil is not leaving room for other types of imports; more probably it is restricting the total volume of trade between these two countries.

Since this trade is balanced on a bilateral basis and is limited to a small number of products, a reduction in imports of any commodity, by either party will tend to have a negative effect on the total volume of trade. The decrease would not have such importance for the country concerned if it were automatically offset by increased trade in another direction. However, there are cases in which a reduction of bilateral trade almost inevitably causes the aggregate trade of one or both of the participating countries to contract. The main point is to know the size of the market that each of the two countries represents for the products of the other. If it be assumed that Argentina can absorb Brazilian products to a value of \$100 million and that Brazil can purchase \$120 million worth of Argentine goods, the minimum trade level would have to be established at \$100 million on both sides. Given this level, the question arises as to whether or not it would be in Brazil's interest to raise its imports to \$120 million. In view

of current conditions in Latin America, the additional \$20 million would have to be covered with foreign exchange, probably dollars, and in this way the substitution problem would again appear in its normal terms. If it were easier to replace \$20 million worth of Argentine products than goods for a similar value paid in convertible currency,<sup>9</sup> it is clear that it would be unsuitable to raise imports to \$120 million. Since imports from Argentina are in the form of agricultural products, their replacement broadly speaking, requires smaller investment. Wheat production, so long as it does not imply the use of land previously employed for export production, demands a lower capital investment per unit of production than that of manufactured articles from the United States, imports of which would have to be reduced as an alternative to replacement.

The terms of the problem would change if Argentina's capacity to absorb Brazilian products expanded beyond \$120 million. Two hypotheses would have to be considered. First, larger exports—an increase in exports of lumber and other primary products, for example—would raise productivity in Brazil. By increasing their sales abroad, Brazilian producers in these sectors would reduce their unit costs. The same applies to certain manufactured goods; manufacturers of railway wagons, for instance, can reduce average costs by raising the scale of production. Wheat imports from Argentina would have to grow to offset greater exports to that country, and, if the losses experienced by Brazilian farmers or producers of other commodities were greater than the export sector's gains, the increment in trade would obviously be to Brazil's disadvantage. But in such cases it may be affirmed almost *a priori* that the more advantageous course is to increase exports, since, especially in an under-developed economy, the export sector is by definition that with the highest economic productivity.

Under the second hypothesis, greater exports to Argentina would not raise the productivity of the sectors making additional sales. This may be the case of a Brazilian commodity the supply of which is occasionally inelastic or which has alternative markets, for example, coffee between 1949 and 1953, and the products of manufacturing industries that are working at full capacity for the domestic market. If steel were currently exported to Argentina, for instance, Brazil would be obliged to increase its own steel imports by an equal tonnage. If such higher Brazilian steel imports had to be based on reductions in other imports of manufactured goods, a decrease in the total availability of manufactures (production for the domestic market plus imports) and an increase in the supply of primary products would take place, a situation which is not always desirable. Problems of this nature frequently arise in bilateral trade, particularly where neighbouring countries are concerned. In fact, because they are neighbours, the possibilities of complementary trade should be studied with great care, since therein often lies the key to the solution of the basic problems of regional development.

<sup>9</sup> This problem would assume a different aspect if the possibility of combining two bilateral trade channels were considered. If, instead of liquidating the balance in convertible currency, Brazil were to pay in the currency of another country that wished to increase its purchases of Brazilian goods, there would be an increase in aggregate trade.



## Chapter V

### UTILIZATION OF THE CAPACITY TO IMPORT

#### 1. INTRODUCTION

The estimate of the total volume of substitution given in the preceding chapter constitutes only an indication of the demand likely to be imposed by development on the economic system in that sector. With due regard to the general remarks embodied in the last two sections of chapter IV, an attempt will now be made to investigate the lines along which the effort towards import replacement should be directed within each sector of production. To this end, substitution trends in the recent past will be examined and a study made of the country's potentialities in terms of the expansion of the domestic market and of the relatively deficient capacity for external payment.

For the purposes of this analysis, imports may conveniently be broken down into the following categories: (a) foodstuffs; (b) manufactured and semi-manufactured consumer goods; (c) fuels and lubricants; and (d) capital goods.

Four main points are included within the general scope of the analysis, namely, the probable volume of import replacement in each sector, past substitution trends, the substitutive potentiality of each sector and the objectives to be attained.

To set up objectives for import replacement is to define by implication the targets at which domestic production must aim. Both the critical examination of these targets and the precise nature of the means whereby the system may be led to attain them are fundamental aspects of the work of programming.

The following is a brief outline of the method adopted in analysing the problem of import replacement. The level and composition of expenditure, as well as the volume of imports, are deduced from previous analyses. Imports bound

up with rigidly bilateral systems are estimated in terms of the probable volume of such trade. Those that are difficult to replace, like petroleum, are calculated on the basis of the probable development of domestic production; other imports of consumer goods are in general assessed on the assumption that an intensive substitution policy will be pursued. Finally, the capacity to import capital goods is estimated residually, by taking the difference between imports of consumer goods and the capacity to import.

#### 2. FOODSTUFFS

If the supply of foodstuffs is measured by the value paid to domestic producers and by the c.i.f. value of imports—that is, if the proportion corresponding to services and taxes is excluded from the amount spent by the population on foodstuffs—imports are seen to have represented 8.4 per cent of the supply over the period 1947–54. If it is assumed that, within the minimum programme outlined, the demand for foodstuffs will expand by 30 per cent between 1954 and 1962, were imports to maintain their share of 8.4 per cent, they would have to rise in value from their 1954 level of 8.3 billion cruzeiros to 10.1 billions (at 1952 prices). Such imports would therefore increase by 22 per cent. The growth envisaged for aggregate imports being 26 per cent, the inference is that in the given hypothesis imports of foodstuffs would absorb a smaller quota of foreign exchange, leaving more available for other imports.

The foregoing paragraph assumed that an average of 8.4 per cent would be representative of the share of imported foodstuffs during the period 1947–54. The objection might be raised, however, that this average is depressed by the abnormally low imports during 1947–49, a factor emphasized in table 43 below.

Table 43. Brazil : share of imports in the total supply of foodstuffs  
(Billions of cruzeiros at 1952 prices)

	1939	1947	1948	1949	1950	1951	1952	1953	1954
Total supply .....	38.6	61.5	64.1	68.8	73.1	76.6	77.0	87.9	90.2
Imports .....	4.8	4.6	4.9	4.9	6.6	7.6	7.0	7.9	8.3
Percentage of imports .....	12.4	7.5	6.4	7.2	9.0	9.9	9.1	9.0	9.2

*Source:* Basic data from official Brazilian statistics.

If the years 1947–49 are excluded, the share of imports reaches 9.2 per cent. The adoption of this last percentage gives an import value for 1962 equivalent to 11 billion cruzeiros, which would represent an increase of 33 per cent above the 1953 figure. In this event, imports of foodstuffs would expand more than total imports.

It is appropriate here to comment on the quantitative restrictions imposed on specific imports of foodstuffs during

the period under review, and it is important to define how far these were real restrictions or how far they merely cancelled out the effects of the heavy exchange subsidy granted to such imports. The data for 1954 are very enlightening in this connexion, as in that year imports were unaffected by any quantitative restrictions and were still subsidized, at least in the case of wheat, by means of an exceptionally low rate of exchange. Yet despite the abolition of quantitative controls,

imports of foodstuffs increased by only 4.5 per cent between 1953 and 1954. It may well be that if wheat had not enjoyed such a high exchange subsidy, imports of foodstuffs in 1954 might actually have been lower than in the previous year. At all events, it is interesting to note the difference between the increment of only 4.5 per cent in imports of foodstuffs and the increase of 23 per cent in total imports.

It is also a fact that the income-elasticity of the demand for imported foodstuffs, which in some cases are of better quality and in others satisfy mainly urban consumption, is considerably higher than that of the average demand for all foodstuffs. The expansion of food imports might therefore be logically expected to be more intensive than that of their demand; yet experience belies this conclusion.

An analysis of the data on food consumption in Brazil reveals a long-term trend towards the replacement of imported items by the domestic production of similar commodities. This phenomenon is perhaps linked with the fact that, however high the income-elasticity of demand for imported foodstuffs, as a general rule it is still higher for imports of manufactures. This being the case, from the moment when internal factors began to stimulate a more intensive growth of the economy than of its capacity to import, prices of imported commodities tended to rise in relation to those of domestically produced goods, the replacement of the former by the latter being thus accelerated in sectors where competition already existed,

as was true of foodstuffs. This accounts for the drop in the share of imports in total foodstuffs supplies from 20 per cent in 1925 to little more than 12 per cent in 1939, and then to an average of 8 per cent in the post-war years. There are thus grounds for assuming that such a trend will persist, and that by 1962 the share of imports in the supply of foodstuffs will have decreased to less than 8 per cent. If it is further assumed that such imports will remain at the level attained in 1954, this figure would fall to 6.9 per cent.

To conclude: in view of the predicted increase in demand and the substitution trends prevailing in the sector, a preliminary objective for imports of foodstuffs might be their maintenance at the 1954 level. A pre-requisite for the fulfilment of this aim will be a permanent change in the composition of imports, since not all imported commodities are equally susceptible to replacement.

Once a general target has been set up, a detailed study of the principal imported foodstuffs must be undertaken, to include, firstly, the probable future behaviour of demand and, secondly, the real possibilities of meeting the demand from Brazil's domestic production.

A preliminary analysis of the demand for the main groups of foodstuffs will next be presented. So important is the problem of wheat that it will be accorded fuller treatment in a special study to be published separately. Table 44 has been prepared to show the composition of imported foodstuffs.

Table 44. Brazil: composition of the value of imports of foodstuffs  
(At current prices)

	1937-39	1947-49	1950-52	1953	1954
Wheat and wheat flour .....	70.0	64.5	58.5	68.1	54.3
Fruit .....	8.8	11.4	13.3	13.0	10.5
Olive oil .....	4.4	2.6	3.9	2.1	6.8
Dried food .....	5.6	5.4	9.9	5.7	10.7
Beverages .....	4.2	4.5	3.1	1.5	2.0
Others .....	7.0	11.6	11.3	9.6	15.6
TOTAL ...	100.0	100.0	100.0	100.0	100.0

#### (a) FRUIT

The considerable increase in fruit imports since the war is linked with the fall in their relative prices, brought about by Brazil's exchange policy and by the sharp devaluation of the Argentine currency as from 1948. Between this latter year and 1951 these two factors operated in conjunction and the volume of fruit imports doubled. An opposite trend set in, however, from 1952 onward and was accentuated by exchange reform in 1953.

As regards the relative prices of domestic and imported fruit, the situation created by exchange reform seems to suggest that during the next few years the volume of imports will be perceptibly lower than during the period 1951-53. Some idea of the relative evolution of the domestic and foreign fruit supplies during the post-war years may be obtained from table 45.

An examination of the population's expenditure on imported fruit shows that between 1953 and 1954 it fell from 665

Table 45. Brazil: comparison of imported fruit with domestic supplies  
(1937-39 = 100)

	1947	1948	1949	1950	1951	1952	1953	1954
Imported fruit .....	233	192	238	288	387	336	296	234
Pineapples .....	78	83	92	110	110	111	122	130
Oranges .....	101	108	113	113	120	124	125	128
Bananas .....	202	210	230	261	265	298	297	320
Total for the three kinds of home-grown fruit .....	135	142	153	166	170	173	179	190

to 549 million cruzeiros,<sup>1</sup> thus declining from 14 to 11 per cent of total expenditure on foodstuffs. However small the reduction, it seems to indicate a price-elasticity higher than unity. It may thus be assumed that the course to be taken by fruit imports in the future will depend far more on relative prices than on real income in Brazil. Again, as these relative prices will be closely bound up with the development of bilateral trade between Brazil and Argentina, it may be concluded that, from the standpoint of the balance of payments as a whole, little interest attaches to a projection of the domestic demand for imported fruit. However, it may be said as a guiding principle that the relative prices prevailing in 1954 are approximately representative of the structure of relative costs in these two countries at the present level of trade. Thus, future demand will tend to develop along the lines laid down by the increase in the income of consumers and by income elasticity.

A calculation of this elasticity gives a coefficient of nearly 0.9, on which assumption, the increment in the demand for imported fruit between 1954 and 1962 would be approximately 35 per cent.

<sup>1</sup> C.i.f. prices, excluding services and taxes within the country.

### (b) Beverages

In 1947 and 1951, which were peak years for free trade, imports of beverages considerably increased. This, however, was the group most affected by the new exchange system. Placed as they were in the last category, there was a sharp rise in beverage prices, which brought imports down to a low level in 1954.<sup>2</sup> (See table 46.) This situation must necessarily encourage domestic production of both distilled beverages and table wines. Clearly, the probable volume of future beverage imports will depend far more on relative prices than on any other factor. Because per capita imports in 1954 were less than half those in 1937-39, despite the substantial increase in income, it can hardly be assumed—given the less favourable outlook for the payments capacity—that the trend towards substitution is likely to be reversed. The hypothesis of a continuation of the 1954 level for imports may therefore be considered as genuine.

<sup>2</sup> The reduced imports in 1953 reflect the consequences of the quantitative restrictions which were intensified at that time. Between this year and 1954 an inelastic supply situation, attributable to import difficulties, gave way to one of elasticity in the supply. In some cases the incidence of this circumstance sufficed to lower the prices paid by the final consumer, despite the sharp rise in import prices.

Table 46. Brazil: some groups of imported foodstuffs  
(1937-39 = 100)

	1947	1948	1949	1950	1951	1952	1953	1954
Beverages .....	266	197	83	97	210	117	68	77
Olive oil .....	38	95	45	236	192	101	122	346
Dried cod .....	83	107	121	145	231	279	128	217

### (c) Cod and olive oil

Imports of olive oil and dried cod, unlike those of beverages, increased in 1954. The rise in prices was not high enough to offset the abolition of the quantitative controls previously in force. Even so, imports of cod were substantially lower than in 1951-52, when they had been comparatively free from restrictions and prices had been much lower. If it is assumed that the relative price level in 1954 reflected the existing cost structure in Brazil and the countries exporting cod, the growth of the demand can be estimated on the basis of income-elasticity, following exactly the same method as for fruit. In this case, the income-elasticity coefficient fluctuates around 0.8, based on the trend for the period 1937-39 to 1954. The aggregate expansion achieved in the period 1954-62 would thus amount to 33 per cent.

Imports of olive oil, which were subject to quantitative restrictions for a long period, increased substantially in 1954. But the raising of the exchange rate for the highest categories in 1955 will certainly have repercussions upon imports. If this should not occur, careful consideration must be given to the problem of creating other incentives for domestic production, a practice which has already begun in some parts of the country. The growth of per capita income cannot alone account for the large volume of imports in 1954, which was three times higher than the average for 1937-39. The explanation is rather to be found in the price, which was relatively low in comparison with the pre-war level. Nevertheless, a considerable reduction in imports may be expected to result from the higher prices already in evidence during 1955.

For want of better grounds on which to base an opinion, it is assumed that, between 1953 and 1962, imports of these products will increase commensurately with the aggregate supply of foreign exchange, that is, by about 32 per cent, thus representing decidedly smaller imports than in 1954.

### (d) Wheat

According to the special study to be published separately, wheat consumption in 1962 will probably stand at about 3 million tons. More than half this demand should be met from domestic production. Imports are expected to come entirely from Argentina and Uruguay and will mainly depend on the volume and relative prices of Brazil's exports to these two countries. It may be assumed that Brazil will import from 1.2 to 1.6 million tons, according to circumstances, 1.3 millions at 1952 prices being adopted as a working hypothesis.

### (e) Total imports of foodstuffs

Imports of foodstuffs have been projected in accordance with the hypotheses formulated in the preceding sections. (See table 47.)

The projections in table 47 are based on the following assumptions:

(1) Wheat production would have to expand sufficiently to satisfy approximately 50 per cent of consumption, estimated at about 3 million tons, and seed;

(2) There would be no basic modifications in the relative prices of imported fruit and cod; in other words, the prices

Table 47. Brazil : projection of imports of foodstuffs

(Millions of cruzeiros at 1952 prices)

Groups of products	1952	1953	1954	1962
Wheat and wheat flour .....	2,744.5	3,705.1	3,503.0	3,212
Fruit .....	585.0	421.2	403.7	545
Beverages .....	130.0	75.4	85.8	86
Dried cod .....	538.6	247.8	420.1	559
Olive oil .....	107.7	130.3	369.4	166
Others .....	692.1	975.9	1,142.0	1,085
TOTAL ...	4,797.9	5,555.7	5,934.0	5,653

reached in 1954 under the new exchange system would be approximately representative of the cost structure in Brazil and in the exporting countries; this being so, it may be assumed that the demand for these commodities would expand on the basis of income-elasticity and the increase in consumer income;

(3) Imports of beverages and olive oil would remain at levels corresponding to foreign exchange availabilities; for beverages, this level would be equal to that of 1954, and for olive oil, 33 per cent higher than in 1953, these being arbitrary values which might be modified as a result of considerations relating to bilateral trade;

(4) The demand for other foodstuffs would follow the same lines as the average trend in the above groups.

If the above-mentioned objectives were attained, the quantum of all imports in 1962 would be only 2 per cent higher than in 1953 and nearly 5 per cent lower than in 1954. Consequently, there are real possibilities of liberating some capacity to import, for the benefit of other sectors where demand is growing more rapidly.

### 3. MANUFACTURED CONSUMER GOODS

Manufactured consumer goods will initially be considered as a whole, excluding processed foodstuffs and fuel, but including industrial chemicals. In a preliminary estimate of the share of imports in total consumption of manufactured goods, production and imports were computed on the cost of the factors employed in the manufacturing process.<sup>3</sup> (See table 48.)

Table 48. Brazil : share of imports in the supply of consumer manufactures

(Billions of cruzeiros at 1952 prices)

Year	Domestic production	Imports	Total supply	Imports as percentage of total supply
1939 .....	17.2	4.2	21.4	20
1949 .....	33.1	6.1	39.8	17
1950 .....	36.8	7.0	43.8	16
1951 .....	38.2	11.7	49.9	23
1952 .....	39.4	8.0	47.4	17
1953 .....	42.1	5.4	47.5	11
1954 .....	47.6	8.0	55.4	14

NOTE.—See table 31 of chapter III.

<sup>3</sup> Chapter III explains the advisability of calculating consumption on the lines indicated in the text.

Despite the substantial increase in the capacity to import which characterized the period under review, it may be seen that import replacement was necessary on a large scale both in 1939–49 and during the more recent five-year period. While the aggregate supply in this sector grew at an annual rate of 6.4 per cent, imports expanded at only 4.7 per cent during 1939–49. Over the recent five-year period, these rates stood at 6.8 and 3.7 per cent respectively. The ratio between these rates provides what may be called the substitution coefficient. During the period 1939–49, this coefficient had stood at 1.4 and rose to 1.8 in 1949–54. It is interesting to note that during the period when development was more rapid, import replacement also proceeded more swiftly in the manufactured consumer goods sector.

According to the projections presented in chapter III, the demand for manufactured consumer goods, in the form defined here, would in the minimum programme rise at an annual rate of 4.7 per cent; this means that the pace of expansion would be slower than in either the 1949–54 or the 1939–49 period. In view of this decline in the process of growth, the substitution coefficient may be expected to decrease. If this coefficient returns to its 1939–49 value of 1.4, imports in this sector will increase by 3.3 per cent annually, on the assumption of a rate of growth of 4.7 per cent for the demand for manufactured consumer goods. The total increment over the whole period 1954–62 should therefore amount to roughly 30 per cent.

The foregoing conclusion clearly indicates that the effort towards import replacement must be intensified in this sector, since, if all the conditions described were fulfilled, imports of manufactured consumer goods would grow more rapidly than the capacity to import. The attempt to reverse this trend would have to be one of the principal objectives of a programme, as there are ample possibilities of expanding the consumer goods industry in Brazil.

Some consideration should now be given to the hypothesis whereby the substitution coefficient recorded for the most recent five-year period is maintained. As this coefficient was 1.8, the inference is that imports must grow at a rate of 2.6 per cent over the period 1954–62. The total increase over these eight years will amount to 22.8 per cent, which is not much lower than the predicted expansion of 26.3 per cent in the capacity to import.

An accelerated process of import replacement is not a very difficult objective in this sector, but the problem should perhaps be examined from another angle. Over the period 1939–49, domestic production of manufactured consumer goods expanded at an annual rate of 6.7 per cent, and in the

most recent quinquennium this rate rose to 7.6 per cent. Clearly, this growth was accompanied by rapid overall development and a pronounced increase in the capacity to import. However, these data emphasize that if suitable incentives were provided, domestic production might reach rates of growth sufficiently high for an acceleration of the substitution process. Thus, if it were to expand between 1954 and 1962 at the rate of 6.7 per cent recorded for the decade 1939-49, at the end of this period domestic production would be equivalent to total demand, or, in other words, import replacement would have attained 100 per cent.

Even though it be taken into account that the total replacement of imports, in a sector so wide as that under consideration, is neither practicable nor desirable, the real possibility of intensifying the substitution of domestically produced for imported manufactured consumer goods cannot be disregarded. If the rate of growth of production is taken to be 5.3 per cent—or 30 per cent lower than that recorded for the whole of the period 1939-54—by 1962 imports of manufactured consumer goods should have risen no higher than their 1954 level. This would hardly be an ambitious objective and could well be established as a target within the minimum programme.

Once this central objective has been defined, the various industry groups must be studied to determine the best way of distributing the load of import replacement.

#### (a) *Non-durable goods*<sup>4</sup>

Contrary to what might be supposed at first sight, the non-durable consumer goods sector proved less suitable for import replacement than that of durable goods. While imports of the latter declined by 42 per cent,<sup>5</sup> between 1949 and 1954, those of non-durable goods rose by 33.7 per cent. This increase caused imports to remain at approximately 9.5 per cent of the total supply of manufactured consumer goods.

Nevertheless, the stability of the proportion represented by imports conceals radical changes in their composition. (See table 49.)

<sup>4</sup> Under this head are included textiles, footwear, processed and semi-processed hides and skins, pharmaceutical and toilet articles, paper and printed matter.

<sup>5</sup> If motor vehicles are excluded, these imports were reduced by 27 per cent.

Table 49. Brazil : imports and domestic supply of non-durable consumer goods in 1949 and 1954

	1949		1954		Percentage in imports change between 1949 and 1954
	Composition of imports	Imports as a percentage of total domestic supply	Composition of imports	Imports as percentage of total domestic supply	
Textiles .....	41.2	7.0	16.3	3.0	46.6
Leather goods .....	2.6	2.4	2.4	2.4	20.9
Pharmaceutical and toilet articles ..	27.4	17.9	34.5	19.7	69.8
Paper .....	25.7	28.0	42.3	38.8	122.0
Printed matter .....	3.1	2.2	4.5	3.6	104.0
TOTAL ...	100.0	9.4	100.0	9.5	33.7

Source : Basic data from official Brazilian statistics.

The only group in which imports decreased during the period under review was that of textiles. The reduction was not, however, great enough to offset the marked increase in the other groups. Imports of pharmaceutical products and paper, which had accounted for a little more than half the total, came to represent more than 75 per cent. More striking still was the enlargement of the share of imports in the domestic supply of these two groups.

It is obvious from these preliminary remarks that if the general target indicated in the foregoing section is to be attained, current trends in the pharmaceutical products and paper sectors must be modified.

With respect to pharmaceutical products, the advent of antibiotics has brought about a basic technological revolution. Suffice it to recall that the volume of antibiotic imports was almost fourteen times as great in 1954 as in 1949. For other pharmaceutical products the pattern was entirely different, since imports decreased by almost 20 per cent during the same period.

It may therefore be assumed that import replacement in this sector is proceeding satisfactorily, and that the basic problem

concerns only antibiotics. Brazil began to produce them very recently, but on a considerable scale. The capacity of two penicillin factories which entered production at the close of 1954 is sufficient to meet the needs of the domestic market in future years; imports of penicillin will therefore drop sharply from 1955 onwards. The same cannot yet be said, however, of other antibiotics, although specific undertakings are planned to produce them.

A thorough study of the steps taken so far will be required. Once research has been devoted to the technological features of this branch of industry—optimum size of factories, relations with kindred industries, etc.—it will be possible to ascertain whether the total replacement of imports can or cannot be expected in this sector.

Even now, however, the reduction of imports of antibiotics to half their 1954 volume<sup>6</sup> and the maintenance of imports of other pharmaceutical products at that year's level may be regarded as a reasonable target. If the latter continue

<sup>6</sup> This implies that, even though imports of penicillin may be entirely replaced by domestic production, other antibiotics will still be imported in increasing quantities during the period under consideration.

being replaced, they will presumably leave room for the new products that the pharmaceutical industry is always putting on the market; in these circumstances, imports of pharmaceutical products will be 28 per cent less in 1962 than in 1954.

The pulp and paper problem must now be considered. This is a typical case of the systematic discouragement of domestic production as a result of exchange policy. The reform carried out at the end of 1953, while it completely altered the situation with respect to pulp, merely aggravated it for newsprint.

It is acknowledged that the possibilities of producing pulp and newsprint in Brazil, as far as the availability of raw materials is concerned, are considerable.<sup>7</sup> Market conditions are also eminently favourable to the development of this industry. Yet production in this sector was far from maintaining its share in the domestic supply. There can be no doubt that this is one of the sectors in which an import replacement policy cannot fail to yield immediate results. Given the experience already accumulated by Brazilian producers, as well as the abundance and accessibility of domestic sources of raw materials, it may be confidently asserted that the consistent provision of incentives will result in very substantial progress.<sup>8</sup> Programmes whose preparation is already well on the way to completion justify the assumption that the present output of newsprint, which barely exceeds 40,000 tons, will be doubled or even trebled. Thus, provided that the requisite conditions are created for this industry to become a sound economic proposition in Brazil, an output of about 100,000 tons will be available in 1962. This is one of the objectives that a programme should define with the utmost precision, for there can hardly be a sector in which the possibilities for import replacement are more certain or more advantageous, the point being to mobilize potential domestic resources, which for the moment have no other prospects of being utilized. If it is taken into account that, even within the exceptionally moderate hypothesis adopted here, newsprint consumption must rise to nearly 225,000 tons in 1962, it may be deduced that the target for the expansion of domestic production already indicated would barely maintain imports at a level close to that of 1954. It is therefore a modest objective. If an investment plan for Brazil were studied more thoroughly, it would perhaps seem advisable to raise the target in question to 150,000 or even to 200,000 tons. The objective of 100,000 tons will be postulated as a minimum to be considered for a development programme.

The problem of pulp for the manufacture of paper is, from one point of view, more serious, because its relative importance is greater and, from another standpoint less complicated, since exchange reform made this industry highly remunerative. At present, several projects for the expansion of domestic production are under way. Here again the definition of precise objectives is indispensable, since, if the steps taken are ina-

dequate, incentives of another sort will have to be created. As a preliminary hypothesis, it may be assumed that the production of pulp for paper will grow at a rate similar to that already suggested for the production of newsprint.<sup>9</sup> Since the consumption of pulp for the manufacture of grades of paper other than newsprint will amount to approximately 250,000 tons in 1962,<sup>10</sup> it may be inferred that 75,000 tons would have to be imported in that year. In 1954, imports had stood at 160,000 tons, though probably not more than 120,000 were actually consumed. In the closing months of the year, considerable stocks were accumulated, as confirmed by the reduction of imports in the early months of 1955. Should the two hypotheses just formulated become a concrete reality, imports in the paper sector would be approximately 40 per cent less in 1962 than in 1954.

A rapid glance must now be given at other non-durable consumer goods. Imports of printed matter should be encouraged, at least as far as scientific and technical publications are concerned. It will therefore be assumed that in this sector imports will grow as rapidly as domestic demand.

It is well known that imports of textiles and leather goods mainly consist of high quality articles, demand for them being to some extent bound up with the prestige of certain trademarks. However, the process of import replacement may be expected to continue in the textile sector, though perhaps at a slower pace.

As a preliminary approximation, it may be assumed that imports will remain at their 1954 level in these two sectors. (See table 50.)

Table 50. Brazil : projection of imports  
of non-durable consumer manufactures  
(Billions of cruzeiros at 1952 prices)

	1949	1954	1952
Textiles .....	0.91	0.53	0.53
Leather goods .....	0.06	0.07	0.07
Pharmaceutical and toilet articles ...	0.60	1.10	0.79
Paper .....	0.57	1.29	0.77
Printed matter .....	0.07	0.10	0.13
TOTAL ...	2.21	3.09	2.29

Source : Basic data from official statistics.

#### (b) Durable goods

The sharp reduction in imports of durable consumer goods already mentioned demonstrates the high price-elasticity of the demand. One of the negative aspects of the exchange policy followed until 1953 was that it effected an artificial reduction in the relative price of imported durable goods. The rigid control imposed on imports of these commodities gave rise to excessive profits for holders of import licences,

<sup>7</sup> See the report on *Possibilities for the Development of the Pulp and Paper Industry in Latin America*, (E/CN.12/294/Rev.2), United Nations publication, Sales No. : 1953.II.G.2, and also *Pulp and Paper Prospects in Latin America*, (E/CN.12/361/Rev.1) United Nations publication, Sales No. : 1955.II.G.4.

<sup>8</sup> The stimulus required is practically confined to the newsprint sector, where imports are heavily subsidized through the exchange system. At the close of 1954 certain compensatory measures were adopted with the limited aim of avoiding a falling-off in production. But still more positive steps must be taken to provide an incentive for investment in this sector.

<sup>9</sup> The output of pulp, which was approximately 55,000 tons in 1954, would have to be increased to 175,000. The four most important projects for expanding capacity in this sector, some of them well on the way to full implementation, represent the addition of 120,000 tons, of which 20,000 would be pulp for rayon.

<sup>10</sup> On the basis of the projections presented in chapter III, it is assumed that consumption will increase by 40.6 per cent between 1954 and 1962. For a paper/pulp ratio of 1 to 0.65, the total consumption of the latter—excluding newsprint and rayon—will be nearly 250,000 tons.

and this, in turn, exerted continuous pressure on the authorities exercising such control. With the introduction of the new exchange system, prices of durable consumer goods, which were generally included in the highest category and were imported from the countries whose currencies were most in demand, became from five to ten times higher. To grasp the effect of this price increase, it is sufficient to compare the quantum of imports in the only two years of the recent period when such import barriers were almost completely removed—namely, 1951 and 1954. During the latter year, imports of durable consumer goods represented only one-quarter of their 1951 volume. The reduction was still more marked in the case of passenger cars.

A comparison between imports of durable consumer goods in 1954 and in 1947–53 reveals that the former represented only 45 per cent of the average, and stood at a lower level than in any other year except 1953. This shows that price increments have constituted a much more effective curb on imports than direct control.

Available data on domestic production of durable consumer goods are too unreliable to be used as a basis for analysis. Nevertheless, it is clear that import substitution was intensive in this sector. Although imports declined by 42 per cent between 1949 and 1954, total domestic supplies seem to have increased by about 60 per cent. If passenger cars are excluded, the increment seems to have been still greater. The development of the China and porcelain and electrical appliance industries proceeded at a really exceptional rate, which, by lowering prices, permitted a considerable expansion of the domestic market.

The new exchange policy placed the process of substituting domestically produced for imported durable consumer goods in a relatively favourable position. It may be taken for granted that the considerable degree of substitution which had been fostered by direct controls was intensified under the new regime. In view of the margin of protection afforded by the exchange rate and the high income-elasticity of demand, few branches of production present such favourable prospects as the durable consumer goods industry.

Within this group, the motor vehicle industry requires separate treatment. All the others have already been installed in Brazil and it may be presumed that existing problems will be solved in the course of their normal development. Some of these industries are benefiting from higher yields arising from an increase in the scale of production. The high degree of profitability caused by these favourable circumstances should provide resources for future growth. This is not true of the motor vehicle industry. Development to date has been limited to the assembly process or the manufacture of simple parts which wear out rapidly. Owing to the concentration of resources and techniques required for the manufacture of basic parts, the domestic entrepreneur finds access to this industry difficult. But the possibility exists that some international groups, which have already placed heavy investments in Brazil, might also become interested in the manufacture of complete vehicles.

The current market problem takes the following form. Brazil's motor vehicle park numbers 350,000 units (excluding lorries and buses). The mere maintenance of such a level requires an annual supply of 35,000 vehicles. On the assumption of a modest rate of increase for income and an income-

elasticity coefficient of 2 (which is undoubtedly very low), the inference is that motor vehicle stocks should expand by 20,000 units by 1955 and by 29,000 units in 1962. By adding the necessary units for replacement, respective totals of 55,000 and 80,000 units are reached. This figure indicates the magnitude of the potential demand for motor vehicles in the future. Obviously, for the potential demand to become real, prices must not exceed certain limits, since the price-elasticity of demand for motor vehicles is high.

In 1951, imports of motor vehicles totalled about 50,000 units, though the number of import licences actually granted during that year was considerably higher. Again, imports in 1954 were limited to about 7,500 units. Given the increase in income and population, it may be assumed *grasso modo* that demand declined from 10 to 1. Yet the average increment in real prices actually paid by the consumer did not exceed 5. The price-elasticity may therefore be roughly estimated at about -2, or, in other words, when prices are doubled, demand is reduced by 50 per cent.

On the assumption that the average price paid by the consumer for a new motor vehicle in 1954 was 400,000 cruzeiros, the conclusion may be drawn that for demand to rise from 7,500 to 50,000 units the price will have to fall to 133,000 cruzeiros. Thus, either motor vehicles must be manufactured in the country so that they can be sold to the consumer at an average price not much higher than 150,000 cruzeiros, or demand for them will not attain the levels previously deduced from income-elasticity. The second inference is that if the price indicated is too low, in view of manufacturing conditions, it is clear that the number of cars available in Brazil is too high for the real level and distribution of income. In other words, some of the available motor vehicles would not have been bought if the exchange subsidy had not placed them within the reach of persons with relatively low incomes.

If the supply of new cars continues to depend exclusively on imports, and if the average price per imported vehicle remains at the 1954 level, by 1962 imports will have to reach about 12,000 units, according to the hypothesis of income growth implicit in the so-called minimum programme. These data have been adopted as a basis for the projection.

It will be assumed that imports of the remaining durable goods, which are being replaced at a rapid rate, will remain stationary at the 1954 level. (See table 51.)

Table 51. Brazil : projection of imports of durable consumer goods

(Billions of cruzeiros at 1952 prices)

	1949	1954	1962
Automobiles .....	0.80	0.29	0.43
Other goods .....	1.40	1.02	1.02
TOTAL ...	2.20	1.21	1.45

Source : Basic data from official Brazilian statistics.

### (c) Industrial chemicals

Industrial chemicals are producer goods—that is, they are incorporated into other goods during the production process. Nevertheless, since the main products, such as alkalis, fertilizers and dyes, are used mainly in consumer goods, they will be



grouped with the latter. It has already been seen that the data available are insufficient to permit a detailed appraisal of the demand. Only a few brief comments can be made on the substitution possibilities in this sector.

Alkalis, fertilizers, insecticides and dyes accounted for about two-thirds of the imports of industrial chemicals in 1954; such imports were, however, exceptionally heavy in that year because of the desire to increase stocks, which had previously been maintained at a low level by the import licence system. Imports of alkalis—that is, caustic soda and sodium carbonate—reached a level of 205,000 tons, against 107,000 in 1953 and an average of 120,000 over the period 1949–53. Imports of dyes rose by 53 per cent between 1949 and 1954, and those of fertilizers and insecticides by 70 per cent.

Demand for fertilizers is basically dependent on the profitability of agricultural activities. The sharp rise in agricultural prices during recent years caused a considerable expansion of the demand for fertilizers, imports of which trebled between 1949 and 1951. The trend was reversed as from 1954, when prices of fertilizers rose and agricultural prices underwent a relative decline, although this drop became marked only from 1955 onward. This is the reason why imports in this sector were 42 per cent less in 1954 than in 1951. Two factors should be taken into account as regards future years. First, the downward movement in the relative prices of farm products which began in 1955 will probably remain unaltered. Secondly, domestic production of fertilizers is bound to expand considerably, since it is expected that, in addition to other plans, by 1956 a plant for the manufacture of nitrogenous products, associated with the Cubatao petroleum refinery,<sup>11</sup> will enter production. It can therefore be assumed that domestic production will meet an increasing share of the requirements in this sector. However, since it is impossible to evaluate the probable extent of substitution, the same level of imports as in 1954 will be postulated for 1962.

Demand for alkalis depends on the growth of a group of industries such as those producing paper, rayon, textiles, glass, etc. The rapid expansion of these industries, some of which have been installed or diversified in recent years, caused a sharp increase in the demand for alkalis, which rose by about 60 per cent between 1948 and 1953–54.<sup>12</sup> A comparison of this increment with that of production of manufactured consumer goods gives a ratio of 1 to 1.33. In the extreme hypothesis that the same rate of expansion of industrial production as in the last six years, and that the same ratio of 1 to 1.33 will be maintained, the demand for alkalis will increase by about 90 per cent between 1954 and 1962. If consumption of imported alkalis in 1954 is estimated at 150,000 tons (the average for 1953–54), demand will total about 285,000 tons by 1962.

The previous calculation does not include domestic production of electrolytic soda, on which no reliable information is available although output is known to be increasing with the expansion of the market for chloride. Moreover, pro-

duction of Solvay soda at Cabo Frio, partly financed by the Banco Nacional do Desenvolvimento Econômico, is expected to begin within two or three years. It may be assumed, with an ample margin of security, that production of alkalis will expand by at least 100,000 tons. Imports in 1962 will therefore fluctuate around 185,000 tons.

It is assumed that the demand for dyes will grow at the same rate as the production of textiles, according to the estimate for the latter presented in chapter VI. Owing to the lack of precise information on substitution prospects for this sector, it is further assumed that imports will increase at the same rate as demand.

Finally, the average for the three groups already analysed will be adopted for the remaining products, which account for about one-third of the aggregate. (See table 52.)

Table 52. Brazil : projection of imports of industrial chemicals

(Billions of cruzeiros at 1952 prices)

	1949	1954	1962
Alkalis .....	262	478	429
Fertilizers and insecticides .....	199	339	339
Dyes .....	208	318	509
Others .....	430	882	992
TOTAL ...	1,099	2,017	2,269

Source : Basic data from official Brazilian statistics.

#### (d) Aggregate consumer manufactures

In drawing up table 53 to show the projections for imports of manufactured consumer goods, the same expansion as for the aggregate of the groups analysed in previous sections was attributed to the "unclassified" group.

Table 53. Brazil : projection for aggregate imports of consumer manufactures

(Billions of cruzeiros at 1952 prices)

	1949	1954	1962
Non-durable goods .....	2.21	3.09	2.29
Durable goods .....	2.21	1.31	1.45
Industrial chemicals .....	1.10	2.02	2.27
Unclassified .....	0.80	1.03	0.96
TOTAL ...	6.31	7.45	6.97

It was suggested earlier that a reasonable target for this sector would be the maintenance of the 1954 level of imports. The analysis summarized in table 53 demonstrates the feasibility of this objective, since the total for 1962 is slightly lower than that for 1954. Given the working margin of error, the two values may be considered approximately equal.

#### 4. FUELS AND LUBRICANTS

Fuels constitute the most rapidly expanding group among Brazilian imports. At 1948 prices, the share of this group rose from 10.2 per cent in 1937–39 to 12.1 in 1947–49, 15.2 in 1950–52 and 19.1 per cent in 1953–54. But, since fuel

<sup>11</sup> In order to utilize the residual gas from the Petrobras refinery at Cubatao, with a daily capacity of 50,000 barrels, a factory is being installed to produce 375 tons of nitrogenous fertilizers and 55,000 cubic metres of hydrogen daily.

<sup>12</sup> The average for these two years has been taken because in 1953 imports were severely restricted, while in 1954, apparently, heavy imports were made in order to replenish stocks.



prices increased less than the total index of import prices, the value of fuel imports in proportion to the value of all imports remained nearly stationary up to 1952. In 1953 the

general decline of imports and the rigidity of the demand for fuels caused the latter's share in the total to rise sharply. (See table 54.)

Table 54. Brazil : share of fuels and lubricants in total value of imports

Year	<i>In millions of cruzeiros at 1948 prices</i>			<i>In millions of cruzeiros at current prices</i>		
	Total imports	Fuels and lubricants		Total imports	Fuels and lubricants	
		Value	Percentage		Value	Percentage
1937 .....	15,221	1,457	9.6	5,315	555	10.4
1938 .....	14,010	1,416	10.1	5,196	572	11.0
1939 .....	13,190	1,425	10.8	4,994	576	11.5
1947 .....	22,902	2,367	10.3	22,789	2,060	9.0
1948 .....	20,985	2,575	12.3	20,985	2,540	12.1
1949 .....	20,516	2,682	13.1	20,648	2,353	11.4
1950 .....	22,845	4,049	17.7	20,313	2,686	13.2
1951 .....	32,327	3,907	12.1	37,198	3,915	10.5
1952 .....	28,582	4,499	15.7	37,179	4,589	12.3
1953 .....	23,271	4,633	19.9	25,152	4,610	18.3
1954 .....	28,556	5,246	18.4	33,700	5,227	15.5

Source : Basic data from official Brazilian statistics.

The projection of the demand for fuels has formed the subject of a special study which appears in Part Two.<sup>18</sup> It shows that the total consumption of petroleum derivatives should rise from 7.6 to 15.3 million tons between 1954 and 1962. (See table 55.)

Table 55. Brazil : projection of fuel and lubricant consumption \*  
(Thousands of tons)

	1954	1962	Percentage increase
Petrol .....	2,408	5,514	129
Fuel oils .....	3,033	5,058	67
Diesel .....	1,229	2,784	127
Kerosene .....	539	1,017	89
Aviation petrol .....	218	517	137
Lubricants .....	209	418	200
Total petroleum derivatives ...	7,636	15,308	200
Coal .....	808	1,200	49

\* Imported products only.

By considering fuels and lubricants at 1952 prices, the value of the projected consumption for 1962 would be raised to 12,028 million cruzeiros. How much of this consumption, then, will be covered by domestic production and how much by imports? If imports were to contribute the same proportion as in 1954, about 30 per cent of the capacity to import would be absorbed by this sector in 1962. This shows that in the case of fuels there is an urgent need for substitution.

Without doubt the effective possibilities for substitution in the petroleum sector are very great, given the country's proven reserves. However, any forecast of domestic production must pay due regard to the limited nature of financial resources and to the shortage of qualified manpower, problems

which Petrobras must continue to face during its early years of operation. This is not the place for a full discussion of the matter, which would unduly divert the present report from its main purposes. It will suffice to accept a few general data mentioned by responsible authorities in Brazil. Two hypotheses should be considered. In both it will be assumed that in 1962 one-half of the required lubricants will be produced within the country, since a definite plan already exists in this sector. As for the production of crude oil, in the first hypothesis it will be assumed that there is a target of 100,000 barrels a day, and in the second, that the aim is much more modest, viz. 30,000 barrels,<sup>14</sup> not counting the petroleum needed in the production of lubricants. In the first case, production would cover about one-third of consumption and in the second one-tenth. As regards refining, it will be presumed that in both cases two-thirds—or about 200,000 barrels a day—will be refined in the country. Finally, so far as transport is concerned, the assumption is that two-thirds of the imported petroleum will be carried in Brazilian ships in the first case, and only one-half in the second. (See table 56.)

Table 56. Brazil : hypothetical replacement of petroleum imports  
(Millions of cruzeiros at 1952 prices)

<i>Value of petroleum derivatives for consumption in 1962 : 11,584</i>		
	Less	1st hypothesis
(A) Domestic production of lubricants ...		648
(B) Domestic production of crude * .....		885
(C) Refining and transport .....		2,030
Total value of domestic production .....	5,628	3,563
Value of imports .....	5,896	7,961

\* Excluding petroleum for lubricant production.

<sup>18</sup> See chapter IV.

<sup>14</sup> The second target could be reached even if the promising field recently discovered in the Amazon basin were not developed.

In the first hypothesis the value of imports would be approximately the same as in 1954, and in the second it would be 45 per cent more. As regards the capacity to import, in the first case there would be a 15-per-cent and in the second a 20-per-cent absorption.

Within the two hypotheses the share of domestic production in total supply will tend to vary between 30 and 50 per cent. Neither assumption can be considered extreme. Optimistic and pessimistic hypotheses may alike be classed as moderate. For the purpose of the projection the average of the two may be taken as a figure representative of present trends. In that event imports of petroleum derivatives will in 1962 amount to 6,928 million cruzeiros (at 1952 prices). If coal imports are added the total becomes 7,432 millions, representing an increase of 27 per cent over 1954 imports.

### 5. CAPITAL GOODS

Once imports of foodstuffs, manufactured consumer goods, fuels and lubricants have been projected, the capacity to import consumer goods may be estimated residually. The use of this method is based on the following premises: for an under-developed country, the importation of capital goods is the most effective way of profiting by the working methods of more-advanced countries which are in the forefront of scientific and technological research; further, in a country whose income level is excessively dependent on the value of its exports, imports of capital goods enjoy much greater flexibility than those of consumer goods. A fall in export values is immediately reflected in a reduced demand for capital goods; if imports mainly consist of the latter, then the reduction in the demand means an immediate relief of the balance-of-payments situation. No such development occurs when imports are mainly composed of consumer goods, since in this case the lowered demand is merely a concomitant of the contraction of income, which is less than the drop in the value of exports and much smaller still than the reduction in investment. The greater flexibility of capital goods imports is fairly obvious. (See table 57.)

Table 57. Brazil: Quantum indices \* of capital goods and consumer goods imports

	1948	1949	1950	1951	1952	1953	1954
Consumer goods	100	107	125	170	147	140	166
Capital goods ..	100	97.8	89	152	138	81	108

Source: Basic data from official Brazilian statistics.  
\* At 1948 prices.

The average annual variation in capital goods imports was 28 per cent in the period under review, as contrasted with 16 per cent in the case of consumer goods. The maximum variation was 71 per cent for the former and 36 for the latter.

When the projections of consumer-goods imports in general are known, it is possible to estimate—by subtraction from the projected capacity to import—the margin remaining for payment of capital-goods imports. (See table 58.)

The above data indicate that consumer-goods imports should remain almost constant, although their composition will be substantially modified. Meanwhile the capacity to import capital goods should rise by over 60 per cent. This heavy increase partially reflects the relatively low level in

Table 58. Brazil: projection of the capacity to import capital goods  
(Millions of cruzeiros at 1952 prices)

	1954	1962
Capacity to import .....	30,268	38,140
I. Consumer-goods imports .....	19,227	20,155
(a) Foodstuffs .....	5,934	5,653
(b) Manufactured goods .....	7,450	6,970
(c) Fuels and lubricants .....	5,843	7,432
II. Capital-goods imports .....	11,041	17,985

NOTE.—The difference between the total capacity to import, as shown in this table, and the data given in chapter III, results from the divergent rates of exchange employed. But since it is the increments which are used in the projections, the difference is not of major importance.

the base year (1954). Compared with the situation in 1952 and 1951, imports would move up by 26 and 14 per cent respectively.

But a substitution policy which treated all capital goods as a single homogeneous bloc would be unsound. The previous argument that capital-goods imports are the gateway admitting a higher technology is not universally applicable. If a comparison is made between the import of a textile and that of a textile-manufacturing machine, the difference is clear, since, while in the first case the effect is of short duration, in the second the national productive apparatus is being permanently enriched by the incorporation of a new technique. Finished capital goods—i.e., equipment—thus specifically possess this characteristic of transmitting a technique. Semi-finished capital goods—industrial metals, building materials, etc.—viewed from the same angle, are in a situation identical with that of consumer goods.

In reality, the domestic production of semi-finished capital goods has priority for more than one reason. Such goods, given their heavy weight and volume per unit of value, are subject to considerable price surcharges on account of freight costs, payable by the importer. Neither should it be overlooked that the production of semi-capital goods is a factor favourably influencing the establishment of industries manufacturing in equipment general.

The semi-finished-capital-goods industry has developed with great intensity in the last decade. Steel and cement output are the main indications of this development. None the less, imports of these products in 1954 constituted almost 40 per cent of all capital goods imports. But in view of plans now in process of implementation, it may be taken for granted that substitution will be intensified in this sector. Imports of cement will be almost completely replaced by domestic production in the next two years. The replacement of other building materials is also progressing or has already been achieved. As regards metals, existing plans show that the substitution process is being reinforced in the iron and steel and aluminium sectors.

If it is assumed as a first hypothesis that in 1962 capital-goods imports will be at the same level as in 1954—when this level was exceptionally high compared with that of previous years—the conclusion is reached that the capacity to purchase equipment will rise from 7.8 to 13.8 billion cruzeiros at 1952 prices, during the period under review. The increase would be 77 per cent in relation to 1954. If, however, the comparison is made with the peak in recent years, which was attained in 1951, there will be a decrease of about 5 per cent.

## Chapter VI

### PRODUCTION FOR THE DOMESTIC MARKET

#### 1. INTRODUCTION

On the basis of the analysis presented in previous chapters it is possible to draw up an outline of the main changes which would have to be introduced into the mechanism of domestic production in order to attain the targets inherent in a development policy.

A minimum target has already been set up for the export sector. This target—the feasibility of which was determined only in a very general way—must be the starting-point for a detailed study of this sector. A preliminary analysis of this question appears in two studies in Part Two. One of them deals with the main aspects of the coffee problem as a fundamental factor in the capacity to import.<sup>1</sup> The other examines briefly the main markets for Brazilian commodities and the potential supply.<sup>2</sup>

The general targets for production of consumer goods for the domestic market are already known, since the study of the substitution problem required an appraisal, albeit an indirect one, of the share of consumption to be covered by domestic production. It now remains to define these objectives more precisely.

The statements made in the preceding paragraphs permit the preparation of a draft programme which will be aimed at directing domestic production and will define the targets for agricultural production and consumer manufactures. The next stage will be to study the sectors of derived demand, that is, capital goods and the basic services, namely transport and energy.<sup>3</sup>

The projection of the demand for basic services pre-supposes a knowledge of the probable development of over-all production of goods. And it is this production which shapes the demand for basic services once the problems of changes in their structure and localization have been considered. Special studies on these sectors appear in Part Two of this report,<sup>4</sup> and constitute only a preliminary description of the principal problems arising from the preparation of a development programme for the complex sectors of transport and energy.

Just as the projection of the demand for basic services implies an approximate forecast of the over-all production of goods, so the hypothetical development of these services must be estimated before the production of capital goods can be projected. These basic services are capital intensive and a sizeable share of the equipment utilized by the production system is allotted to them.

The interdependence of the projections of demand for capital goods on the one hand and basic services on the other, is not, however, a problem of real practical significance. Capital-goods industries and basic services have one feature in common: they normally operate with some margin of idle capacity owing to the high degree of concentration which is characteristic of both sectors. As a general rule, neither a railway nor a blast-furnace is built for immediate use at full capacity. This implies that the basic sectors—production of capital goods, energy and transport—intrinsically require projections over a longer term in a development programme.

The aim of the present chapter is to define the production targets for the capital-goods sector. They will be fundamentally derived from the predicted rate of expansion of the production of goods for the domestic consumer market and for export, and from the preliminary hypotheses of the development of basic services. The process of capital formation provides the basis for such deductions. When the rate of expansion of an industry—that is, the increase in its productive capacity—is known, and when this productive capacity has been expressed in terms of equipment and structures, an idea can be formed of the demand for capital goods deriving from this expansion. Thus, in order to project the demand for capital goods it will be necessary to estimate the investment required for the expansion of the sectors producing consumer and export goods.

The estimates of investment by groups of industries made in the present chapter have only limited value. Their purpose is to permit the projection of demand for capital goods. This demand will be compared with the capacity to import capital goods in order to define the part which will have to be covered by domestic production.

The content of the programme will therefore comprise a series of growth indices which can be grouped as “targets for import replacement” and “targets for domestic production”. It is essential to bear in mind that these objectives constitute an organic whole, and are interdependent. Under the general conditions assumed, available investment will be sufficient to permit their simultaneous attainment. In more than one specific case it is probable that the volume of resources required will differ from the estimate made in order to project the over-all demand for capital goods. But there is no reason to believe that all these miscalculations will be in the same direction. In practice they are likely to cancel one another out, unless the statistical material used for the initial estimate contains a high degree of distortion, since they mainly arise from changes in relative prices which as a rule counterbalance one another.

The method to be used in this chapter will now be described in broad outline. First, an attempt will be made to infer from the foregoing data the production target for agriculture and for the sector producing manufactured consumer goods. The investment required to attain these objectives will then

<sup>1</sup> See Part Two, chapter II.

<sup>2</sup> See Part Two, chapter I.

<sup>3</sup> Both transport and energy are “consumer” as well as producer services, in that part of them reaches the final consumer. The projection of the demand for such “consumer services” is an independent problem and must be so considered.

<sup>4</sup> See chapter III and IV.

be estimated on the basis of the so-called coefficients of capital, which are the result of observations made with respect to each group of activities. These coefficients represent the ratio between one unit of fixed capital in a productive activity and the unit of net production obtained. They are therefore similar to the product-capital ratios used in chapter II. The capital coefficients are largely affected by the position of relative prices in the same period. These prices fluctuate constantly—although such changes are not always evident over a short term—under the influence of a series of economic and technological factors. It has already been noted that the errors resulting from these fluctuations tend to cancel one another out. So long as the coefficients in question are used strictly to estimate demand for equipment, the distortions caused by changes in relative prices are not very significant. The demand for certain commodities in general use in the capital-goods industry—cement and industrial metals, for instance,—can be projected by following the same method advocated in the previous chapter with respect to intermediate products for the manufacture of consumer goods.

## 2. AGRICULTURAL SECTOR

Agricultural production is destined both for the export market and to cover domestic requirements of foodstuffs and certain raw materials. The analysis made in previous chapters of foreign and domestic demand for agricultural commodities enables a general target to be defined for this sector.

As data for the numerous branches of agricultural production in 1954 have not yet all been published, only a preliminary estimate can be presented. (See table 59.)

Table 59. Brazil : agricultural production in 1954  
at prices paid to the producer  
(Billions of cruzeiros at 1952 prices)

Foodstuffs for the domestic market .....	58.5
Raw materials for the domestic market .....	4.7
Forest products .....	5.5
Increase in animal stocks .....	5.2
Production mainly for export .....	23.9
<b>TOTAL ...</b>	<b>97.8</b>

Some brief comments will now be made on the rate of expansion of each of these items within the framework of a minimum programme. To judge from the data presented in the two previous chapters, demand for domestically produced foodstuffs will have risen by about 37 per cent by 1962. Domestic market demand for raw materials will inevitably keep pace with the expansion of the industries that absorb them, and its probable future increment may be estimated at about 50 per cent. The production of the forestry sector will receive a strong impetus from the development of the pulp and paper industry, while it is assumed that the output of fuelwood will remain stationary. Nevertheless, the latter plays so important a part (representing more than 50 per cent of total production at present), that the over-all growth rate is unlikely to exceed 30 per cent. The increase in animal stocks is an item of capital formation, and will therefore not be included in this calculation. Finally, production mainly for the export market will expand by about

26 per cent, given the projection for the capacity to import postulated here.

The calculation of expansion in the various groups shows that total agricultural production—excluding animal stocks—will have to rise from 92.6 to 124.9 billion cruzeiros, at 1952 prices, or by about 34 per cent. The exclusion of the forestry sector has virtually no effect on this calculation.

It is interesting to note that the rate of growth of agricultural production resulting from the foregoing estimate (3.7 per cent annually) exceeds by an ample margin that prevailing in the period 1940-54 (2.3) and is also higher than the rate for the last five years (3.5). These discrepancies are explicable, in that during the period 1940-54, agricultural production for export remained stationary. If this group is set aside and an analysis is made of production for the domestic market, the rate forecast for the period 1955-62 (4.1 per cent) is equal to that registered over the whole period 1940-54, and lower than the rate for 1950-54 (5 per cent).

How far is the attainment of these objectives feasible? The growth of agricultural production in the last period mentioned was mainly stimulated by a substantial rise in relative prices favouring this sector. Such a phenomenon is very unlikely to recur in the near future, the probabilities being that any readjustment will take place in the opposite direction. This suggests that it may be no easy matter for the projected rate of growth to be spontaneously achieved by the agricultural sector. At a later stage of programming it would be necessary to make a detailed study of the sector, since this would be the only way to define the concrete measures to be adopted for the attainment of the targets set up. As an example of this type of study, an analysis of the wheat problem is to be published separately. In it the real possibilities of an increment in production are enumerated; the feasibility of the target is examined; the difficulties hampering current development are outlined; the resources required for the development envisaged in the programme are estimated; and the problems most urgently in need of solution are set forth.

The essential point in an agricultural development programme is that its objective should be integrated in an over-all study. It is not necessary to establish definite targets for all commodities, since medium-term factors within the agricultural sector have a high degree of mobility. But it is indispensable to expand the production capacity of agriculture by reclaiming land, enlarging storage and transport capacity, providing necessary equipment, and so on. Once agricultural enterprise has been organized, production plans may be modified by annual measures aimed at satisfying changes in demand which can be forecast over the short term.

Agricultural production for export constitutes an independent problem, some aspects of which, as already mentioned in the introduction to the present chapter,<sup>5</sup> are dealt with in two studies in Part Two. One of them will analyse world market prospects—even if only on broad lines—with a view to a recovery of the quantum of Brazilian exports. In the other, a specific examination will be made of the problem of coffee.

## 3. MANUFACTURING SECTOR

In previous chapters a projection was made of the demand for consumer manufactures, and the possible contribution

<sup>5</sup> See page 61.

of imports to the satisfaction of this demand was estimated. Table 60 has been prepared on the basis of these data, and shows the projection for the domestic production of consumer manufactures. The foodstuffs industry was included, as it had not been dealt with in the analysis of demand together with the other branches of manufacturing industry.

Table 60. Brazil : projection of the production of consumer manufactures  
(Billions of cruzeiros at 1952 prices)

Commodity-groups	1954	1962	Annual rate of increase
<i>Non-durable goods</i>			
Foodstuffs .....	20.26	28.90	4.6
Textiles .....	15.37	20.87	3.9
Garments .....	5.10	7.00	4.0
Footwear .....	2.83	3.93	4.1
Pharmaceutical products and toilet articles .....	4.00	7.01	7.2
Pulp and paper .....	1.91	3.73	8.7
Printed matter .....	3.60	4.97	4.1
Tobacco and matches .....	1.80	2.80	5.7
<i>Durable goods</i>			
China and table-ware .....	1.70	2.60	5.5
Furniture .....	2.40	3.70	5.6
Motor vehicles .....	1.11	1.87	6.7
Others .....	3.28	5.68	7.1
<i>Industrial chemicals</i> .....	3.30	6.10	8.0
<i>Unclassified</i> .....	1.60	2.50	5.5
<b>TOTAL ...</b>	<b>68.26</b>	<b>101.66</b>	<b>5.2</b>

Sources : Basic data from official Brazilian statistics and the Fundação Getúlio Vargas.

Production of consumer manufactures, according to these data, may be expected to expand by 49 per cent in the period 1955-62, or 52 per cent if the food industry is excluded. Unlike that of the agricultural sector, the rate of growth forecast in the minimum programme for manufactured consumer goods is considerably lower than that registered in recent years, having reached 7 per cent in 1940-54, and 7.8 per cent in 1950-54, as against the 5.4 per cent projected for the period 1955-62.

The over-all increase for the industries producing non-durable consumer manufactures will be 44 per cent, corresponding to an annual rate of 4.7 per cent. There will, however, be considerable fluctuations among the different industrial activities, the lowest rate being found in the textile industry (3.9 per cent) and the highest in the pulp and paper industry (8.7 per cent). It is important to stress that this latter is the only branch in which the rate of growth would have to rise above the 1950-54 level (from 6.6 to 8.7 per cent). For all other branches of production of non-durable consumer manufactured goods the rate of growth of the last five years is higher than that forecast for the immediate future, according to the development hypothesis implicit in the minimum programme.

As regards durable goods, the only sector in which considerably more effort would have to be expended than has been in recent years is the motor vehicle industry. As has been pointed out elsewhere, in this branch of production it is indispensable to progress from the stage of manufacturing

parts which wear out rapidly, to the production of more valuable parts such as motor blocks and transmission gear. It is even possible that the manufacture of complete cars might be undertaken. In this case the expansion index has virtually no significance, since present production mainly comprises parts such as tires and batteries which do not belong to the motor vehicle industry proper.

The general problem of the motor vehicle industry—including both passenger-cars and lorries—has been specially studied by the Economic Commission for Latin America in a document to be published separately.<sup>6</sup> An analysis is made therein of the main obstacles to the installation of such an industry in Brazil. Up to now, studies carried out by official organizations have paid exclusive attention to freight vehicles. Government policy in this sector seems to be aimed at fostering gradual substitution, through the manufacture of medium-size lorries. The main objective indicated by the Comissão do Desenvolvimento Industrial is to achieve the manufacture of 70 per cent of the weight of some 100,000 medium-size lorries by 1962.

The authorities have not yet directly concerned themselves with the production of automobiles. Nevertheless, certain steps taken by European and United States firms have been discussed in Brazil. Some of these related the manufacture of parts to the concession of trade and market privileges, which naturally provoked objections. However, it is to be hoped that, once the present stage of exchange adjustments has passed and a long-term policy for the development of automobile production has been established, rapid strides will be made towards the solution of this problem. Difficulties in the supply of the raw materials concerned have already been overcome, and if a formula is adopted similar to that suggested for lorry production, the question of skilled labour will be easier to tackle.

It has previously been noted that during the last five years the rate of expansion of the different branches of consumer manufactures—with the exception of the pulp and paper and motor vehicle industries—may be considered more than satisfactory. This should be understood in its exact implications. It should be recalled that the rates of growth quoted are averages for the period 1950-54 and that in general they tend to decline in the last years of the period. Thus the food industry, which expanded by about 40 per cent between 1949 and 1953, contracted slightly in 1954. A similar trend was apparent in the footwear industry. Paper production, which increased at an average rate of 6.6 per cent between 1949 and 1954, remained practically stationary in this latter year. If the rate of growth for aggregate consumer manufactures remained high in 1954, this was due to the vigorous recovery in the textile industry.

The second comment to be made is that industrial production was strongly stimulated in the recent past by foreign trade policy, which favoured it by low prices for raw materials, semi-processed goods and equipment, while protecting it against competition from abroad. The new exchange policy, although maintaining the margin of protection by the system of categories, considerably increased costs of semi-processed imports and—more important still—effected a substantial reduction in the real value of funds for investment by raising

<sup>6</sup> See chapter on Brazil in *Iron and Steel Transforming Industries in Selected Latin American Countries* (E/CN.12/377).

the prices of imported equipment. In 1953, with the reform of the exchange system, the phase during which this latter provided a strong incentive to industrial investment may be said to have closed. The new system barely permitted the consolidation of profits made under the previous regime. It should not be forgotten that the economy evolved from a stage of vigorous expansion to one of relative stagnation in the capacity to import. The previous system had made it possible for part of the increment in the capacity to import to be channelled towards industry in the guise of real capital earnings. The present regime will allow only for the maintenance of the advances made. The process of accumulation will no longer benefit from the abundant inflow of resources it received during the stage just ended, not because these resources have been directed towards other sectors, but simply because the sources from which they were generated—improvement in the terms of trade, liquidation of reserves accumulated during the war, and short-term debts—have been completely exhausted.

From these considerations, it can be inferred that a series of measures will have to be adopted to counterbalance the depressive effect of the reduction in the marginal profitability of capital, if expansion is to be maintained even at a lower rate than during the previous five-year period. The problem can be summarized as follows. Prices of industrial equipment doubled or trebled between 1953 and 1955, while those for domestically-produced industrial commodities did not rise more than 30 per cent in the same period. Consequently there was a sharp reduction in the self-financing capacity of the industrial sector. Even with the same margin of profits as before, an industry can now accumulate only with difficulty a volume of resources, in terms of external purchasing power for expansion purposes, which will still be much smaller than in the past. And it is not that the resources which fail to reach industry are being accumulated in another sector, leaving open the possibility of channelling their application through the banking system. The resources concerned, owing to the reduction in the average economic productivity caused by the reversal of foreign trends, are simply no longer flowing into the system.

This curtailment of resources for self-financing may possibly be felt with greater intensity in those industries with higher current and replacement costs to be paid in foreign exchange. A detailed study of each branch should therefore be made in order to determine: (a) the possibilities for better utilization of the existing installed capacity; (b) the volume of financial expenditure involved in the possible replacement of imported equipment by domestic production; (c) the reduction in self-financing capacity arising from the exchange reform; and (d) the means that will have to be placed at the disposal of industrialists to enable production to develop at the desired rate.

#### 4. CAPITAL GOODS

Manufactured goods to be used for capital formation purposes are, in the final instance, intermediate products. Their purchase is but a stage in the investment process. It is therefore necessary to analyse this process and to formulate some hypotheses on its future development before projecting the demand for capital goods.

The preparation of a programme requires two estimates of investment needs. The first has already been calculated in

chapter II as part of the aggregate projections. According to the annual data presented on the volume of depreciation expenditure and net investment, gross investment will expand by 72 per cent between 1954 and 1962.

The projection of over-all investment needs is an element of fundamental importance for formulating the general outline of a programme. With the help of such an outline the specific targets for each sector of economic activity can be defined. Once these sectorial objectives have been ascertained, it will be possible to estimate capital requirements from the particular to the general, that is, on the basis of a study of specific cases. This second estimate of investment expenditure, if all sectors of economic activity are included, will necessarily be equivalent to the estimate made from the general to the particular, once all the partial data have been added up. Any difference between the two figures will give an approximate indication of the degree of unreliability of the basic material and of the methods used.

The definition of the investment needs implicit in the targets for the main group of activities is not difficult. These needs are closely linked to specific conditions in each sector. It is more or less obvious that capital requirements for an expansion of the paper industry will depend on the type of raw materials to be utilized, size and integration of the mills, location and availability of public services, etc. This kind of estimate is possible only when concrete projects are prepared.

Investment estimates by sector are an essential element in the projection of demand for capital goods. Thus, if no hypothesis is available for the probable expansion of building activities, it will be practically impossible to project the demand for the materials required. But, if the projection of the demand for capital goods were to depend on the preparation of all the projects required for a programme, industries in this sector would be deprived of all guidance for an indefinite period. It is therefore indispensable to work out techniques to facilitate preliminary estimates of capital goods requirements as a function of the general targets of the programme.

Table 61 shows data on the supply of capital goods in 1949, on the basis of the Census and of import statistics. In table 33 of chapter III, data on imports are presented, including not only capital-goods imports as such, but also those which are incorporated in other imported manufactures. Thus, of the c.i.f. value of iron and steel imports, only 69 per cent represented their value on leaving the steel mill; on the other hand, imported iron and steel goods as such constituted only 46 per cent of the total value of iron and steel products purchased abroad. The remaining 54 per cent was made up of ferrous raw materials incorporated in Brazil's imports of products of the mechanical industries—namely, equipment and durable consumer goods.

The break-down of imports as indicated in the previous paragraph is very useful as a guide for a substitution policy. With the help of these elements it is possible to appraise the impact on the market for intermediate products of any change in the composition of imports aimed at intensifying substitution. In a country which imports manufactured articles, producer goods, whether equipment or intermediate products, therefore command two markets, which could be called direct and indirect. In the first stages of development, when imports of consumer manufactures increase rapidly, the indirect market for producer goods grows at a faster rate than the direct. If the former attains a certain magnitude, the installa-

Table 61. Brazil : supply of manufactured goods for investment 1949  
(Millions of cruzeiros at 1949 prices)

Capital goods	Production	Imports		Supply	Imports as a percentage of supply
		Direct	Total		
<i>Metallurgical products</i> .....	2,752	1,322	2,596	5,348	49
Iron and steel .....	2,032	828	1,793	3,825	47
Other metals .....	720	494	803	1,523	53
<i>Mechanical industries</i> .....	3,730	4,897	6,221	9,951	63
Machinery .....	1,001	2,353	2,353	3,354	70
Transport equipment .....	1,023	1,531	1,531	2,554	60
Electrical equipment .....	512	649	982	1,494	66
Others .....	1,194	364	1,355	2,549	53
<i>Building materials</i> .....	4,032	204	204	4,236	5
Cement .....	392	108	108	500	22
Lime, bricks, etc. ....	1,306	59	59	1,365	4
Porcelain .....	820	—	—	820	—
Wood .....	1,382	7	7	1,389	—
Glass .....	132	30	30	162	19
<b>TOTAL</b> ...	<b>10,514</b>	<b>6,423</b>	<b>9,021</b>	<b>19,535</b>	<b>46</b>

Sources : For production : 1949 Census; for imports : table 33 of chapter III.

tion of a producer-goods industry may bring about rapid transformations in the over-all structure of the production system.

A typical example was Brazil's installation of a steel mill with coke blast furnace, after the Second World War. Production of iron and steel was mainly centred on building materials until 1946, when production of sheet and other rolled products for the mechanical industries began. Between 1946 and 1954 consumption of iron and steel products by the mechanical industries increased threefold, while the over-all growth of industrial production did not exceed 64 per cent. The existence of an indirect or potential market implies that the launching of the producer-goods industry automatically creates stimuli for a large number of other industries which in one way or another depend on it. In effect it is very difficult to imagine the installation of large mechanical industries on the basis of imported iron and steel in a country whose capacity to import is subject to periodic crises and whose foreign supplies have at times been almost totally suspended for other than economic reasons.

Capital goods will be classified in three groups for the projection of demand : (a) metallurgical products, (b) building materials and (c) equipment.

#### (a) Metallurgical products

The analysis will be confined for the moment to semi-processed ferrous products. Each of the main non-ferrous metals requires a special study involving a definition of production targets for the electric materials industry and certain sectors of the metallurgical and mechanical industries, such as would not be possible in this general outline. The same applies to special steels.<sup>7</sup>

Table 62 shows the data relating to iron and steel supplies in the period 1946-54, excluding special steels.

Table 62. Brazil : supply of semi-processed iron and steel goods  
(Thousands of tons)

Year	Imports	Production	Total	Production as a percentage of total supply
1946 .....	411	298	709	42
1947 .....	439	384	823	47
1948 .....	205	505	710	71
1949 .....	230	626	856	73
1950 .....	256	724	980	74
1951 .....	351	732	1,083	68
1952 .....	344	755	1,099	69
1953 .....	209	892	1,101	81
1954 .....	280	972	1,252	78

Source : Banco Nacional de Desenvolvimento Econômico.

The data in this table refer to direct supplies of iron and steel. It has already been seen in table 61 that indirect consumption accounted for about 25 per cent of the total in 1949. This indirect demand, however, will be shown in the projections only in so far as it affects the substitution of domestic production for imported equipment.

In the most recent of the periods under review, the composition of iron and steel consumption in Brazil was approximately as follows : mechanical industries, 40 per cent; construction and public works, 40 per cent; agriculture (mainly in the form of wire), 14 per cent; and railways (rails and accessories), 6 per cent. Clearly the growth of demand will depend on the evolution of each of these items. The first step is to appraise this evolution within the general context of the minimum programme.

In the case of the mechanical industry, only the probable expansion of the group producing consumer goods will be considered at present. This, according to the data in table 60 on motor vehicles and other durable goods, will amount to 72 per cent between 1954 and 1962. A more accurate estimate might later be made, but the difference would not be significant.

<sup>7</sup> See *Iron and Steel Transforming Industries in Selected Latin American Countries*, prepared by the Economic Commission for Latin America as a technical study of the problem of special steels.



Investment in building depends basically on the growth of the population, on income and on the Government's social policy. Yearly fluctuations in this sector, however, are principally due to factors depending on the level of economic activity. In order to identify long-term trends, it is necessary to isolate these fluctuations as far as possible from the action of the factors in question. The evolution of the index of building activities during the last ten years may be studied in table 63.

Table 63. Brazil : index of building activities

1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
83	105	111	100	87	92	113	149	151	144

Source : *Conjuntura Econômica*.

These data clearly indicate that there were two stages of expansion in building activities during the post-war period. The first reached its peak in 1947 and the second in 1953. With respect to building, these two years can therefore be considered as the points of inflection of a rising trend, so that the annual growth rate recorded between these two peaks (5.3 per cent) is provisionally representative of the long-term trend over the last ten years.<sup>6</sup> This rate may decline in the next few years owing to the slowing down of over-all development. It may, however, be adopted as an initial estimate. The consequent increase between 1954 and 1962 will be 51 per cent.

On the basis of the studies prepared for agriculture and railways, rates of 3.8 and 6.0 per cent, respectively, will be assumed for these sectors. Table 64 gives the preliminary projection of the demand for iron and steel.

Table 64. Brazil : projection of demand for iron and steel  
(Thousands of tons of rolled products)

	Demand in 1954 <sup>a</sup>	Percentage increase between 1954 and 1962	Demand in 1962
Mechanical industries .....	500	72	860
Construction .....	500	51	755
Agriculture .....	175	35	236
Railways .....	75	59	119
<b>Total<sup>b</sup> ...</b>	<b>1,250</b>	<b>58</b>	<b>1,970</b>

<sup>a</sup> The distribution of demand among the groups is the average for 1949-53.

<sup>b</sup> A second estimate, taking account of the growth of mechanical industries producing capital goods, would raise total demand by about 50,000 tons.

Demand for rolled products will therefore rise to about 2 million tons in 1962—i.e., some 2.5 million iron ingots. What proportion of this demand will be covered by domestic supplies? For domestic production to satisfy total requirements, the 1954 level of about 1.2 million tons of ingots would have to be raised by 113 per cent. This is perfectly feasible according to existing plans for expansion and for the installation

<sup>6</sup> Since the annual growth of urban population exceeds 4 per cent and the coefficient of demolition is high in large cities, the rate of 5.3 per cent does not seem to indicate that the area available per city dweller has increased appreciably.

of new factories, some of which are already totally or partially financed.

The detailed discussion on this point in the relevant study<sup>9</sup> indicates that the plans in question will enable production of rolled goods to expand to 1,712,000 tons before 1960. Special mention should be made of four projects : the Volta Redonda project, where production should rise from the 1953 figure of 363,000 tons to 750,000; Mogi das Cruzes, where it should expand from 60,000 to 300,000 tons; Monlevade, with a probable increase from 145,000 to 250,000; and Mannesmann, where production should reach 110,000 tons.

#### (b) Building materials

If metallurgical products are excluded, building materials mainly include cement, wood, porcelain and glass. Wood and porcelain products are manufactured by small-scale industry, and nearly always locally. In the development programme careful consideration should be given to the expansion of these industries in order to provide lower cost housing. The main problem is one of technical assistance, whereby better utilization of available resources may be achieved through rational production systems. As to glass, demand will grow at the same rate as building activities.

In view of the importance of cement for public works and the fact that it is produced in large-scale plants, special attention should be devoted to it in the development programme. Without adequate cement supplies it is practically impossible to carry out an investment plan. Consumption of cement grew rapidly in Brazil after the war. (See table 65.)

Table 65. Brazil : apparent consumption of cement  
(Thousands of tons)

Year	Production	Imports	Consumption	Production as percentage of consumption
1947 .....	914	339	1,253	73
1948 .....	1,112	351	1,463	76
1949 .....	1,281	428	1,709	75
1950 .....	1,386	394	1,780	78
1951 .....	1,456	638	2,094	70
1952 .....	1,619	812	2,431	67
1953 .....	2,030	967	2,997	68
1954 .....	2,406	340	2,746	88

Source : Official Brazilian statistics.

The exceptional expansion of consumption shown in table 65 seems to be due mainly to the increase in public works. No separate data are available on the cement consumed in this important sector. However, it can be proved that the share absorbed by building activities (whose index of expansion refers only to urban construction) is a good deal less than half. Even on the assumption that all cement consumed in 1947 had been used for building activities and that this consumption therefore grew at the same rate as the index for urban construction, the total for 1953 would stand at 1.7 million tons, or only 57 per cent of total consumption in that year. If in 1947 construction had absorbed three-quarters of the available cement—which is obviously an exaggeration—in 1953 the corresponding fraction would have been only 43 per cent.

<sup>9</sup> See footnotes 6 and 7.



There is every indication that consumption of cement, apart from urban construction, rapidly increased in the period under review, since under the hypothesis that this consumption absorbed 25 per cent of the total in 1947, it must have risen from 300,000 tons in that year to 1.7 million tons in 1953.

This period witnessed the initiation and expansion of the national road programme, the plan for improving road surfaces in the State of São Paulo, the construction of the Paulo Alfonso dam and other like projects in the States of Rio, Minas Gerais, São Paulo and Rio Grande do Sul, the real estate boom in large cities, etc. This phase of development reached its peak in 1953. By 1954, an 11-per-cent decline in cement consumption in activities other than building was already apparent.

It will be assumed here that cement consumption, excluding building activities, will grow at the same rate as the total volume of investment<sup>10</sup>—that is, by 72 per cent. In other words, the possibility of the Government's undertaking a vast plan of public works, which might serve as a guide, is being tacitly excluded. If it is borne in mind that the number of highways will probably increase more slowly, that the expansion of coffee areas has already lost impetus, and that, in brief, the whole of the economy is entering a stage of consolidation of development, the hypothesis does not seem unduly pessimistic. Demand for cement is likely to increase by 63 per cent between 1954 and 1962. (See table 66.)

Table 66. Brazil : projection of the demand for cement

(Thousands of tons)

	1954	1962	Percentage increase between 1954 and 1962
Building activities .....	1,214	1,833	51
Other sectors .....	1,532	2,635	72
TOTAL ...	2,746	4,468	63

The contribution of imports to domestic supply began to decline in 1954, after a sharp increase in previous years. The expansion forecast for domestic production justifies the belief that imports will be totally eliminated, perhaps from 1955. On the assumption that by 1962 all demand will be covered by domestic production, the latter will have to expand by 86 per cent in the period under review.

### (c) Equipment

The mechanical industries producing capital goods are very heterogeneous. An over-all survey of these industries is of only limited value for specific purposes. The items in this group range from heavy transport material to laboratory instruments. The data in table 61 therefore represent a substantial simplification of real facts. They show that in 1949 machinery accounted for one-third of equipment, and that the contribution of imports to total supplies amounted to 70 per cent in this sector. Electrical material comes next in dependence on imports, with 66 per cent, followed by transport with 60 per cent.

<sup>10</sup> Volume of gross investment—that is, the sum of net investment and depreciation. (See table V of the statistical annex to chapter II.)

Available data fail to indicate the supply trends for each group during 1949–54. The analysis will have to be confined to the over-all series, which is based on the domestic production index for the whole mechanical industry,<sup>11</sup> and on the quantum of equipment imports. According to these statistics, the share of imports declined to 43 per cent in 1953, after having risen from 63 to 66 per cent between 1949 and 1951. (See table 67.)

Table 67. Brazil : equipment supplies

(Millions of cruzeiros at 1952 prices)

Year	Imports	Production	Total supplies	Imports as percentage of total supplies
1949 .....	6,221	3,730	9,951	63
1950 .....	5,854	4,207	10,061	58
1951 .....	10,821	5,685	16,506	66
1952 .....	9,562	6,519	16,081	59
1953 .....	4,883	6,822	11,705	42
1954 .....	5,758	7,770	13,528	43

Sources : Banco do Desenvolvimento Econômico and Economic Commission for Latin America, Joint Working Party.

The figures in question reveal on the one hand wide fluctuations in imports, and on the other a steady growth of domestic production, which has increased at an average annual rate of about 15 per cent.

It must be repeated that the over-all projection of demand for equipments is of only limited value. The heterogeneity of the articles produced and the variety of technical processes involved in their manufacture make it impossible to set up objectives for the mechanical industries as a whole on the basis of simplified expedients. In any case, some additional considerations will help to give an idea of the extent of the problem and will provide a subsidiary element for the projection of demand for iron and steel.

According to available information, the composition of the demand for equipment is more or less as follows :

	Percentage
1. Industrial machinery .....	25
2. Transport equipment .....	26
3. Electrical equipment .....	15
4. Other equipment .....	34
TOTAL	100

Each group will now be briefly reviewed. Because of its multiple utilization, machinery constitutes the group most difficult to analyse. The best method is to calculate fixed capital stocks in the various industrial groups and to project these figures on the basis of capital coefficients<sup>12</sup> and of the

<sup>11</sup> The index referred to in the text was calculated on the basis of supply data for the semi-manufactured ferrous products used by the mechanical industry. The index includes the industries producing both capital goods and durable consumer goods made with ferrous raw materials. Only a rough approximation is possible, owing to the way in which this index has been used in the text.

<sup>12</sup> Capital coefficients indicate the product-capital ratio for each group of industries. This ratio, when applied to the manufacturing industry as a whole, is very stable, to judge from the experience of countries with greater economic maturity; but its stability decreases in isolated industries owing to the fluctuations in relative prices. The data presented in the

probable growth of production. A pre-requisite for this kind of projection is a hypothesis of the expansion of the various industrial groups. Consideration will be given only to consumer-goods industries at present.

According to the projection of capital stocks for this group of industries (see table 68), the fixed capital in consumer-goods industries will increase from 114.4 to 169.5 billion cruzeiros, or roughly 50 per cent. Machinery accounts for about

Table 68. Brazil : projections of the reproducible capital stock of manufactured consumer goods  
(Billions of cruzeiros at 1952 prices)

Consumer goods	Production		Index of production increase (1954 = 100)	Product-capital ratio	Capital stock	
	1954	1962			1954	1962
<i>Non-durable goods</i> .....	54.87	79.21	144	—	97.1	140.4
Foodstuffs .....	20.26	28.90	143	2.0	40.5	57.8
Textiles .....	15.37	20.87	136	2.1	32.3	43.8
Garments .....	5.10	7.00	137	0.8	4.1	5.6
Footwear and leather goods .....	2.83	3.93	139	1.1	3.1	4.3
Pharmaceutical products and toilet articles .....	4.00	7.01	175	1.0	4.0	7.0
Paper .....	1.91	3.73	195	3.1	5.9	11.6
Printed matter .....	3.60	4.97	138	1.5	5.4	7.5
Tobacco and matches .....	1.80	2.80	156	1.0	1.8	2.8
<i>Durable goods</i> .....	8.49	13.85	164	—	10.0	16.3
China and table-ware .....	1.70	2.60	153	1.2	2.0	3.1
Furniture .....	2.40	3.70	154	1.5	3.6	5.6
Motor vehicles .....	1.11	1.87	168	1.0	1.1	1.9
Others* .....	3.28	5.68	173	1.0	3.3	5.7
<i>Industrial chemicals</i> .....	3.30	6.10	185	1.4	4.6	8.5
<i>Unclassified</i> .....	1.60	2.50	156	1.7	2.7	4.3
TOTAL .....	68.26	101.66	149	—	114.4	169.5

Sources : Production data : table 2; product-capital ratio : on the basis of the 1939 Census.

\* Includes metals for production of consumer goods : tinplate, aluminium, etc.

35 per cent of this total, so that its value will rise from 40 to 60 billion cruzeiros. On the assumption of consistent growth, the increment in 1962 will be 2.8 billion cruzeiros, to which must be added the 3 billion cruzeiros for replacement needs.<sup>13</sup> Aggregate demand in the sector of consumer manufactures will therefore amount to about 5.8 billion cruzeiros.

Machinery supplies in 1954 reached a level of about 4.7 billion cruzeiros<sup>14</sup> and it may be assumed that the consumer industries absorbed about two-thirds of this total,<sup>15</sup> or 3.1 billion cruzeiros. In that case the increment in the demand for machinery in this sector would rise to 87 per cent in the period under review.

Footnote 13 (continued)

text may help in the appraisal of the evolution of fixed capital stocks for industry as a whole, but they are of much less value for the study of each branch of industrial production. The coefficients used in the text have been calculated on the basis of the 1939 census.

<sup>13</sup> On the assumption of an average useful life of twenty years for industrial machinery as a whole.

<sup>14</sup> According to the data in table 67, supplies of equipment in 1954 were worth 13.5 billion cruzeiros (at 1949 prices); 25 per cent of this amount equals 3.4 billion cruzeiros. Since the price index for capital goods rose by 38 per cent between 1949 and 1952, supplies of industrial machinery in 1954, at 1952 prices, stood at 4.7 billion cruzeiros.

<sup>15</sup> Capital-goods industries contribute less than 30 per cent of the aggregate value of manufacturing production. Since they have a more rapid rate of growth and higher capital intensity, they probably absorbed at least one-third of the new equipment in 1954.

In order to project the growth of demand for machinery in the capital goods industries a simple formula will be used, which will probably not be too unrealistic. Hypotheses have already been set up for the prospective growth of the steel-making, cement and other building-material industries. The over-all expansion in these three branches between 1954 and 1962 would be equivalent to 74 per cent, or 50 per cent more than that of the consumer-goods industries. If the same difference were assumed for the growth of machinery stocks, their value in the capital-goods industries would increase from 20<sup>16</sup> to 35 billion cruzeiros. By the same procedure, machinery replacement needs can be estimated at 1.8 billion cruzeiros and demand corresponding to liquid investment at 2.6 billion, which gives an aggregate demand of 4.4 billion. The increase in relation to the 1954 supply level of 1.6 billion in this sector would therefore be 175 per cent. Aggregate demand for industrial machinery would then rise from 4.7 to 10.2 billion cruzeiros, that is, by 117 per cent.

The demand for electrical and transport equipment will be projected on the basis of annual rates of increase of 7.2 and 6 per cent respectively, established in the special studies to be found in Part Two of this report.<sup>17</sup> The average rate prevailing in these sectors is applied to the residual group. (See table 69.)

<sup>16</sup> It was postulated that one-third of total machinery stocks would fall to the share of the capital-goods industry.

<sup>17</sup> See chapters III and IV.

Table 69. Brazil : projection of the demand for equipment  
(Thousands of millions of cruzeiros at 1952 prices)

	1954	1962	Percentage increase between 1954 and 1962
Industrial machinery .....	4.7	10.2	117
Transport equipment .....	4.8	7.6	59
Electrical equipment .....	3.0	5.2	74
Others .....	6.1	11.2	84
<b>TOTAL ...</b>	<b>18.6</b>	<b>34.2</b>	<b>84</b>

What part of this over-all increment in demand for equipment must be supplied by domestic production? It has already been seen that the capacity to import capital goods, in the minimum programme, might rise by about 60 per cent.<sup>18</sup> But if imports of semi-finished capital goods—building materials, industrial metals, etc.—remain at the same level as in 1954, the capacity to import equipment might grow by 77 per cent. Under this hypothesis, domestic production would have to expand by at least 90 per cent.

(d) *Capital-goods industries as a whole*

The data presented in previous sections permit the establishment of a general target for the production of capital goods as a whole. (See table 70.)

<sup>18</sup> See section 5 of the preceding chapter.

Table 70. Brazil : capital goods industries as a whole :  
production projected for 1962  
(Billions of cruzeiros at 1952 prices)

	1954	1962	Percentage increase between 1954 and 1962
Metallurgical .....	5.9	12.6	113
Mechanical .....	10.7	20.4	90
Building materials .....	9.3	14.4	55
<b>TOTAL ...</b>	<b>25.9</b>	<b>47.4</b>	<b>84</b>

In order to satisfy the requirements of the minimum programme, manufacturing production of capital goods would have to expand at an average annual rate of about 8 per cent, in comparison with only 5 per cent for consumer-goods manufactures. Within this framework, over-all industrial production would grow at the rate of 6 per cent—that is, at a much lower rate than during 1950–54 (7.9 per cent) and even than in 1940–54 (7.2 per cent). In the less favourable circumstances prevailing at present, the slower progress envisaged for the immediate future would imply a greater effort on the part of enterprises and the community as a whole than during the recent past. The effort required to attain the targets set forth in chapter II would be very difficult to make without the guidance of an over-all programme, both in the agricultural sector, which would have to expand at a faster rate, and in the industrial sector, for which the possibility of a slower rate of growth was assumed.

## STATISTICAL APPENDIX

Table I. Brazil : estimate of geographic income according to the main branches of production

(At factor cost; billions of cruzeiros)

Year	Agriculture	Industry	Services	Total
1939 .....	10.6	4.8	17.0	32.4
1940 .....	11.6	5.1	18.1	34.8
1941 .....	12.9	6.6	20.5	40.0
1942 .....	14.1	7.8	23.3	45.2
1943 .....	18.4	10.1	28.1	56.6
1944 .....	23.9	14.2	35.8	73.9
1945 .....	27.1	16.7	42.3	86.1
1946 .....	35.2	21.1	55.1	111.4
1947 .....	39.8	29.3	73.8	142.9
1948 .....	47.6	31.7	80.4	159.7
1949 .....	53.6	36.3	91.8	181.7
1950 .....	66.0	41.9	103.6	211.5
1951 .....	76.6	52.3	123.4	251.3
1952 .....	90.6	63.4	145.0	299.0
1953 .....	106.3*	64.2*	176.9*	347.4

Sources : For the period 1939-46 : Economic Commission for Latin America; for 1947-53 : Fundação Getúlio Vargas.

\* Provisional data.

Table II. Brazil : effect of fluctuations in the terms of trade

(Billions of cruzeiros at 1952 prices)

Year	Quantum of exports	Index of the terms of trade (1952 = 100)	Real value of exports (A) (B) 100	Effect of fluctuations in the terms of trade in relation to 1952
	(A)	(B)	(C)	(C-A)
1939 ...	39.4	45.6	18.0	-21.4
1940 ...	32.5	38.5	12.5	-20.0
1941 ...	25.7	42.9	11.0	-14.7
1942 ...	28.1	47.8	13.4	-14.7
1943 ...	28.9	39.4	11.4	-17.5
1944 ...	31.7	56.8	18.0	-13.7
1945 ...	34.1	61.7	21.0	-13.1
1946 ...	42.2	71.0	30.0	-12.2
1947 ...	39.8	84.6	33.7	-6.1
1948 ...	40.1	71.4	28.6	-11.5
1949 ...	36.1	77.7	28.0	-8.1
1950 ...	31.7	117.4	37.2	+ 5.5
1951 ...	34.9	103.0	35.9	+ 1.0
1952 ...	26.1	100.0	26.1	—
1953 ...	30.5	110.7	33.8	+ 3.3
1954 ...	29.0	123.0	36.0	+ 7.0

Sources : Banco do Desenvolvimento Econômico and Economic Commission for Latin America, Joint Working Party.

NOTE.—The quantum expresses the purchasing power of exports according to the hypothesis of stability in the terms of trade. The "real value" represents the quantum corrected by variations in the terms of trade. The final column shows the difference between "real value" and the value of exports under the above-mentioned hypothesis of stability in the terms of trade.

Table III. Brazil : calculation of the index of the general price level

(Billions of cruzeiros)

Year	Gross geographic income		General index of prices	
	(At current prices)	(At 1952 prices)	(1952 = 100)	(1939 = 100)
1939 .....	39.3	178.9	22.0	100.0
1940 .....	42.3	180.3	23.5	106.8
1941 .....	48.3	195.3	24.7	112.3
1942 .....	55.0	188.8	29.1	132.3
1943 .....	69.5	191.5	36.3	165.0
1944 .....	89.6	205.7	43.6	198.2
1945 .....	104.4	221.5	47.1	214.1
1946 .....	133.5	245.5	54.4	247.3
1947 .....	169.5	272.2	62.3	283.2
1948 .....	190.7	282.6	67.5	306.8
1949 .....	217.7	294.0	74.0	337.4
1950 .....	252.3	329.6	76.5	347.7
1951 .....	307.0	347.5	88.3	401.4
1952 .....	360.9	360.9	100.0	454.5
1953 .....	421.6	379.4	111.1	505.0

NOTE.—The series of income at current prices is the same as for table I, with suitable adjustments; the series of income at constant prices is that which appears in table 1 of chapter I.

Table IV. Brazil : calculation of the index of consumer goods prices

(Billions of cruzeiros)

Year	Geographic expenditure (At current prices)	Gross investment (At current prices)	Consumption		Index of consumer goods prices	
			(At current prices)	(At 1952 prices)	(1952 = 100)	(1939 = 100)
1939 .....	38.7	6.2	32.5	153.5	21.2	100.0
1940 .....	42.1	6.3	35.8	156.8	22.8	107.5
1941 .....	47.0	7.1	39.9	165.9	24.1	113.7
1942 .....	52.3	7.9	44.4	159.9	27.8	131.1
1943 .....	66.4	11.2	55.2	162.6	33.9	159.9
1944 .....	85.9	15.2	70.7	173.1	40.8	192.5
1945 .....	99.5	13.9	85.6	190.8	44.9	211.8
1946 .....	128.5	20.5	108.0	206.9	52.2	246.2
1947 .....	171.5	26.5	145.0	236.9	61.2	288.7
1948 .....	190.7	25.9	164.8	245.9	67.0	316.0
1949 .....	218.2	33.6	184.6	248.0	74.4	350.9
1950 .....	247.4	36.7	210.5	271.6	77.5	365.6
1951 .....	314.6	52.8	261.8	296.3	88.4	417.0
1952 .....	377.5	65.6	311.9	311.9	100.0	471.7
1953 .....	415.8	64.0	351.8	316.4	111.2	524.5

NOTE.—The series of expenditure (=total domestic supply) is that which appears in table 1 of chapter I; the series of investment at current prices emanates from the Fundação Getúlio Vargas; the series of consumption at current prices was obtained residually; the series of consumption at 1952 prices was also calculated by subtracting investment at constant prices from expenditure.

Table V. Brazil : effect of the net inflow of resources on income

(Billions of cruzeiros)

Year	Balance of payments on current account	Balance on current account as a percentage of income at current prices	Balance on current account at 1952 prices
1939 .....	- 0.6	1.5	- 2.7
1940 .....	- 0.2	0.5	- 0.9
1941 .....	- 1.3	2.7	- 5.3
1942 .....	- 2.7	4.9	- 9.3
1943 .....	- 3.1	4.5	- 8.6
1944 .....	- 3.7	4.1	- 8.4
1945 .....	- 4.9	4.7	-10.4
1946 .....	- 5.0	3.7	- 9.1
1947 .....	+ 2.3	1.4	+ 3.8
1948 .....	- 1.0	0.5	- 1.4
1949 .....	+ 0.5	0.2	+ 0.6
1950 .....	- 4.9	1.9	- 6.3
1951 .....	+ 7.6	2.5	+ 8.7
1952 .....	+16.7	4.6	+16.6
1953 .....	- 5.8	1.4	- 5.3

NOTE.—The basic data were calculated from estimates of the Banco Nacional do Desenvolvimento Econômico and the Superintendência da Moeda e do Crédito, adjusted by the rates of exchange shown in table VI. It has been assumed that the ratio balance income would be the same at constant prices as at current prices.

Table VI. Brazil : calculation of the exchange rate

Year	Index of the General price level (1950 = 100)	Deflator of the G.N.P. of the United States (1950 = 100)	Index of the parity purchasing power of the cruzeiro	Rates of exchange (Base : 1950)
1939 .....	28.7	54.5	52.7	13.2
1940 .....	30.6	55.4	55.2	13.8
1941 .....	32.2	59.8	53.8	13.5
1942 .....	37.9	68.0	55.7	13.9
1943 .....	47.3	72.8	65.0	16.3
1944 .....	56.8	74.3	76.4	19.1
1945 .....	61.4	76.6	80.2	20.1
1946 .....	70.9	83.3	85.1	21.3
1947 .....	81.4	92.0	88.5	22.1
1948 .....	88.3	98.7	89.5	22.4
1949 .....	96.9	97.9	99.0	24.8
1950 .....	100.0	100.0	100.0	25.0
1951 .....	115.1	108.0	106.6	26.7
1952 .....	130.4	110.0	118.5	29.6
1953 .....	144.8	111.0	130.5	32.6

NOTE.—The estimate of parity in the base year (1950) is based on observation of relatively normal years, such as 1929 and 1937, and has been confirmed by a survey made in Rio at the request of the United Nations.

Table VII. Brazil : estimate of investment  
(Billions of cruzeiros)

Year	Gross investment	Depreciation	Net investment
1939 .....	6.2	3.3	2.9
1940 .....	6.3	3.4	2.9
1941 .....	7.1	3.7	3.4
1942 .....	7.9	5.2	2.7
1943 .....	11.2	7.2	4.0
1944 .....	15.2	8.4	6.8
1945 .....	13.9	9.3	4.6
1946 .....	20.5	9.6	10.9
1947 .....	26.5	9.7	16.8
1948 .....	25.9	11.1	14.8
1949 .....	33.6	11.7	21.9
1950 .....	36.7	12.2	24.5
1951 .....	52.8	16.0	36.8
1952 .....	65.6	19.3	46.3
1953 .....	64.0*	22.7	41.3

Sources : For gross investment : Fundação Getúlio Vargas; for depreciation : Economic Commission for Latin America.

\* Preliminary estimate.

Table VIII. Brazil : estimate of investment at constant prices  
(Billions of cruzeiros at 1952 prices)

Year	Gross investment	Depreciation	Net investment
1939 .....	22.7	12.0	10.7
1940 .....	22.6	12.2	10.4
1941 .....	24.1	12.5	11.6
1942 .....	19.6	12.9	6.7
1943 .....	20.3	13.1	7.2
1944 .....	24.2	13.4	10.8
1945 .....	20.3	13.6	6.7
1946 .....	29.5	13.8	15.7
1947 .....	39.1	14.3	24.8
1948 .....	35.3	15.1	20.2
1949 .....	46.6	16.3	30.3
1950 .....	51.7	17.2	34.5
1951 .....	59.9	18.2	41.7
1952 .....	65.6	19.3	46.3
1953 .....	57.7	20.5	37.2
1954 .....	59.0*	21.8	37.2

Sources : Economic Commission for Latin America.

\* Preliminary estimate.

Table IX. Brazil : distribution of expenditure between  
consumption and investment  
(Billions of cruzeiros)

Year	Expenditure	Consumption	Gross investment	Investment as a percentage of expenditure
1939 .....	38.7	32.5	6.2	16.0
1940 .....	42.1	35.8	6.3	15.0
1941 .....	47.0	39.8	7.1	15.1
1942 .....	51.9	44.0	7.9	15.2
1943 .....	66.4	55.2	11.2	16.7
1944 .....	85.9	70.7	15.2	17.7
1945 .....	99.5	85.6	13.9	14.0
1946 .....	128.5	108.0	20.5	16.0
1947 .....	171.5	145.0	26.5	15.5
1948 .....	190.7	164.8	25.9	13.6
1949 .....	218.2	184.6	33.6	15.4
1950 .....	247.2	210.5	36.7	14.8
1951 .....	314.6	261.8	52.8	16.8
1952 .....	377.5	311.9	65.6	17.4
1953 .....	415.8	351.8	64.0	15.4

Sources : Preceding tables.

Table X. Brazil : utilization of geographic income  
(Billions of cruzeiros)

Year	Geographic income	Consumption	Saving	Percentage of saving in income
1939 .....	39.3	32.5	6.8	17.3
1940 .....	42.3	35.8	6.5	15.4
1941 .....	48.3	39.9	8.4	17.4
1942 .....	55.0	44.4	10.6	19.3
1943 .....	69.5	55.2	14.3	20.6
1944 .....	89.6	70.7	18.9	21.1
1945 .....	104.4	85.6	18.8	18.0
1946 .....	133.5	108.0	25.5	19.1
1947 .....	169.5	145.0	24.5	14.5
1948 .....	190.7	164.8	25.9	13.6
1949 .....	217.7	184.6	33.1	15.2
1950 .....	252.3	210.5	41.8	16.6
1951 .....	307.0	261.8	45.2	14.7
1952 .....	360.9	311.9	49.0	13.6
1953 .....	421.6	351.8	69.8	16.6

NOTE.—The series of income and consumption are those which appeared in previous tables; the series of saving was obtained residually.

Table XI. Brazil : distribution of income between consumption and saving

(Billions of cruzeiros at 1952 prices)

Year	Geographic income	Consumption	Saving	Saving as a percentage of income
1939	178.9	153.5	25.4	14.2
1940	180.3	156.8	23.5	13.0
1941	195.3	165.9	29.4	15.0
1942	188.8	159.9	28.9	15.3
1943	191.5	162.6	28.9	15.1
1944	205.7	173.1	32.6	15.8
1945	221.5	190.8	30.7	13.9
1946	245.5	206.9	38.6	15.7
1947	272.2	236.9	35.3	13.0
1948	282.6	245.9	36.7	13.0
1949	294.0	248.0	46.0	15.6
1950	329.6	271.6	58.0	17.6
1951	347.5	296.3	51.2	14.7
1952	360.9	311.9	49.0	13.6
1953	379.4	316.4	63.0	16.6
1954	416.9	354.9	62.0	14.9

NOTE.—The series of income and consumption are those which appeared in previous tables; the series of saving was obtained residually.

Table XII. Brazil : calculation of the net investment rate  
(Billions of cruzeiros)

Year	Net geographic income at market prices	Net investment	Net investment rate
1939	36.3	2.9	8.0
1940	38.9	2.9	7.5
1941	44.6	3.4	7.6
1942	49.8	2.7	5.4
1943	62.3	4.0	6.4
1944	81.2	6.8	8.4
1945	95.1	4.6	4.8
1946	123.9	10.9	8.8
1947	160.1	16.8	10.5
1948	180.3	14.8	8.2
1949	206.6	21.9	10.6
1950	240.5	24.5	10.2
1951	290.9	36.8	12.7
1952	341.6	46.3	13.6
1953	398.9	41.3	10.4

NOTE.—The series of net income was adjusted to market prices in order to render it strictly comparable with net investment.

Table XIII. Brazil : income, product and terms of trade of the agricultural sector  
(Billions of cruzeiros)

Year	Net income at factor cost		Product at 1952 prices	Terms of trade (1952 = 100)
	Current prices	1952 prices		
1939	10.6	45.5	69.1	65.8
1940	11.6	49.4	65.1	75.9
1941	12.9	52.2	69.4	75.2
1942	14.1	48.5	65.0	74.6
1943	18.4	50.7	68.0	74.6
1944	23.9	54.9	68.2	80.5
1945	27.1	57.5	67.6	85.1
1946	35.2	64.7	74.1	87.3
1947	39.8	64.0	74.7	85.7
1948	47.6	70.2	78.6	89.3
1949	53.6	72.3	82.8	87.3
1950	66.0	86.3	86.6	99.7
1951	76.6	86.7	86.4	100.3
1952	90.6	90.6	90.6	100.0
1953	106.3	95.7	90.7	105.5

NOTE.—The series of income at current prices is that given in table I; that of income at 1952 prices is the same deflated by the general price index; the series of the product was obtained with the index of the production quantum shown in table 8 of chapter I. The terms of trade show the extent to which income at constant prices increases at a slower or faster rate than real production.

Table XIV. Brazil : income, product and terms of trade of the industrial sector

Year	Net income at factor cost		Product at 1952 prices	Terms of trade (1952 = 100)
	Current prices	1952 prices		
1939	4.8	21.8	25.4	85.8
1940	5.1	21.7	26.8	81.0
1941	6.6	26.7	29.5	90.5
1942	7.8	26.8	28.5	94.0
1943	10.1	27.8	31.8	87.4
1944	14.2	32.6	33.1	98.5
1945	16.7	35.5	34.9	101.7
1946	21.1	38.8	40.8	95.1
1947	29.3	47.1	42.5	110.8
1948	31.7	46.8	46.6	100.4
1949	36.3	49.0	49.5	99.0
1950	41.9	54.8	55.0	99.6
1951	52.3	59.2	59.3	99.5
1952	63.4	63.4	63.4	100.0
1953	64.2	57.1	67.6	84.5

NOTE.—See the note in table XIII.

Table XV. Brazil : income, product and terms of trade of the services sector

Year	Net income at factor cost		Product at 1952 prices	Terms of trade (1952=100)
	Current prices	1952 prices		
1939 .....	17.0	77.3	81.3	95.1
1940 .....	18.1	77.0	81.8	94.1
1941 .....	20.5	83.0	84.4	98.3
1942 .....	23.3	80.1	82.4	97.2
1943 .....	28.1	77.4	82.5	93.8
1944 .....	35.8	82.3	87.7	93.8
1945 .....	42.3	89.8	95.6	93.9
1946 .....	55.1	101.3	103.4	98.0
1947 .....	73.5	118.2	113.4	104.2
1948 .....	78.7	116.1	119.6	97.1
1949 .....	91.2	123.1	120.8	101.9
1950 .....	103.2	134.9	130.2	103.6
1951 .....	122.5	138.7	144.3	96.1
1952 .....	145.0	145.0	145.0	100.0
1953 .....	164.2	147.8	148.8	111.1

NOTE.—See the note in table XIII.

Table XVI. Brazil : distribution of expenditure between imports and domestically-produced commodities

(Billions of cruzeiros at 1952 prices)

Year	Geographic expenditure	Imports	Domestically-produced commodities	Imports as a percentage of expenditure
1939 .....	176.2	23.6	152.6	13.4
1940 .....	179.4	20.8	158.6	11.6
1941 .....	190.0	21.4	168.6	11.3
1942 .....	179.5	16.1	163.4	9.0
1943 .....	182.9	19.2	163.7	10.5
1944 .....	197.3	23.4	173.9	11.9
1945 .....	211.1	23.6	187.5	11.2
1946 .....	236.4	26.7	209.7	11.3
1947 .....	276.0	40.9	235.1	14.8
1948 .....	281.2	36.9	244.3	13.1
1949 .....	294.6	39.3	255.3	13.3
1950 .....	323.3	43.1	280.2	13.3
1951 .....	356.2	61.3	294.9	17.2
1952 .....	377.5	55.0	322.5	14.6
1953 .....	374.1	44.8	329.3	12.0
1954 .....	413.9	55.0	358.9	13.3

NOTE.—The exchange rates appearing in table VI were used to calculate imports.

Table XVII. Brazil : distribution of consumer expenditure between imports and domestically-produced commodities

(Billions of cruzeiros at 1952 prices)

Year	Total consumer expenditure	Imports	Domestically-produced commodities	Imports as a percentage of the total
1939 .....	153.5	16.8	136.7	10.9
1940 .....	156.8	15.4	141.4	9.8
1941 .....	165.9	15.2	150.7	9.2
1942 .....	159.9	12.6	147.3	7.9
1943 .....	162.6	14.8	147.8	9.1
1944 .....	173.1	17.1	156.0	9.9
1945 .....	190.8	16.0	174.8	8.4
1946 .....	206.9	14.7	192.2	7.1
1947 .....	236.9	23.1	213.8	9.8
1948 .....	245.9	22.6	223.3	9.2
1949 .....	248.0	24.8	223.2	10.0
1950 .....	271.6	30.1	241.5	11.1
1951 .....	296.3	39.0	257.3	13.2
1952 .....	311.9	34.5	277.4	11.1
1953 .....	316.4	32.8	283.6	10.4
1954 .....	354.9	39.0	315.9	11.0

NOTE.—See the note in table XVI.

Table XVIII. Brazil : share of exports in the formation of geographic income

(Billions of cruzeiros)

Year	Income	Exports	Production for the domestic market	Percentage of exports in income
1939 .....	39.3	5.6	33.7	16.6
1940 .....	42.3	5.0	37.3	13.4
1941 .....	48.3	6.7	41.6	16.1
1942 .....	55.0	7.5	47.5	15.8
1943 .....	69.5	8.7	60.8	14.3
1944 .....	89.6	10.7	78.9	13.6
1945 .....	104.4	12.2	92.2	13.2
1946 .....	133.5	18.2	115.3	15.8
1947 .....	169.5	21.2	148.3	14.3
1948 .....	190.7	21.7	169.0	12.8
1949 .....	217.7	20.2	197.5	10.2
1950 .....	252.3	24.9	227.4	10.9
1951 .....	307.0	32.5	274.5	11.8
1952 .....	360.9	26.1	334.8	7.8
1953 .....	421.6	32.0	389.6	8.2

NOTE.—The f.o.b. value of exports at the official rate of exchange has been used, since it reflects total export earnings.



Table XIX. Brazil : consolidated account of receipts and expenditure in the public sector  
(Millions of cruzeiros)

	1947	1948	1949	1950	1951	1952
<i>Current account</i>						
Receipts .....	28,833.6	33,826.0	40,470.4	46,459.4	62,158.2	70,233.4
Direct taxes .....	6,450.9	7,247.6	8,451.6	10,026.4	13,205.4	16,351.4
Indirect taxes .....	18,797.2	22,153.4	26,662.8	30,860.0	41,805.3	46,019.1
Other receipts .....	3,585.5	4,426.0	5,356.0	5,573.0	7,147.5	7,862.9
Expenditure .....	21,874.6	25,841.7	32,294.2	38,712.0	45,326.3	55,708.2
Employees' salaries .....	10,124.3	12,302.3	14,678.0	16,960.8	20,398.1	25,585.6
Other purchases of goods and services ....	5,676.6	6,502.6	8,088.3	10,448.6	11,418.2	13,568.6
Other expenditures .....	6,073.7	7,036.8	9,527.9	11,302.6	13,510.0	16,554.0
Balance .....	+6,959.0	+7,984.3	+8,176.2	+7,747.4	+16,831.9	+14,525.2
<i>Capital account</i>						
Receipts .....	6,963.7	8,143.1	8,264.3	7,796.7	16,853.1	14,698.4
Balance on current account .....	6,959.0	7,984.3	8,176.2	7,747.4	16,831.9	14,525.2
Liquidation of real assets .....	4.7	158.8	88.1	49.3	21.2	173.2
Expenditure .....	7,324.3	9,167.7	13,059.8	15,429.8	17,238.2	21,578.6
Purchase of new real assets .....	5,777.6	8,118.6	11,536.3	14,101.8	15,482.6	15,239.0
Purchase of existing real assets .....	93.8	92.0	165.6	213.1	139.5	183.0
Increase (+) or decrease (—) in inventories	—13.7	+10.8	—16.3	+6.3	+5.7	+4,453.5
Financial transactions .....	1,466.6	946.3	1,374.2	1,108.6	1,610.4	1,703.1

Source : Economic Commission for Latin America.

Table XX. Brazil : value of agricultural production  
(Billions of cruzeiros)

Year	Total	Production for the domestic market	Production for export
1939 .....	10.6	7.0	3.6
1940 .....	11.6	8.3	3.3
1941 .....	12.9	9.5	3.4
1942 .....	14.1	10.8	3.3
1943 .....	18.4	13.5	4.9
1944 .....	23.9	17.7	6.2
1945 .....	27.1	20.8	6.3
1946 .....	35.2	26.0	9.2
1947 .....	39.8	29.8	10.0
1948 .....	47.6	36.6	11.0
1949 .....	53.6	39.2	14.4
1950 .....	66.0	42.1	23.9
1951 .....	76.6	49.9	26.4
1952 .....	90.6	60.4	30.2
1953 .....	106.3	75.6	30.7
1954 .....	114.3	73.5	40.8

Source : Economic Commission for Latin America.

Table XXI. Brazil : index of the quantum of agricultural production  
(1939 = 100)

Year	Total	Production for the domestic market	Production for export
1940 .....	94.7	95.4	95.4
1941 .....	100.3	106.4	96.4
1942 .....	93.9	107.2	78.1
1943 .....	98.4	110.3	95.2
1944 .....	98.7	118.8	88.9
1945 .....	97.7	124.9	78.3
1946 .....	107.5	141.1	82.5
1947 .....	108.0	141.2	81.3
1948 .....	113.6	148.8	82.9
1949 .....	119.7	153.2	92.0
1950 .....	125.2	165.7	92.5
1951 .....	125.0	166.8	88.0
1952 .....	131.0	167.6	104.2
1953 .....	131.1	179.7	90.0
1954 .....	141.4	184.0	96.0

NOTE.—The total, which was calculated at 1939 prices, includes eighteen main products. Production for export comprises coffee, cacao and cotton (fibre and seed).

Table XXII. Brazil : index of prices paid  
to the agricultural producer  
(1939 = 100)

Year	Total	Production for export	Production for the domestic market
1940 .....	115.5	124.3	96.1
1941 .....	121.3	127.5	97.9
1942 .....	141.6	143.9	107.4
1943 .....	176.4	174.9	143.0
1944 .....	228.5	212.9	193.7
1945 .....	261.7	237.9	223.5
1946 .....	308.9	263.2	309.8
1947 .....	347.7	301.5	341.7
1948 .....	395.3	351.4	368.6
1949 .....	422.5	365.5	434.8
1950 .....	497.3	362.9	717.7
1951 .....	578.1	427.4	833.3
1952 .....	652.4	480.2	805.1
1953 .....	764.9	601.0	938.2
1954 .....	762.6	570.7	1,180.5

NOTE.—The series presented in this table were obtained by comparing those in tables XX and XXI.

Table XXIII. Brazil : index of the quantum of investment  
(1939 = 100)

Year	Imports of capital goods	Production of mechanical industries	Building	Total
1940 .....	59.3	107.5	120.2	96.5
1941 .....	70.0	96.2	145.7	106.3
1942 .....	37.0	78.0	143.6	89.3
1943 .....	46.4	84.0	133.6	90.5
1944 .....	53.4	132.6	158.5	116.3
1945 .....	82.5	117.0	187.1	132.1
1946 .....	147.4	169.6	255.7	194.8
1947 .....	237.9	235.9	264.9	247.5
1948 .....	219.3	200.8	234.2	219.5
1949 .....	257.4	243.2	230.3	243.0
1950 .....	351.5	271.0	240.7	286.0
1951 .....	346.3	364.6	288.7	329.9
1952 .....	311.6	419.3	348.6	357.1
1953 .....	160.4	438.2	352.0	314.3
1954 .....	214.1	500.0	286.2	319.0

NOTE.—The index of production of mechanical industries is based on an estimate of iron and steel input. The building index was provided by the Fundação Getúlio Vargas. The quantum of imports was calculated at 1948 prices. The aggregate index was weighted as follows (1948 Census data):

Imports .....	32.9
Mechanical industry .....	29.3
Building .....	37.8
TOTAL 100.0	

**Part Two**

**PROJECTIONS IN DIFFERENT SECTORS OF ACTIVITY**



## Chapter I

### THE PROJECTION OF EXPORTS

In establishing projections for the external sector in Part One of this study, two hypotheses were formulated as to the probable future behaviour of the export quantum. This chapter contains an analysis of the evolution of the quantum between 1937 and 1954. It begins with a geographic survey to determine the national markets in which Brazil has lost ground. There follows a summary of some of the more important products; coffee, however, requires a separate study.<sup>1</sup>

#### I. ANALYSIS BY COUNTRIES

During the period immediately preceding the Second World War (1937-38), about 40 per cent of Brazilian exports were shipped to the Americas. By the time the war was over, this figure had risen to 60 per cent. Since the aggregate quantum did not increase, it is clear that the expansion of Brazil's sales to the Americas simply offset the reduction of shipments to other markets. It should not be overlooked, however, that the relative increase in coffee prices—the United States is the principal market for this product—also helped to bring about this shift.

Brazil's exports to Latin America had increased from 6.6 per cent in 1937-38 to 13.8 per cent in 1948. In succeeding years, however, they declined to a level of 8.1 per cent in 1950.

The most important structural change in Brazilian exports between the pre-war period and recent years consisted of

the partial loss of the German and Japanese markets. In 1937-38, these two markets absorbed 22.6 per cent of all exports, a proportion which had fallen to 1 per cent by 1948. Except for Western Germany, continental Europe's share in Brazilian exports had recovered by 1948, when it stood at 33.2 per cent as compared with 32.5 per cent in 1937-38. It is thus clear that the relative increase of the share of the Americas merely counter-balanced the loss of the German and Japanese markets. Nevertheless, a marked recovery in shipments to these countries has been taking place during the last few years.

#### 1. United States of America

The value of imports from Brazil has increased substantially in the United States. In 1937-38, Brazil's share of United States imports amounted to 4.3 per cent; in 1948 it had risen to 7.2 per cent and by 1949 reached 8.3 per cent. The major reason for the increase during the latter year was the decline in aggregate imports by the United States as a result of a relative recession in business activity, although special conditions affecting the coffee market were also helpful for Brazil. During the two subsequent years, the value of United States imports rose sharply (34 per cent in 1950 and 24 per cent in 1951), but the relative position of Brazil was unchanged. (See table 71). Although the value of United States imports almost remained at the 1951 peak level throughout 1952 and 1953, Brazil's share fell to 7.5 and 6.8 per cent respectively. In 1954, a year in which Brazilian sales to the United States

Table 71. Brazil : Quantum of exports to ten selected countries

	1937-38 (average)	1948	1949	1950	1951	1952	1953	1954
<i>Absolute value (millions of dollars)</i>								
United States .....	109.2	513.9	551.8	715.2	910.6	808.4	745.2	578.4
Argentina .....	14.8	111.0	83.7	75.7	116.9	95.5	76.6	100.0
United Kingdom .....	39.6	95.6	86.6	113.7	185.3	43.6	70.7	74.4
Western Germany .....	81.4	11.8	24.6	20.6	74.9	74.3	147.1	187.5
Italy .....	7.9	35.3	29.4	30.7	34.7	37.9	46.3	53.2
France .....	22.5	31.9	32.0	53.3	88.8	85.5	87.6	91.7
Netherlands .....	7.5	25.8	17.0	18.8	28.7	20.7	37.3	45.6
Belgium-Luxembourg .....	11.6	50.7	42.0	40.7	38.5	30.8	23.2	22.0
Sweden .....	9.1	30.9	33.6	38.7	53.8	54.0	54.2	56.3
Japan .....	15.6	0.3	3.5	1.6	32.1	15.4	40.8	68.3
<i>Relative value (percentages of the total of each country's imports)</i>								
United States .....	4.3	7.2	8.3	8.1	8.3	7.5	6.8	5.7
Argentina .....	3.3	7.4	7.8	7.2	8.1	8.0	8.7	10.5
United Kingdom .....	0.8	1.1	1.0	1.6	1.7	0.5	0.8	0.8
Western Germany .....	3.5	0.8	1.1	0.8	2.1	1.9	3.9	4.1
Italy .....	1.2	2.3	1.9	2.1	1.6	1.6	1.9	2.2
France .....	1.5	0.9	1.0	1.7	1.9	1.9	2.2	2.2
Netherlands .....	0.9	1.4	0.9	0.9	1.1	0.9	1.6	1.6
Belgium-Luxembourg .....	1.4	2.5	2.3	2.1	1.5	1.3	1.0	0.9
Sweden .....	1.7	2.3	2.9	3.3	3.0	3.1	3.4	3.2
Japan .....	1.7	—	0.4	0.2	1.6	0.8	1.7	2.8

Source: United Nations, *Direction of International Trade*.

declined to near the 1949 level, the proportion dropped to 5.7 per cent.

The price index for imports to the Americas from Brazil has risen much more than that of all imports, especially since

Table 72. Brazil : Indices of trade with the United States (1948 = 100)

Year	Exports			Percentage of coffee <sup>a</sup>	Aggregate United States imports
	Total	Coffee	Other products		
1948 .....	100	100	100	73	100
1949 .....	108	105	116	80	98
1950 .....	93	83	121	86	119
1951 .....	96	90	114	83	117
1952 .....	72	80	50	86	123
1953 .....	74	77	67	83	128
1954 .....	49	48	51	88	119

Sources : Banco Nacional do Desenvolvimento Econômico and United Nations publications.

<sup>a</sup> At current prices.

1949. Consequently, if Brazil maintained the 1949 share of the over-all value throughout the years 1950 and 1951, it may be assumed that the effect of the rise in relative coffee prices was neutralized by the real or virtual decline in the quantum of Brazil's exports to the United States. This downward movement, which began early in 1950, was chiefly a reflection of the reduced volume of coffee sales. Since 1952, a sharp decline in the quantum of the other products was also apparent. (See table 72.)

The export quantum (coffee excepted) closely followed the increase in aggregate United States imports until 1951. During subsequent years, however, aggregate imports continued to rise, while, in contrast, Brazilian shipments declined to less than half. The most pronounced drop in Brazil's exports to the United States—except for that of coffee in 1954—represented agricultural raw materials and vegetable extracts. (See table 73.) Lower exports of castor-oil seed, carnaúba wax, babazú and sisal were mainly responsible for the decline in this group.

Table 73. Brazil : Indices of exports to the United States (1948 = 100)

Year	Total		Foodstuffs		Agricultural raw materials and vegetable extracts		Minerals		Manufactures and semi-manufactures	
	Quantum	Prices	Quantum	Prices	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 .....	73	23	80	24	40	16	9	29	6	16
1936 .....	72	26	77	27	50	22	23	18	9	21
1937 .....	64	30	67	30	56	29	45	33	7	28
1938 .....	80	24	86	23	52	24	15	55	13	29
1939 .....	86	25	89	24	77	33	42	45	32	43
1940 .....	81	26	84	23	76	37	80	62	32	57
1941 .....	103	34	98	32	126	44	150	57	169	48
1942 .....	63	49	57	46	87	62	96	59	120	78
1943 .....	85	49	83	47	86	48	125	90	163	83
1944 .....	104	48	103	49	86	33	113	75	232	105
1945 .....	103	53	99	50	96	66	144	60	147	100
1946 .....	97	76	97	72	89	102	86	60	169	117
1947 .....	85	100	86	99	87	117	73	61	73	112
1948 .....	100	100	100	100	100	100	100	100	100	100
1949 .....	108	105	112	108	186	87	100	134	95	96
1950 .....	93	169	88	183	102	98	150	131	222	77
1951 .....	96	189	90	199	99	138	202	203	278	94
1952 .....	72	185	77	202	46	88	195	239	156	80
1953 .....	74	210	75	229	46	104	126	237	188	73
1954 .....	49	—	48	—	45	—	115	—	99	—

Source : Banco Nacional do Desenvolvimento Econômico.

## 2. The United Kingdom

In relation to the pre-war period, Brazil was able to increase its share of the British market from 0.83 per cent in 1937-38 to 1.14 per cent in 1948. Brazil's share rose slightly higher in 1950-51, through the relative increase in raw material prices, but during 1952 the percentage dropped sharply and the quantum fell to one-quarter of the 1951 level. The improvement up to 1951 was all the more significant because aggregate imports into the United Kingdom had expanded relatively little in comparison with the pre-war level.

Cotton plays a predominant part in Brazil's exports to Great Britain. In 1937-38, this commodity contributed 57 per cent of the total value of Brazil's shipments to the British market and 52 per cent of that in 1948-1951. Never-

theless, Brazil achieved greater success on the market of the United Kingdom with products of less relative importance. (See table 74.)

In 1952, the decrease in the "other products" group of exports was similar to that observed in sales to the United States. But, while coffee maintained its position on the United States market, cotton shipments to Great Britain disappeared altogether.

The cotton problem is considered separately.<sup>a</sup> It will be seen that any possibilities of increasing sales to the market of the United Kingdom are subject to a series of limitations the most important of which is the stationary level

<sup>a</sup> See sub-section 1 in section II of this chapter.

Table 74. Brazil : Indices of the quantum of exports to the United Kingdom  
(1948 = 100)

Year	Exports			Percentage of cotton *	Aggregate British imports
	Total	Raw cotton	Other products		
1937 .....	54	73	37	58	95
1938 .....	62	78	47	56	91
1948 .....	100	100	100	48	100
1949 .....	83	91	76	56	109
1950 .....	111	88	133	41	109
1951 .....	95	84	105	65	122
1952 .....	24	—	46	—	112
1953 .....	53	56	50	34	120
1954 .....	63	65	61	37	123

Sources : Banco Nacional do Desenvolvimento Econômico and United Nations publications.

\* Based on current values.

in the British cotton textile industry. Among those products which showed most progress on the British market are : coffee, cacao, hides and pinewood. Others, such as rice and maize, have been exported in relatively large tonnages,

but only sporadically; they all have a relatively elastic supply, although at different periods. In the case of cacao, the higher exports from Brazil arose from the decline in output from the British Non-Self-Governing Territories in West Africa. Although exports of hides increased between pre-war and recent years, they reached their peak in 1947. Pinewood exports have risen significantly since the war. This is a product with an elastic supply, so that continuing exports to the United Kingdom will depend mainly upon the price policy adopted.

The difficulties of entering the United Kingdom market are self-evident. Imperial preferences exist and the nature of Brazilian products is such that most of them must compete with commodities from British Non-Self-Governing Territories where wages are very low. The short-term fluctuations of many products exported to Great Britain reflect their marginal character on the British market. In fact, Brazilian commodities are imported from time to time to bridge gaps which appear in one or another sector of the British market. Apart from cotton and a few other commodities which are highly competitive, the remaining exports from Brazil depend entirely upon import policy in the United Kingdom. (See table 75.)

Table 75. Brazil : Indices of exports to the United Kingdom  
(1948 = 100)

Year	Total		Foodstuffs		Raw materials		Semi-manufactures	
	Quantum	Prices	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 .....	32	29	22	31	36	30	41	7
1936 .....	64	32	26	35	86	31	21	23
1937 .....	54	32	28	39	69	29	27	24
1938 .....	62	18	29	5	78	25	76	19
1939 .....	69	29	45	36	77	28	130	15
1940 .....	84	29	74	30	87	29	103	20
1941 .....	71	31	81	30	63	32	121	20
1942 .....	83	33	119	34	61	34	133	14
1943 .....	79	44	103	54	55	40	256	34
1944 .....	93	46	114	48	72	46	232	31
1945 .....	119	52	86	61	126	49	253	34
1946 .....	114	61	97	87	123	50	94	26
1947 .....	85	86	41	114	102	70	161	103
1948 .....	100	100	100	100	100	100	100	100
1949 .....	83	104	57	117	93	65	126	60
1950 .....	111	132	111	216	108	94	153	60
1951 .....	95	197	79	230	102	184	112	141
1952 .....	24	178	45	235	14	158	27	50
1953 .....	53	143	10	237	73	102	68	44
1954 .....	63	—	30	—	79	—	81	—

Source : Banco Nacional do Desenvolvimento Econômico.

### 3. Continental Europe

Excluding Western Germany, which is dealt with separately, the countries of continental Europe maintaining a certain volume of trade with Brazil are considered as belonging to this group. They are France, Sweden, Italy, Belgium-Luxembourg and the Netherlands. Table 71 gives Brazil's share of their aggregate imports.

In 1948, Brazil had gained a foothold in the markets of each of these countries, except France. Further progress was made including the French market during 1950, although

some ground was lost in Belgium and the Netherlands. It should be recalled, however, that Brazil's increased share in the imports of these countries chiefly reflects an improvement in the terms of trade. As regards France, the quantum of aggregate imports substantially exceeded pre-war indices but imports from Brazil continued to be on a much lower level. Since 1948, a more rapid decline is apparent in Italy's purchases from Brazil, although aggregate imports from all sources were increasing steadily during the same period. The Netherlands and Belgium show trends similar to that of Italy. Sweden is the only country which is an exception to

the rule; imports from Brazil have, in fact, risen more than aggregate imports as a whole.

(a) *France*

French imports from Brazil consist chiefly of coffee and raw cotton. Cacao and leaf tobacco figure regularly but are of less relative importance. Other products from time to time meet a demand unsatisfied by suppliers in the French

Union. The drop in the quantum of Brazilian exports to France since the pre-war period reflects reduced coffee shipments more than any other factor. But coffee sales to France show an upward trend; they rose steadily between 1949 and 1953, declining slightly in 1954. Excluding the decline in 1952-53, exports of cotton remained stable during 1950-54 at about the average for 1937-38. (See table 76).

Table 76. Brazil : Indices of exports to France

(1948 = 100)

Year	Total		Foodstuffs		Raw materials		Iron ore	
	Quantum	Prices	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 .....	160	21	356	4	53	31	—	—
1936 .....	161	20	323	5	73	29	—	—
1937 .....	131	18	253	7	66	25	—	—
1938 .....	205	16	323	4	145	22	—	—
1939 .....	219	28	329	38	163	23	—	—
1940 .....	67	13	187	36	—	—	—	—
1945 .....	4	2	—	5	6	1	—	—
1946 .....	68	54	47	6	79	81	79	63
1947 .....	115	53	96	5	129	82	—	—
1948 .....	100	100	100	100	100	100	100	100
1949 .....	72	113	131	13	36	103	125	—
1950 .....	126	76	172	34	104	102	—	—
1951 .....	135	144	201	40	100	196	26	102
1952 .....	99	152	198	139	45	163	—	—
1953 .....	119	117	235	134	57	111	—	—
1954 .....	153	—	182	—	141	—	—	—

Source : Banco Nacional do Desenvolvimento Econômico.

(b) *Sweden*

This is the only example among the five countries where exports from Brazil increased, both between 1937-38 and 1948, and since that date. It is entirely the result of higher coffee sales, which in some years reach 90 per cent of Brazil's exports to Sweden. In 1952, shipments of coffee exceeded 50,000 tons, while in 1937-38 they had stood at approximately 30,000. Nevertheless, in 1953 and 1954 these sales declined to 40,000 and 30,000 tons respectively. Ranking next in importance in trade with Sweden is cotton. In 1937-38, exports had barely surpassed 1,000 tons. After the war they reached 16,500 tons in 1949, although in 1951 they fell to 3,500. In 1952, as occurred with other markets, they dropped to an insignificant figure and for the next two years remained at a level of 3,500 tons. Cacao exports were lower than before the war. Hides were exported on a fairly high scale in 1947-48 and then immediately dropped back to their low pre-war level; by 1952 they had practically disappeared from the Swedish market. The only new export of any importance is the banana. However, after reaching 19,000 tons in 1950, shipments declined and finally disappeared in 1953 and 1954. In brief, the behaviour of Brazilian exports to Sweden is no different from that of sales to other countries in Europe with the sole exception that Sweden has continued to buy relatively large tonnages of coffee. (See table 77.)

Table 77. Brazil : Indices of exports to Sweden

(1948 = 100)

Year	Total		Foodstuffs		Raw materials	
	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 ....	97	26	184	22	2	30
1936 ....	82	39	151	48	6	29
1937 ....	91	33	163	32	11	34
1938 ....	119	26	217	24	11	27
1939 ....	62	77	95	116	24	34
1940 ....	28	20	48	24	5	15
1941 ....	46	32	22	46	67	17
1942 ....	179	34	91	48	252	19
1943 ....	122	37	140	48	93	24
1944 ....	193	40	116	49	253	29
1945 ....	130	39	168	45	80	32
1946 ....	166	80	231	76	86	85
1947 ....	133	96	193	99	61	92
1948 ....	100	100	100	100	100	100
1949 ....	153	103	165	100	128	107
1950 ....	139	136	229	182	37	86
1951 ....	124	184	206	198	31	170
1952 ....	161	159	303	201	4	114
1953 ....	133	178	228	233	26	117
1954 ....	108	—	179	—	31	—

Source : Banco Nacional do Desenvolvimento Econômico.

(c) *Italy*

Before the war, cotton and coffee contributed more than three-quarters of the value of all exports from Brazil to

Italy. In 1948, the share of these two products exceeded 85 per cent, but cotton, which had figured in first place after trade was resumed in 1945, practically disappeared in



1949 and 1952. Between 1953 and 1954, cotton recovered and reached a substantially higher level than before the war, although it is still somewhat below the peak of 1946-48. The relative importance of coffee has thus tended to increase. In 1952, its share rose to 86 per cent, but the quantum of exports decreased between 1948 and 1952 from 34,800 to 25,600 tons. Herein lies the cause of the sharp and continuous decline of the quantum of Brazilian exports to Italy which was apparent until 1952. In 1953-54, thanks to the recovery in cotton and cacao exports, the index showed an upswing and in 1954 it exceeded the 1948 level. The other products of some importance demonstrated no tendency to rise either in comparison with the pre-war period or during more recent years. (See table 78.)

Table 78. Brazil : Indices of exports to Italy  
(1948 = 100)

Year	Total		Foodstuffs		Raw materials	
	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 ....	58	27	124	8	17	39
1936 ....	72	36	137	31	33	38
1937 ....	47	36	74	37	31	36
1938 ....	67	35	110	27	41	28
1939 ....	79	29	116	26	56	30
1940 ....	43	32	91	27	13	34
1945 ....	14	56	0	54	22	57
1946 ....	195	84	128	97	237	76
1947 ....	58	102	9	103	88	101
1948 ....	100	100	100	100	100	100
1949 ....	70	45	155	117	118	119
1950 ....	56	154	100	191	23	131
1951 ....	50	218	108	236	15	207
1952 ....	51	96	118	244	9	5
1953 ....	84	190	135	283	53	132
1954 ....	104	—	117	—	95	—

Source : Banco Nacional do Desenvolvimento Econômico.

#### (d) Belgium-Luxembourg

In 1947-49, Brazil's export quantum to Belgium-Luxembourg was substantially higher than during the pre-war period and arose from a remarkable advance in cotton and coffee sales. Exports of the former, which had stood at about 6,500 tons in 1937-38, rose to 25,600 in 1946-48. The volume of coffee purchases also more than doubled. Exports of cotton fell sharply after 1949; those of coffee also declined after 1950, but returned to the pre-war figure in 1952 and finally reached a much lower level. Cotton shipments, which had dropped to an insignificant figure between 1949 and 1952, again rose in 1953 and 1954 and recovered their pre-war position. Among other regular exports are tobacco, cacao and frozen meat, which all showed a tendency to decline in relation to their 1947-48 levels. Maize demonstrates a somewhat irregular trend, while Paraná pine seems to be strengthening its position on the Belgium-Luxembourg market. (See table 79.)

#### (e) The Netherlands

The major exports to the Netherlands are cotton, coffee and cacao. In 1947, the volume of Brazilian exports exceeded the pre-war level through a sharp increase in cotton shipments—which reached 17,700 tons, as compared with an average of 6,000 in 1937-38—and through a substantial

Table 79. Brazil : Indices of exports to Belgium-Luxembourg  
(1948 = 100)

Year	Total		Foodstuffs		Raw materials	
	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 ....	36	31	40	30	29	34
1936 ....	32	32	30	32	36	32
1937 ....	27	37	25	40	30	31
1938 ....	48	40	55	31	33	56
1939 ....	41	29	47	31	31	26
1940 ....	12	31	16	31	5	33
1945 ....	20	43	24	46	13	4
1946 ....	93	88	60	96	152	74
1947 ....	95	95	79	98	122	89
1948 ....	100	100	100	100	100	100
1949 ....	80	110	113	111	22	106
1950 ....	36	57	46	33	17	100
1951 ....	39	231	53	244	14	207
1952 ....	23	166	32	253	6	11
1953 ....	25	222	19	272	37	132
1954 ....	26	—	13	—	50	—

Source : Banco Nacional do Desenvolvimento Econômico.

rise in cacao sales. Nevertheless, cotton exports have declined considerably since 1949. The recovery witnessed in that year resulted from increased coffee exports, but since 1950 they have returned to the 1937-38 level. Among the other exports, only cacao has a larger volume after 1950 than before the war; even so, the quantum returned to the level of the 'thirties in 1953. In 1954 an encouraging recovery became evident, due chiefly to cotton shipments, which exceeded those of 1947, and to cacao exports, which were well above their pre-war level. Other products, such as hides and tobacco, also remained firm. Coffee alone declined substantially. (See table 80.)

Table 80. Brazil : Indices of exports to the Netherlands  
(1948 = 100)

Year	Total		Foodstuffs		Raw materials	
	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 ....	143	23	441	24	47	23
1936 ....	141	24	386	29	62	23
1937 ....	117	34	227	32	82	35
1938 ....	168	30	466	24	72	31
1939 ....	150	34	201	44	134	30
1940 ....	44	39	91	27	28	43
1945 ....	40	41	45	48	39	39
1946 ....	234	87	667	80	96	89
1947 ....	176	103	305	102	135	103
1948 ....	100	100	100	100	100	100
1949 ....	149	108	490	100	57	111
1950 ....	112	121	375	181	28	102
1951 ....	134	199	394	212	50	195
1952 ....	94	162	339	212	15	146
1953 ....	89	156	270	235	31	130
1954 ....	155	—	272	—	117	—

Source : Banco Nacional do Desenvolvimento Econômico.

#### 4. Western Germany

Before the war, Germany ranked second as a market for Brazilian exports. If this position was not regained until after 1954, the main cause lay in the fall of Brazil's export quantum. In 1937-38, Germany had absorbed 18 per cent

of all Brazilian exports, but in 1950-51 this figure had dropped to 5 per cent. Despite a sharp upswing in shipments to Western Germany, the proportion had reached only 9.6 per cent in 1953. As the recovery continued, the West German share rose to 12 per cent in 1954. In 1951-52, the volume of Brazil's sales to Germany declined to less than one-third of their 1937-38 level. It is interesting to note that this was apparently a true loss of market, since other countries replaced Brazil in Western Germany's import quantum which in recent years has become greater than it was before the war. In spite of a substantial improvement in the relative prices of Brazil's exports, the share of German imports in fact diminished from 3.52 per cent in 1937-38 to 0.80 in 1949-50 and to 2.00 in 1951-52. Not until 1951 did the German market begin to improve as regards Brazilian exports. This recovery became more marked in 1953 and was virtually consolidated

in 1954. In the latter year, the export quantum to Western Germany was 85 per cent that of 1938, the peak during the five-year period 1935-39, and was equal to or more than that of any other year of that period.

Table 81 shows the evolution of some of the principal exports to Western Germany as compared with the position of these same products during 1937-38. It is at once evident that the only commodity which substantially exceeds the pre-war level is cacao. All the other products which formed the basis for trade before the war remained at a lower level. Greater cacao shipments, the appearance of a new commodity—sisal—and an expansion in exports of some other less important products raised the over-all quantum of Brazil's exports to Western Germany to a level higher than that of the average for the main products.

Table 81. Brazil : Quantum of exports to Western Germany  
(1937-38 = 100)

Year	Raw cotton	Ginned cotton	Coffee	Cacao	Hides	Tobacco	Total (quantum indices)	Total imports by Western Germany (quantum indices)
1949 ....	0.02	—	19.2	5.8	62.4	31.6	9.7	—
1950 ....	2.6	6.4	4.1	14.7	21.4	64.7	8.6	114
1951 ....	17.9	76.8	27.1	62.7	66.9	39.6	34.4	116
1952 ....	3.8	93.6	45.8	36.1	15.7	62.5	27.3	134
1953 ....	26.5	73.6	68.0	294.8	34.4	37.4	63.4	151
1954 ....	64.4	56.2	50.8	373.4	4.3	51.8	84.9	190

Sources : Banco Nacional do Desenvolvimento Econômico and United Nations publications.

Before the war, cotton was the major product sold to Germany, followed by coffee and cacao, the latter being of much less relative importance. Today, because of the increase in cacao shipments and an expansion in relative coffee prices, these three products are practically on an equal footing.

Increased exports to Western Germany may be partly attributed to efforts on the part of the Federal Government to provide Brazil with an opportunity to liquidate outstanding trade obligations over the past two years. But there has

still been a recovery of the Brazilian position. Since this is an example of typical complementary economies, the natural trend is in the direction of more extensive trade. (See table 82.)

### 5. Japan

Before the war, Japan represented an important market for Brazil and in 1937-38 absorbed 4.66 per cent of the value

Table 82. Brazil : Indices of exports to Germany \*  
(1948 = 100)

Year	Total		Foodstuffs		Raw materials	
	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 .....	1,425	40	677	37	2,396	44
1936 .....	1,058	51	642	46	1,599	58
1937 .....	1,573	62	659	53	2,762	74
1938 .....	2,008	56	1,387	43	2,814	65
1939 .....	1,177	64	432	63	2,146	66
1940 .....	136	56	167	39	96	79
1948 .....	100	100	100	100	100	100
1949 .....	174	158	156	119	197	206
1950 .....	154	259	70	298	262	207
1951 .....	616	338	460	342	821	333
1952 .....	489	310	441	358	553	247
1953 .....	1,135	316	1,304	390	916	220
1954 .....	1,521	—	1,316	—	1,786	—

Source : Banco Nacional do Desenvolvimento Econômico.

\* Since 1948 to the Federal Republic only.

of all Brazil's exports. In 1951-52, the figure had fallen to little more than 1 per cent. As in the case of Western Germany, since 1953—when the percentage reached 3.1—an appreciable recovery can be observed. The fall in the export quantum to Japan is as clearly defined as it was with Germany. Taking the index of the trade volume in 1937-38 as a base, it had reached 30 in 1951-52 and 43 in 1953. However, if it is recalled that Japan's import quantum in 1951-52 was at only half the pre-war level, while that of Western Germany varied around 125 per cent, it may be seen that the true loss of market in Japan was less than in the case of Germany. Brazil's share of Japanese imports in reality declined from 1.69 per cent in 1937-38 to 1.07 in 1951-52.

Raw cotton formerly contributed almost 90 per cent of shipments to Japan. Among all the major markets for Brazilian exports, Japan represented the outstanding example of the domination of a single product. Since the war other commodities have appeared, such as sisal, rice and sugar, but cotton exports, although reduced, continue to exercise a predominant role. In 1953, they reached 23,000 tons, as against 10,300 in 1951 and an average of 63,000 for the period 1937-40. In 1954, aggregate Brazilian exports to Japan surpassed those of the pre-war years, reaching an index of 144. Cotton sales (59,000 tons) still remained on a lower level than before the war, but this was more than offset by an increase in sugar shipments (95,000 tons). (See table 83.)

Table 83. Brazil : Exports to Japan  
(Tons)

Year	Unspun cotton	Rice	Raw and skinned hides	Sisal	Sugar	Indices (1937-38 = 100)
1935	2,492	—	—	—	—	5
1936	43,328	—	—	—	—	83
1937	50,918	—	7	—	—	92
1938	60,159	—	—	—	—	108
1939	77,807	—	479	—	—	142
1940	64,193	—	1,799	—	—	118
1941	53,014	—	—	—	—	95
1948	497	—	—	—	—	1
1949	—	—	—	6,042	—	4
1950	9,320	—	625	—	—	18
1951	9,575	6,055	837	—	960	21
1952	10,268	3,000	—	—	33,999	40
1953	22,952	—	152	760	9,600	43
1954	58,910	—	—	1,948	95,275	144

Source : Banco Nacional do Desenvolvimento Econômico.

## 6. Argentina

Argentina's share in Brazilian exports rose from 4.63 in 1937-38 to 9.46 per cent in 1948. It has declined since 1949 to 6.8 per cent in 1952 and 5.0 in 1953; in other words, exports returned to their relative pre-war position. The considerable decline reflects the reduced quantum, which was halved in the years 1948 to 1953.

The reduction in Argentine imports since 1948 is a general phenomenon. If imports for 1951-52 are compared with the pre-war level, then the decline shown by Brazilian pro-

ducts is definitely less. But from the same aspect, it is clear that Brazil's exports have definitely been losing ground since 1948.

Exports to Argentina consist of three well-defined groups : foodstuffs, raw materials and manufactured goods. The first, which is the most important, is composed of coffee, cacao, bananas, oranges and yerba maté. (See table 84.) None of the products of this group indicates a definite tendency to increase, while two (yerba maté and oranges) show every sign of declining. However, yerba maté alone reflects a long-term downward trend based on a real process of substi-

Table 84. Brazil : Foodstuff exports to Argentina  
(Thousands of tons)

Year	Coffee	Cacao	Bananas	Oranges	Yerba maté	Quantum indices of the 5 products (1948 = 100)
1937	19.8	4.1	166.8	46.1	34.0	81
1938	26.2	5.6	160.5	47.8	29.8	100
1948	42.1	5.0	138.4	52.8	22.2	100
1949	18.5	4.6	146.4	34.3	14.3	66
1950	30.3	4.4	90.6	43.7	8.9	72
1951	28.5	6.3	132.5	31.1	13.6	78
1952	25.4	5.5	178.5	12.1	10.5	70
1953	34.1	9.9	139.0	8.9	6.5	84
1954	33.7	8.0	189.0	16.3	15.5	91

Source : Banco Nacional do Desenvolvimento Econômico.

tution. As regards the others, their stagnation or decrease arises from a contraction of income in Argentina on the one hand—a phenomenon apparent since 1949—and on the other to balance-of-payments difficulties. The lower exports to Brazil, caused principally by reduced wheat production and a considerable increase in raw material imports, induced the Argentine authorities to curtail their purchases of foodstuffs to avoid accumulating substantial trade deficits with Brazil. Recently, however, the foodstuffs group recovered while that of raw materials declined. The deferred demand for tropical products in Argentina is considerable, and the chief factor limiting mutual trade is the inability, within bilateral agreements, to pay for more foodstuffs without sacrificing raw material imports. The solution to the problem thus lies in a return to normal conditions for Argentina's

agricultural production and in a recovery of exports to Brazil.

After 1948, the loss in the raw material group was a good deal greater than that in foodstuffs; it can partly be explained by the reduction in the volume of investment. Even in recent years, and despite the near-collapse of raw material exports in comparison with previous levels, the volume of shipments was still equal to the average for 1937–38. As regards foodstuffs, it has already been seen that in 1952 the volume was considerably lower than before the war. The market for Brazilian lumber in Argentina is known to be large. If the investment level in that country were to recover, a strong demand for lumber would be assured. In this case, and even more so in that of foodstuffs, trade will depend on the recovery of Argentina's economy, and in particular on the capacity to import from Brazil. (See table 85.)

Table 85. Brazil : Raw material exports to Argentina

(Thousands of tons)

Year	Pinewood	Cedar	Peroba	Sisal	Leaf tobacco	Quantum indices of the 5 products (1948 = 100)
1937 .....	166.8	3.3	—	—	5.3	38
1938 .....	145.7	2.4	—	—	4.7	33
1948 .....	472.7	15.5	27.5	3.9	6.4	100
1949 .....	310.6	14.1	16.7	2.1	5.2	70
1950 .....	242.9	2.5	1.4	2.0	2.0	47
1951 .....	332.0	48.9	1.2	1.0	1.0	65
1952 .....	207.6	4.8	—	0.6	—	37
1953 .....	244.9	—	—	0.9	—	43
1954 .....	161.3	14.8	—	1.7	—	31

Source : Banco Nacional do Desenvolvimento Econômico.

Exports of manufactured goods consist fundamentally of textiles and cotton yarn. Such shipments were in existence on a small scale before the war and expanded considerably at that time. Between 1942 and 1945, cotton textile goods were the principal article of export from Brazil to Argentina,

amounting to 33 per cent of the total, as against approximately 1 per cent in 1937–38. These exports, however, declined during the post-war period and in 1951–52 represented only 4 per cent of the total value. Exports of cotton yarn, which hardly existed before the war, did not develop

Table 86. Brazil : Indices of exports to Argentina

(1948 = 100)

Year	Total		Foodstuffs		Raw materials		Semi-manufactures	
	Quantum	Prices	Quantum	Prices	Quantum	Prices	Quantum	Prices
1935 .....	37	19	73	35	28	13	5	6
1936 .....	40	19	75	32	31	16	8	8
1937 .....	45	21	81	34	38	18	10	7
1938 .....	47	20	100	27	33	19	1	10
1939 .....	63	22	95	31	44	19	57	14
1940 .....	67	23	73	32	38	19	113	16
1941 .....	92	31	86	36	43	32	191	23
1942 .....	149	44	76	52	57	45	420	33
1943 .....	92	49	92	49	48	51	174	45
1944 .....	126	67	88	53	49	84	320	53
1945 .....	109	75	116	58	44	90	222	70
1946 .....	77	82	89	83	69	96	76	55
1947 .....	109	100	121	89	74	121	156	77
1948 .....	100	100	100	100	100	100	100	100
1949 .....	82	102	66	104	70	106	125	90
1950 .....	53	123	72	187	47	97	37	87
1951 .....	69	156	78	223	65	119	62	136
1952 .....	48	134	70	232	37	105	39	56
1953 .....	46	123	84	254	43	94	—	—
1954 .....	43	—	91	—	31	—	—	—

Source : Banco Nacional do Desenvolvimento Econômico.

during the period of hostilities, on account of supply difficulties in Brazil. But they increased after the war, reaching a peak in 1951-52, when they represented 20 per cent of the aggregate value of Brazilian shipments to Argentina. Exports of cotton yarn in 1952 stood at 25 per cent of the total, exceeding those of pinewood and practically equalling coffee shipments. The drop in exports of manufactured goods during 1948 and 1952 was no greater than that in raw material shipments. (See table 86.)

The prospects for manufactures are in no way comparable to those for raw materials and foodstuffs because cotton textiles and yarn have almost disappeared from mutual trade already. Even so, when cotton textiles and yarns are excluded, the drastic decline in the exports of manufactured goods must be attributed more to administrative measures than to purely economic factors. Manufactured goods do not need to disappear entirely from Brazil's export schedule, since other products will inevitably take the place of those which are replaced by domestic production in other countries. This is a problem which must be considered in broader terms, bearing in mind the bilateral character of the trade, the elasticity of the supply of manufactures in Brazil, and other factors.

## II. ANALYSIS BY PRODUCTS

The foregoing observations clearly show that Brazil's export trade is composed of a small group of products. Except for coffee and cotton, Brazil's shipments to practically all markets are limited to insignificant tonnages. If cacao, hides and pinewood are also excluded, the list of exports is reduced to commodities of scant importance but which enjoy a stable demand on certain markets; such products include, *inter alia*, manganese and fruit. There are others lacking an assured market, but which have definite export possibilities for the future.

The comparative importance of the principal products in the value of Brazilian exports has been much influenced in recent years by the advance in relative coffee prices. Table 87 shows the position of the major products. Only coffee and pinewood among them show a larger share of the aggregate value of exports in 1948-53 than they did in 1937-38. The position of cacao practically remained unchanged. In 1948-53, cotton was well below the level which it reached in 1937-38. Hides and skins present a clearly diminishing trend, partly because of the competition from plastics. Other

regular export products are meat, rubber, yerba maté, tobacco, castor oil and carnaúba wax. The three latter showed averages in 1948-52 that are higher than those of 1937-38, but with a tendency to decline in more recent years. Rubber and yerba maté are typical products of an export branch that is tending to disappear, the first because no exportable surplus exists and the second because of the process of substitution which has been taking place in the principal import market. Meat has practically disappeared from the export schedule and its situation is similar to that of rubber as regards the increase of domestic consumption; yet, unlike rubber which suffers from growing synthetic competition, meat continues to enjoy excellent prices and expanding markets.

Table 87. Brazil : Share of the principal products in export values  
(Percentages)

Year	Coffee	Raw cotton	Cacao beans	Skins and hides	Pine	All Others
1937 .....	42.2	18.5	4.5	5.9	1.0	27.7
1938 .....	45.0	18.2	4.2	4.1	1.1	27.4
1948 .....	41.6	15.6	4.9	3.5	3.7	30.7
1949 .....	57.6	10.0	4.8	3.4	2.9	21.3
1950 .....	63.8	7.8	5.8	2.3	2.4	17.9
1951 .....	59.8	11.8	3.9	2.2	2.8	19.5
1952 .....	73.7	2.4	2.9	0.8	2.3	17.9
1953 .....	70.6	6.6	4.9	—	2.5	14.8
1954 .....	60.7	14.3	8.7	—	2.4	13.6

Source : Statistical Service, Ministry of Finance, Brazil.

Sisal and iron ore are among the few products for which exports have increased in relation to the pre-war period and sales of which are not sporadic. Sisal fibres, which were not shipped abroad before the war, appear in 1948 with 19,900 tons, rising strongly in the following years until they reached 57,400 tons in 1951. The value of sisal exports in 1951 amounted to \$23.6 million and was exceeded only by sales of coffee, raw cotton, cacao, pinewood and hides. But sisal exports declined during the next two years, decreasing by 60 per cent of their volume and 75 per cent of their value between 1951 and 1953. In 1954, however, the export volume rose again to 55,000 tons, although its value was only slightly more than \$9 million because lower prices prevailed.

Table 88. Brazil : Quantum of exports, by principal products  
(1948 = 100)

Year	Coffee	Cacao	Other food-stuffs	Raw cotton	Pinewood	Animal and vegetable raw materials	Iron ore	Other mineral raw materials	Textile manufactures	Other manufactures	Total
1937 .....	69.3	146.6	63.9	91.3	35.9	88.6	31.0	56.1	10.9	60.5	75.0
1938 .....	97.8	178.4	70.7	103.9	37.7	86.6	61.5	74.6	3.9	73.7	92.0
1948 .....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1949 .....	110.7	184.5	31.8	54.0	67.8	89.6	112.7	62.3	77.1	95.1	89.6
1950 .....	84.8	184.1	38.8	49.8	87.4	95.0	148.5	65.3	25.2	117.0	79.2
1951 .....	93.5	134.1	57.3	55.4	114.6	100.4	220.3	112.7	54.3	123.5	87.0
1952 .....	90.4	81.2	42.7	10.9	67.5	53.8	260.5	109.0	29.2	77.1	64.7
1953 .....	89.0	172.0	43.6	53.9	98.6	61.0	258.2	106.0	2.0	117.3	77.4
1954 .....	62.4	168.8	29.2	119.6	84.8	70.3	280.0	69.8	—	64.0	74.0

Source : Banco Nacional do Desenvolvimento Econômico.

Exports of iron ore, of little significance in 1937-38, rose in 1948 to 599,000 tons, continued to increase in subsequent years and reached 1,638,000 tons in 1954. The value of such exports in that year stood at \$21.6 million and was exceeded only by coffee, cacao, raw cotton and pinewood. (See table 88.)

### 1. Cotton

Lower cotton sales have been the chief factor in the fall of the quantum of Brazilian exports. This represents a serious problem, since cotton was the main product exported to some of Brazil's major supplier markets and in some instances became practically the only steady export item.

According to the analysis in section I, it is doubtful whether Brazil will be able to recover the previous capacity to import from certain markets—especially Germany and Japan—if the former level of cotton exports is not regained. Table 89 shows the importance of cotton among Brazilian exports to a large number of countries.

Table 89. Brazil: Cotton exports, 1937-38

Countries	Volume (Average of the two years in thousands of tons)	Percentage of the export value, by country
Germany .....	83.3	32.7
Japan .....	55.5	92.3
United Kingdom .....	48.9	39.2
France .....	21.2	22.8
Italy .....	8.6	30.2
Belgium-Luxembourg ....	6.8	15.1
Portugal .....	6.2	61.5
Netherlands .....	6.1	11.6
Poland .....	5.3	67.8
China .....	3.8	58.9
Others .....	6.8	1.1
<b>TOTAL ...</b>	<b>252.5</b>	<b>18.4</b>

Source: Banco Nacional do Desenvolvimento Econômico.

Brazilian cotton production has not improved since the 'thirties; the annual average for 1934-38 stood at 389,000 tons and in 1948-53 at 395,000. During this period there was no appreciable change in world production, although the 1947-48 level was lower and that of 1951-52 higher than the pre-war period. Output from the Americas as a whole increased, while the Brazilian share declined from 11.5 per cent in 1934-38 to 9.7 in 1948-53.

Although there was no real decrease in Brazilian production, the exportable surplus declined as a result of greater consumption by the domestic textile industry and of larger stocks used for other purposes. (See table 90.)

Table 90. Brazil: Production, export and apparent consumption of raw cotton  
(Thousands of tons)

Period	Production	Export	Apparent consumption
1934-38 .....	389.0	194.1	194.9
1939-48 .....	429.0	224.0	205.0
1949-53 .....	408.0	116.0	292.0

Source: Banco Nacional do Desenvolvimento Econômico.

Even by adding to aggregate exports in 1949-53 a volume of 150,000 tons which remained in bond at the end of 1953, average exports would represent only 136,000 tons. This compares with domestic consumption of 262,000 tons, or about three-fifths of the production, in contrast to one-half in 1934-38. The exportable surplus would therefore be reduced to two-thirds of the figure in the 'thirties.

The Brazilian share of aggregate exports from the Americas declined from 11.9 per cent in 1934-38 to 8.6 in 1949-51; in 1952 there was a complete collapse and the figure fell to 2.2 per cent. The Brazilian share of total world exports for the two periods stood at 6.3 and 5.1 per cent, respectively.

Comparing the world situation in recent years with the pre-war period, it may be seen that while cotton production increased, world trade in this commodity decreased. In 1951-52, world production was almost 900,000 tons (15 per cent higher than in 1934-38, but world exports over the same period declined by more than 400,000 tons (18 per cent). This falling-off in trade was mainly due to lower British and Japanese imports, which represented 25 per cent of the aggregate world trade in cotton during 1934-38. The post-war import peak of these two countries (1954) was not more than 19 per cent of the world total. The decline in imports by the United Kingdom and Japan is a reflection of the reduced world trade in cotton fabrics. The development of cotton textile industries in many under-developed countries has led them to encourage the domestic cultivation of cotton. In Latin America—excluding Brazil—production increased from 236,000 tons in 1934-38 to 561,000 in 1951-52; in Asia—excepting India, Pakistan and China—from 130,000 to 306,000; in Africa—excluding Egypt—from 190,000 to 311,000 tons. In many countries where production for export could not be justified, because of competition from lower-cost production, domestic consumption could be supplied, given adequate protection, and thus the decentralization of the cotton textile industry is also giving rise to a similar trend in cotton production.

Prospects are therefore unfavourable for cotton shipments to the large exporting centres of cotton fabrics; and this is not the only problem. European countries which import cotton for their own use are also unlikely to raise their purchases, since at relatively high income levels there is little elasticity in demand for cotton fabrics. Competition from rayon is also becoming increasingly severe, especially as regards prices. The consumption of rayon, which stood at only 11 per cent of that of cotton in 1935-39, had risen to 22 per cent in 1949-52.

Although it is true that the prospects are unfavourable for the world cotton trade, there is no reason why Brazil's share should decline. Had Brazilian exports in 1949-52 retained the percentage of world trade enjoyed in 1934-38, cotton shipments would have been 50 per cent higher than those actually achieved. This loss of markets has largely arisen from United States trade policy, principally since 1949, when Marshall Plan funds or credit were used to encourage exports funds of United States cotton. The effects of this policy are mainly apparent in Western Germany and Japan, which were the principal markets for Brazilian cotton before the war. It must be noted, however, that Brazilian price policy was also partly to blame for the loss of these markets.

In Brazil, the area under cotton cultivation may be widely varied by means of an effective price policy. This area has

been altered recently, from one year to another, by more than 20 per cent, as a result of price variations; from 1951 to 1952, for instance, there was an increase from 2.5 to 3.0 millions hectares. At the same time, the average yield per hectare is extremely low and could be greatly expanded by improved cultivation techniques.

As previously mentioned, apparent domestic consumption between 1949 and 1953 was approximately 260,000 tons. But these data are only approximate and do not agree with statistics for mill consumption, which stood at 179,000 tons in 1949.\* The discrepancy arises from inaccuracies in estimating stocks, consumption by small artisan spinning establishments and utilization outside the textile industry, etc. The projection of demand for textile products indicates a possible increase of approximately 60 per cent in the consumption of cotton fabrics between 1949 and 1962, which would involve a consumption of 286,000 tons by textile mills at the end of that period. Allowing for other types of consumption, the minimum domestic demand for cotton in 1962 may be estimated at 320,000 tons.

If domestic output can again equal the 1944 peak of 592,000 tons, an exportable surplus of 272,000 tons would remain. If, on the other hand, production falls to the 1948 level (320,000 tons) there would be no surplus for export, while an average of these two extremes (136,000 tons) would still be higher than 1949–53 exports. The production necessary to meet domestic demand plus this export figure would represent 484,000 tons; this is less than the 1952 total of 515,000 tons, and no marketing difficulties for that tonnage would apparently exist.

Cotton is the only one of the three main Brazilian export items which has a high elasticity of supply, and its world market is not appreciably affected by Brazilian exports; for these reasons cotton is one of the chief products affecting Brazil's capacity to import. A well-directed development policy could achieve a substantial increase in production, whose sale on the world market would be unlikely to cause a reduction in prices such as would occur in the case of coffee and to a smaller degree in that of cacao.

## 2. Cacao

Brazil's share of the world cacao trade is considerably greater than that of cotton: 17 per cent in 1934–38 and 18 per cent in 1950–52. Not only is this share greater, but the trade is more stable and shows a slight upward trend. (See table 91.)

Table 91. Brazil: Share of world exports of cacao beans  
(Percentages)

	1935–39	1945–49	1949–50
Brazil .....	17.0	17.0	18.1
Gold Coast .....	39.2	36.2	37.0
Others .....	43.8	46.8	44.9
TOTAL ...	100.0	100.0	100.0

Source: Food and Agriculture Organization of the United Nations.

\* See *A Study of Trade between Latin America and Europe* (E/CN.12/225) United Nations publication, Sales No.: 1952.II.G.2.

A principal feature of the cacao market is that world demand is inelastic in the high-income countries, which are the main consumers. A major part of the consumption is indirect—as an ingredient for sweets—and a relative price increase causes manufacturers to reduce the cacao content of their product; although the demand for cacao as a final product is inelastic, substitution is possible when it is used as a raw material. Moreover in high-income countries the demand tends to reach a saturation point beyond which it becomes inelastic in terms of higher income. In the United States, for instance, in spite of the considerable increase in the income available for consumer spending between the pre-war period and recent years, the per capita consumption of cacao remained almost constant; increased imports covered only the amount required to meet the needs of population growth. In Europe, per capita consumption has not yet returned to its pre-war level, although there are wide differences between individual countries. Peak consumption in recent years was reached in 1950, when aggregate world imports were only 8.4 per cent higher than in 1935–39. It is therefore clear that per capita consumption in importer countries as a whole has fallen—a decline partly explained by insufficient supply, which in turn has been causing heavy and continued increases in cacao prices since 1949.

As regards supply, it should be mentioned that short-term variation is impossible because of the manner of cultivation. Thus price cycles tend to be of long duration. The highest price of the Accra product in the 'thirties amounted to 8.2 dollar cents per pound in 1937, while it had stood at 15 cents in 1927. After the long recession, lasting until 1945, prices rose abruptly and since 1947 a high level has been maintained. The effects of this continued price increment on the supply will undoubtedly be felt in coming years, although there are other factors adversely affecting the supply in producer countries. On the Gold Coast, for instance, plagues have had very serious effects, while the availability of suitable land is limited, a circumstance which is affecting West African production more and more as the population grows.

Nor are prospects favourable for greater production in Brazil, although improved methods of tree-culture and the substitution of more productive varieties could in time improve the yield. Shortage of suitable land prohibits greater cultivation in the Bahia area, although there are possibilities of expansion in the Espiritu Santo zone. It is estimated that some 100,000 hectares are available for cacao cultivation on the lower Rio Dulce, which gives a theoretical production capacity of between 50,000 and 80,000 tons. Only 10,000 hectares of this land are already planted, and most of the trees are new. Production in Espiritu Santo has been steadily increasing during recent years—from 1,704 tons in 1947 to 4,312 in 1951. If prices remain firm during the next few years—which is most probable (assuming a high price level of over 30 dollar cents per pound)—production in Espiritu Santo may well reach 15,000 to 20,000 tons annually during the next ten years; at the worst, 10,000 tons may be expected.

On the basis of these data, two hypotheses may be presented upon the probable production of cacao in Brazil. (See table 92.)

Assuming that exports and consumption maintain the same relationship as in recent years, exports in 1926 would vary between 129,000 and 141,000 tons. This is an acceptable figure in view of the fact that 132,000 tons were exported

Table 92. Hypotheses of growth of Brazilian cacao production  
(Thousands of tons)

	1947-51	1953-57	1958-62
<i>Hypothesis A:</i>			
Bahia .....	120	125	125
Espirito Santo .....	3	5	10
Other States .....	2	2	2
TOTAL ...	125	132	137
<i>Hypothesis B:</i>			
Bahia .....	120	125	130
Espirito Santo .....	3	7	20
Other States .....	2	2	2
TOTAL ...	125	134	152

Source: Economic Commission for Latin America.

in 1949-50. Compared with average 1947-51 exports—106,000 tons—the minimum and maximum represent 22 and 33 per cent respectively. The average of the two agrees with the hypothesis of the increase in the quantum of exports assumed in these projections.

### 3. Pinewood

Brazilian exports of pine have almost doubled in relation to the pre-war figure. In 1937-39, average exports represented 240,000 tons per year, while recent annual sales stood at more than 600,000 tons; during only two years—1949 and 1950—have they fallen below 400,000 tons. In 1951, when 655,000 tons were exported, foreign exchange income from this source rose to \$50.5 million. In subsequent years, there was a slight decline, but in 1954 pinewood still held fourth place, with an income of \$37.2 million. Until 1949, exports were chiefly shipped to Argentina, which took 70 to 80 per cent of the total, but since that year there has been a steady trend towards a diversification of markets, partly owing to insufficient demand in Argentina. Between 1950 and 1952 sales to Argentina varied around 50 per cent of the total, falling in 1953 and 1954 to 43 and 33 per cent respectively. Meanwhile, other countries increased their purchases; among them were Australia, the United Kingdom—which bought 26 per cent in 1954—Western Germany, the Netherlands, Uruguay and the Belgo-Luxembourg Union. Since pinewood is a product whose supply is very elastic, it is possible, and even probable—taking into account the exchange rate used—that such exports may rise considerably. An annual level of exports higher than the present 500,000 tons might, however, rapidly exhaust forestry reserves.

### 4. Sisal

Large-scale cultivation of sisal is a relatively recent innovation in Brazil, the first exports having been made in 1946. From 2,800 tons in that year, foreign sales have risen rapidly to 57,400 tons in 1951, when the foreign exchange income derived from this product amounted to more than \$20 million. Exports declined in 1952-53, but in 1954 rose again to 55,200 tons, with a value of a little over \$9 million at the reduced market price during that period. Brazil's share of world exports of hard fibres (sisal, manilla and hemp) varies around 10 per cent, from which it may be assumed that greater exports would not have any appreciable effect on

world prices. As in the case of other minor export products, an increase in sales of sisal would, in addition to enlarging foreign exchange resources, give remunerative employment to productive factors which would otherwise remain idle or only partially utilized.

### 5. Tobacco

Leaf tobacco is a traditional Brazilian export product; but its share of world tobacco exports rarely exceeds 6 per cent. Tobacco has recently taken sixth place among export items, providing foreign exchange revenue of \$15.8 million in 1953 and \$17.9 million in 1954. Since there is an expanding world market, in which Brazil has but a small share, a substantial increase in tobacco exports appears to be possible. Such an increase is desirable not only from the aspect of its effect upon the capacity to import, of the prospects for greater employment and of higher real incomes in rural areas, but even more so because an increase in production does not require heavy investment.

### 6. Minerals

The export of mineral raw materials in 1954 provided foreign exchange revenue totalling almost \$30 million. Greater sales of ferrous ores and the favourable prices for most mineral products have led to their increasing share of aggregate export values. Substantial investment is needed to expand export capacity, but a number of projects are in hand, especially for iron and manganese. In spite of the instability of the world metals market, therefore, a considerable increase in sales—possibly as much as 200 to 300 per cent—may be expected in the near future.

### 7. Other commodities

The remaining Brazilian export products have a fairly broad elasticity of supply. Some of them are being absorbed on an increasing scale by the domestic market, but even in extreme cases, such as meat, the exportable surplus can be recovered, since there are ample possibilities for raising production. By-products present a different problem, since their supply situation is inelastic, depending always upon the market for the main commodity; typical examples are cotton by-products, such as cotton-seed cake, linters and their respective oils. The domestic demand for these items increases with the growth of the population, higher real income, industrialization, etc. If there is no increment in cotton production—possibly because foreign demand is being fully met—the exportable surplus of by-products is reduced. The same may occur for hides, since the demand for leather goods—chiefly footwear—is increasing rapidly. Because leather is a by-product of meat, it is possible that the exportable surplus may show a declining trend.

In other cases, the development of the domestic market enables an exportable surplus to be maintained. The Brazilian sugar industry, for instance, was excluded from the world market many years ago, but the increasing domestic demand has given the industry stability and substantial expansion prospects. Some parts of the country have idle capacity and would benefit from both higher yields and an increase of production greater than that warranted by the domestic market. World prices, however, are much lower than those in Brazil, so that exports would have to be subsidized. The capacity of the world market is limited and is at present



Table 93. Brazil : Exports indices, 1935-54  
(1939 = 100)

Year	Total		Foodstuffs		Agricultural raw materials		Mineral raw materials		Textile manufactures and semi-manufactures		Manufactures and semi-manufactures (others)	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
1935	73	25	89	25	56	28	20	18	3	14	24	5
1936	78	28	85	28	73	31	34	21	5	18	48	12
1937	75	31	75	32	83	31	50	29	11	18	60	21
1938	92	25	99	24	90	27	71	30	4	20	74	18
1939	98	26	99	25	106	28	73	34	32	18	82	21
1940	81	27	82	25	78	31	99	37	70	21	95	35
1941	64	33	74	33	98	33	168	55	174	27	165	39
1942	70	48	54	49	64	42	141	82	439	38	103	68
1943	72	52	65	52	44	47	181	95	441	50	123	66
1944	79	57	79	55	52	56	125	141	344	63	117	71
1945	85	61	76	59	64	61	122	127	412	69	163	82
1946	105	81	95	82	112	80	58	127	226	63	143	78
1947	99	100	89	102	106	98	65	89	264	92	95	91
1948	100	100	100	100	100	100	100	100	100	100	100	100
1949	90	106	101	108	68	104	75	108	77	107	95	87
1950	79	148	83	176	70	105	86	91	25	131	117	82
1951	87	182	90	196	79	166	140	105	54	134	123	117
1952	65	174	80	199	33	138	147	135	29	153	77	85
1953	77	184	83	229	62	118	144	152	1	100	117	53
1954	74	—	65	—	98	—	123	—	—	—	64	—

Source : Banco Nacional do Desenvolvimento Econômico.

NOTE.—(A) = Quantum.

(B) = Prices.

Table 94. Brazil : Geographic distribution of Brazilian exports  
(Percentages)

Specification	Average 1937-38	1948	1949	1950	1951	1952	1953	1954
United States and Canada	35.73	44.70	51.98	55.86	50.21	53.18	50.0	38.0
Argentina	4.63	9.46	7.68	5.62	6.65	6.78	5.0	6.4
Latin America (others)	2.03	4.37	2.85	2.51	2.12	2.33	—	—
United Kingdom	8.89	9.44	8.50	8.34	9.83	2.72	4.6	4.8
Belgium-Luxembourg	3.32	4.75	4.35	2.53	2.36	2.05	1.5	1.4
France	6.38	2.52	2.10	4.72	5.05	5.67	5.7	5.9
Western Germany	17.99	1.06	1.55	1.34	4.78	5.64	9.6	12.0
Netherlands	3.69	2.50	3.13	2.40	2.94	2.82	2.4	2.9
Sweden	2.10	1.76	2.87	3.29	2.67	4.45	3.5	3.6
Italy	2.16	2.61	2.57	1.75	1.72	2.32	3.0	3.4
Western Europe (others)	3.72	7.50	6.55	6.33	5.73	5.17	—	—
Eastern Europe	2.47	2.09	1.65	1.68	1.48	2.18	—	—
Japan	4.66	0.07	0.16	0.79	0.93	1.33	2.7	4.4
Other countries	2.23	7.17	4.06	2.84	3.55	3.36	—	—
Brazil's share in world exports	1.44	2.22	2.03	2.43	2.33	1.94	2.06	2.02

Sources : Banco Nacional do Desenvolvimento Econômico and United Nations publications.

nearing saturation point, but by means of bilateral agreements, Brazil should be able to sell between 100,000 and 200,000 tons abroad.

In general, Brazil shows favourable possibilities for increasing exports of most of the minor products. Because in no case would they constitute more than 1 per cent of the world supply, it may be accepted in principle that the demand is sufficiently elastic to absorb such tonnages without affecting world prices. The problem, therefore, is basically one of

an adequate export price policy, which depends upon foreign exchange measures, the guidance of credit, technical assistance, investments tending to aid import substitution, etc.

From the aspect of supply, many of the minor export products come from areas where the means of production have but limited alternative use and where it is of prime importance that exports should be maintained. In the case of primary products, an interruption would mean abandoning the land or other natural factors; any alternative employment

of labour at the same economic productivity level would require greater investment.

In a country in process of development, exports must be regarded not only as a source of income, but even more as a means of increasing the capacity to import and therefore of contributing to a higher technical level of the economy.

In the case of Brazil, it must be recalled that many of the so-called minor products are fundamentally necessary for maintaining and increasing the level of income of the less-developed areas of the country. Export development policy must therefore be considered not only from the angle of supplying foreign exchange, but also as an integral part of zonal development plans.

## Chapter II

### THE COFFEE PROBLEM

#### 1. INTRODUCTION

Some preliminary projections of the external payments capacity of Brazil's economy until 1962 are given in Part One of this study. They are basically founded upon the hypothesis of a return to normal conditions in coffee exports. Such an assumption implies the recovery of the average export level for 1949-53, the preservation of Brazil's share in the world coffee trade, and the establishment of firm relative prices similar to those existing in 1952, or, in fact, before the sharp upswing caused by the frosts in 1953.

It is unlikely that these two objectives—the maintenance of Brazil's quota in world trade and the stabilization of relative prices at a level similar to that of 1952—can be attained spontaneously. In view of their peculiar nature, the economics of coffee require a long-term policy. When such a policy is lacking, those elements of instability appear which are inherent in the coffee sector and which render any forecast of its behaviour impracticable.

This chapter aims at analysing the courses open to Brazil in terms of the prospects for the world coffee trade. In other words, an attempt will be made to ascertain how far the above-mentioned objectives are feasible and by what means they might be attained. As a beginning, a brief study based upon data since 1939 is devoted to the position of coffee in Brazil's economy, with particular reference to its significance as an element in the formation of income and of the capacity to import. A subsequent section attempts to define the special features of the coffee sector as it has evolved in Brazil. The specific nature of the crop, Brazil's exceptional position as a producer and the characteristics of the demand for the commodity are all fundamental elements for drawing up any national or international coffee policy. At a later stage, this chapter describes the current situation as regards present or future disequilibria between world supply and demand. Finally, consideration is given to the possible objectives of a coffee policy consistent with the development targets for Brazil's economy detailed in Part One.

#### 2. COFFEE IN BRAZIL'S ECONOMY

It is well known that coffee constitutes a fundamental element in Brazil's economy. If the structural modifications which have taken place in this latter during the last twenty-five years have in some respects weakened the importance of coffee, they have increased its significance from other angles.

In 1939 the value of coffee production—planter's income—represented 5.1 per cent of Brazil's aggregate income. During the war years this share declined, dropping to 3 per cent in 1942. After the war, thanks to the relatively high prices, it rose to 7.5 per cent in 1950, and has remained above 6 per cent during subsequent years.

In addition to the income directly accruing from coffee production, it should not be forgotten that its transport, marketing and export give rise to another substantial source of income. The whole coffee economy undoubtedly represents a large proportion of Brazil's productive activities.<sup>1</sup>

It has already been seen that coffee's share in gross income has increased since 1939. Allowing for the 20-per-cent reduction in production between 1939 and 1950-54, the magnitude of the relative rise in coffee prices which took place during this period is clear. On the one hand, the gross real product doubled;<sup>2</sup> on the other, coffee production declined by 20 per cent. Even so, coffee's contribution to gross income rose from 5.1 to 6.6 per cent.

An examination of the evolution of coffee output within the value of over-all agricultural production reveals that its share increased from 20.3 per cent in 1939 to 26.8 per cent in 1950-54. It is interesting to note that between 1939 and 1944 this proportion declined from 20.3 to 13.6 per cent, and that even in 1948 it was no greater than 18.8 per cent. Since the volume of coffee production decreased by some 20 per cent during this period, while the quantum of agricultural production expanded by approximately 30 per cent, it is apparent that the relative prices of coffee improved substantially within this sector.

These manifestations of a relative improvement in both the agricultural sector and the economy as a whole do not mean that there has been a redistribution of income in favour of the coffee sector. As explained in chapter I of Part One, what is implied is in fact an improvement in the economic productivity of the sector, a reflection of higher coffee prices on the world market. The coffee sector did not absorb the entire product of this improvement, but the proportion retained was sufficiently large to modify coffee's position within the economy, as described above.

The 3,042,000 hectares planted with coffee represented 22.3 per cent of the aggregate area in 1939. During the five-year period 1950-54, the acreage under coffee declined to 2,821,000 hectares, while the aggregate area increased by 37 per cent. Monetary income per hectare, which was 6.3 times greater in 1950-54 than in 1939 for agriculture as a whole, was twelve times larger for the coffee sector.

The above remarks show the considerable alteration caused during the last fifteen years in the relative position of the coffee sector within the over-all economy of Brazil. Nevertheless, it should be recalled that during the period used for reference purposes the economy of the coffee sector was in a highly precarious situation, since it had fallen to one of the

<sup>1</sup> The coffee sector probably contributes at least 10 per cent of the national product, which means that its share represents approximately 60 per cent of that of the whole manufacturing sector.

<sup>2</sup> See table 1 of Part One.

lowest levels recorded during a depression which had lasted ten years.

Although the share of coffee in gross income rose, the increase in its relative significance as an element in forming the capacity to import was even greater. The proportion represented by coffee in the value of aggregate exports grew from 40 per cent in 1939 to 66 per cent in 1950-54. Table 95 gives percentages and indices of coffee's part in the formation of income and of the capacity to import. With respect to income, the maximum increase, 47 per cent, was registered in 1950; for the capacity to import, the peak of 85 per cent was reached in 1952.

Table 95. Brazil : Coffee's share in the formation of income and of the capacity to import

Year	Income		Capacity to import	
	Percentage share	Index	Percentage share	Index
1939 .....	5.1	100.0	39.8	100.0
1940 .....	4.0	78.4	32.0	80.4
1941 .....	3.4	66.7	30.0	75.4
1942 .....	3.0	58.8	26.2	65.8
1943 .....	3.1	60.8	32.1	80.7
1944 .....	3.2	62.7	36.2	91.0
1945 .....	4.3	84.3	34.9	87.7
1946 .....	4.8	94.1	35.3	88.7
1947 .....	3.9	76.5	36.6	92.0
1948 .....	4.0	78.4	41.6	104.5
1949 .....	4.7	92.2	57.6	144.7
1950 .....	7.5	147.1	63.9	160.6
1951 .....	6.6	129.4	59.8	150.3
1952 .....	6.4	125.5	73.7	185.2
1953 .....	6.2	121.6	67.7	170.1

Source : Tables of the Statistical Annex.

Nevertheless, this information is insufficient to give an accurate idea of the strategic importance of coffee in the recent growth of Brazil's economy. The explanation for the impetus gathered by this development during the last five-year period perhaps lies in the way in which the increase in the income of the coffee sector took place. It has already been noted that this increase was determined by higher coffee prices on the world market. As is readily understandable, this caused an immediate upswing in the profits of planters and dealers, as well as capital gains for all those in possession of stocks. Under such conditions an immediate increase in the funds available for investment might have been expected. The data in Part One on the rate of saving clearly emphasize this phenomenon, since it advanced from 13.0 to 17.6 per cent between 1948 and 1950. But the agricultural-export sector did not retain all these earnings for very long. Higher domestic prices led to a progressive transfer of this income to the other sectors and, in particular, to manufacturing. The mechanism of the transfer was simple; because the rate of exchange remained stable, prices of imported goods underwent a relative decline, while the internal price level rose. The industrial sector was thus able to acquire a great deal of equipment at relatively low prices. Under such circumstances, it was enough to maintain the rate of profits for the rate of investment in the industrial sector to accelerate.

There is every indication that industry, as a result of this process, absorbed several hundred million dollars, which represented real capital gains. It may well be asked here what would have happened if prices in the internal sector had not risen. In that case, the additional earnings derived from higher coffee prices would have been concentrated in the planting and exporting sector. As agricultural wages primarily depend upon the elasticity of the labour supply, it is easy to see that the higher income accruing from the rise in coffee prices would mainly have taken the form of profits. The practical consequence of this situation would have been an even greater concentration of capital in the coffee sector. The increase in this sector's relative profitability would have been much larger, within both the over-all economy and that of agriculture.

If it were assumed that investment in expanding coffee plantations had been heavy enough to cause a disequilibrium between the world supply of coffee and the demand that would hypothetically affect the market for several years to come, the question would arise as to whether the situation might not have been far more serious still, if the profits from higher coffee prices had not been diverted towards other agricultural activities and other sectors. This reflection suffices to show how important, from the standpoint of Brazil's development, was the fact that a substantial proportion of the gains accruing from the rise in coffee prices was transferred to sectors linked with the domestic market. Clearly, such an observation in no way excludes the possibility that, by means of fiscal policy, investment could have been suitably re-directed and an even greater share of the increment in income channelled towards capital formation.

The vital significance of coffee as a determining factor in development during the recent period may therefore be deduced from the circumstance that an increase in its price enables the profitability of both other agricultural activities and manufacturing to rise sharply. As regards industry, this phenomenon is particularly interesting, since profits earned by this sector are reflected in imports of capital goods; a strong incentive was thus created to renew these latter and to expand the productive capacity of every branch of industry, with the partial exception of that actually manufacturing such equipment.

### 3. CHARACTERISTICS OF THE COFFEE SECTOR

Before dealing with the coffee problem as it exists at present, it is well to draw attention to some of the main economic characteristics of this sector in Brazil.

Coffee cultivation originally met with conditions exceptionally favourable for its development in the southern area of Brazil, where suitable soils in great abundance and an elastic supply of labour were available. Once the transport problem had been solved by the extension of the railways, the crop quickly spread throughout its most suitable habitat, the São Paulo tableland. By the beginning of the present century, the most rapid stage of this expansion had already terminated; the Brazilian product had secured a pre-eminent place on the world market, eliminating many of the previous competitors.

When the maximum development permitted by the world market had been reached, expansion continued, creating surpluses which were to upset the balance of the coffee eco-

nomy throughout the subsequent fifty years. A detailed analysis of this problem would exceed the limited objective of the present study, which is simply to examine the alternative courses open to Brazil in view of the immediate prospects of the coffee economy. Nevertheless, the basic causes of the chronic disequilibrium in the coffee trade require at least a cursory glance.

The expansion of coffee cultivation took place at a period when, in face of the lack of a domestic market, foreign trade alone permitted economic activities of any size to be organized in Brazil. Coffee requires specific ecological conditions and a large labour force. Once planting was established on a satisfactory business basis, the very fact that the crop brought in a large income set a problem for the entrepreneurs: how were these profits to be used? It was natural that efforts should have been made to devote such earnings to the most profitable activity, which was in fact coffee cultivation itself. It should also be recalled that the abundant labour force required during the harvest was available at other periods of the year and could easily be used to expand the size of the plantations. As a result, when suitable land and means of transport were available, the expansion of coffee plantations tended to take place automatically, depending only on the labour supply. This is why coffee planters themselves combined to establish railway companies or to encourage immigration.

This automatic process of expansion obviously came to an end when the world market was saturated. Given the characteristics of the demand for coffee, once a supply surplus had arisen, persistent price decreases were inevitable, and were bound to reduce income from the crop sufficiently to discourage further expansion and even to cause the plantations with the lowest yields to be abandoned. Since coffee is a perennial plant, no alternative employment exists for the labour force, and the expenditure of planters is very modest, it is clear that price reductions would have to be very steep and persistent to bring about the abandonment of the coffee plantations. In Brazil their yield is substantially influenced by climatic factors. An abundant harvest weakens the trees and is followed by a scanty crop. Furthermore, it must be borne in mind that part of a crop or even of successive crops, may be lost. In this way periods of over-production may alternate with others of shortage, and sharp and pronounced price fluctuations may occur.

The marked instability characterizing the coffee market very early drew attention to the advisability of introducing a disciplinary mechanism. The fact that the production of a single country had such large relative importance must also have helped the decision to introduce this mechanism.

It was these two factors—market instability and the concentration of production in one country—that gave rise to the Brazilian policy of defending coffee prices, which so greatly influenced the world market for three decades. The principal aim of this policy was to withhold from the market the surplus accumulated in good harvest years, and to use it when there was a partial loss of production. In this way it was possible to reduce the pressure of the supply on the market and to stabilize prices at a relatively high level.

It is easy to understand that such a policy made coffee planting even more attractive, so that expansion tended to become more intensive. This aspect of the problem was

grasped in time, and various restrictive measures were adopted. Nevertheless, later experience showed that under the conditions then prevailing, it was practically impossible to halt the growth of coffee plantations in Brazil. The price defence policy, therefore, by guaranteeing an income for this crop, created a privileged situation for coffee among the alternatives open to the entrepreneur for the investment of resources, the accumulation of which was also fostered by the policy in question.

The way in which this latter was applied, above all during the 'twenties, necessarily aggravated the problem of over-production. Only by combining price defence with a strict re-direction of investment—which would have required a far more active fiscal policy than was possible at that time—could this vicious circle have been broken.

This problem presented another aspect of fundamental importance. It has been seen that during the last decades of the nineteenth century the development of coffee cultivation brought about Brazil's steady conquest of the world market. From the moment the country ceased to compete and devoted itself to the defence of a relatively high price level, favourable conditions were automatically created for an expansion of coffee planting elsewhere in the world. In this way, Brazil's share of the United States market, which had been 80 per cent at the turn of the century, fell to 65 per cent in 1929 and to 52 per cent in 1937, the last year of the price-defence policy. In the final instance, the unilateral guarantee of a minimum price implied a reduction or an elimination of the relative advantage by means of which coffee planting had expanded in Brazil. Furthermore, the development of coffee cultivation in other Latin American countries, particularly Colombia and Central America, enabled other, different grades to be produced, a situation which was to have major consequences at a later date. It was the more careful harvesting methods practised in these countries—where production as a general rule is in the hands of families or relatively small units—which caused these differences in grade and ultimately led to a definite reduction of Brazil's ability to compete on world markets, especially that of the United States.

This decline in Brazil's share of the world market, on the one hand, and the differences in grade, on the other, would seem to have radically altered the general terms of the coffee problem. The possibility of recovering markets through a price reduction policy is becoming more and more remote, given the differences in grade and the relative increase of costs in Brazil.

It is recognized that the inelasticity of the coffee supply in all producing countries is high. The experience of the 'thirties demonstrated that, whatever price decline took place, the crop would continue to be harvested normally. To understand this phenomenon, it should be recalled that a coffee plantation represents a relatively large capital outlay per hectare, the fixed costs thus being substantial. The variable costs are constituted by the remuneration of the labour force. As is the case in Colombia, within a family unit this remuneration is not of a monetary nature; the same is true in some instances of the large Brazilian plantations. Even when this is not so, rural labour in under-developed countries usually lacks alternative employment and for this reason can accept substantial reductions in its monetary wages.

In producing countries, the problem of coffee production costs is a question fundamentally related to the level of real wages, or in fact to the stage of development of each country. As average productivity grows and the surplus population is absorbed, the rise in average wages will cause an increase in the variable proportion of coffee costs, namely, that dependent upon wages. Thus, over the long term there is a tendency towards greater elasticity in the coffee supply, as a function of short-term price fluctuations.

Perhaps the trends mentioned above may be accentuated at an even earlier date in Brazil. Because coffee production is organized there on the basis of large plantations, a relatively higher proportion of the costs must be paid in money. As real wages rise, this share will also grow and coffee production will assume the characteristics of an industry. In this case, a sharp drop in prices may lead to agricultural unemployment, since the planter will be obliged to reduce his current expenditure. But it should be recalled that Brazil is one of those coffee-producing countries where production is developing most rapidly. If it were not for the vast labour reserves available in other areas, the rapid industrialization of São Paulo would already have had a substantial influence upon the structure of coffee production. Finally, large-scale coffee-planting in Brazil has led to an impoverishment of the most suitable soils and hence to an appreciable drop in average yields. The attempts at recovering production levels during recent years have been based on incorporating more remote areas with a less favourable climate, or on large investments aimed at reclaiming the impoverished soil. It is inevitable that the average level of costs rises in both cases.

The remarks above, indicating the trend of the relative rise in coffee production costs in Brazil, confirm the previous statement that the country will encounter increasing difficulties if efforts are made to recover the position lost on the world market during the last fifty years. Clearly this conclusion does not exclude the possibility of a partial recovery of these markets over the short term. Nevertheless, apart from the problem of a return to normal trade conditions and of recovering some markets which are at present artificially restricted, the characteristics of coffee demand are such that it would be difficult to increase consumption by means of a mere reduction of prices. The most that might be achieved from this method would be the elimination of a competitor; but, given the inelasticity of supply in the principal producing countries, it is easy to see that, both individually and collectively, all would suffer from the effects of a price war.

#### 4. THE PRESENT SITUATION

For a clearer definition of the present status of the coffee economy, the production and export data of the last three decades must be carefully examined. (See table 96.)

The intensive growth of Brazilian production during the 'thirties was due to a large increase in the area under coffee, a development which took place between 1925 and 1929 as a result of the very strict application of the price defence policy during that period. In 1925, production amounted to 15.8 million bags, and by 1933 it had reached a peak of 29.6 million. It is of interest to note that in the latter year there was a surplus of 3.3 million on the world market. This trend underwent a natural reversal in the following decade. Production declined considerably owing to the

Table 96. Brazil : Exportable coffee production since 1925  
(Millions of 60 kg. bags)

Period	Brazil	Other countries	Total	Percentage of Brazil in total
1925-29 .....	21.3	7.8	29.1	73.2
1930-34 .....	22.7	8.5	31.2	72.8
1935-39 .....	22.8	10.2	33.0	69.1
1940-44 .....	13.4	14.7	28.1	47.7
1945-49 .....	14.7	13.7	28.4	51.8
1950-54 .....	15.4	16.9	32.3	47.7
1954 .....	13.8	18.5	32.3	42.7

Source : Instituto Brasileiro do Café.

partial abandonment of plantations during the depression. Older plantations and those with comparatively small yields were not replaced and the number of trees was substantially reduced. The net result of the coffee crisis, which lasted from 1930 till the end of the war, may be summarized as follows : there was a loss of 1 billion trees—one-third of the plantations existing during the peak period of expansion—and almost one-third of the crop—approximately 80 million bags—was destroyed.

Between 1925-29 and 1935-39, the volume of the world coffee trade increased from 23.6 to 28.8 million bags. The latter level was recovered in 1945-49, when the difficulties created by the war had been overcome; during the following five-year period, 1950-54, a yearly average of 31.6 million bags was reached, despite the considerable rise in prices. It should be noted, however, that Brazil's share in the coffee trade fell from 60 per cent in 1925-29 to 47 per cent in 1950-54. Thus, it accounted for only 800,000 bags out of a total world consumption of 8 million during the period under review.

The effect of Brazil's huge accumulation of stocks was negative in two ways : the crisis of the first period was rendered more acute and lasted longer. Thus, during 1945-49, Brazil was able to export an annual average of 16.3 million bags, when its average production was only 14.7 million. This situation helped to aggravate the disequilibrium caused by an inadequate supply in the following five-year period. Had it not been for the stocks accumulated, coffee prices would have recovered earlier and at a more gradual pace; an adequate increase in supply would have thus been facilitated. The sharp rise in prices that took place at the end of 1949, a year in which Brazilian stocks covered about 10 per cent of world imports and were then exhausted, created a vigorous stimulus to an expansion of the area under coffee. This gave rise to intensive speculation in land and to indiscriminate coffee planting, without regard to the crop's most favourable habitat.

The area under coffee, which had amounted to 3.5 million hectares in 1938, was reduced to 2.5 million in 1948. Nevertheless, the price recovery later caused an expansion of this area, which stood at 3 million hectares in 1954. The price recovery itself was aided by the incorporation of new plantations, an addition in area which in recent years has more than offset the abandonment of the older plantations. In the States of Rio de Janeiro, Minas Gerais and São Paulo (the traditional coffee-growing areas), the older plantations—of low yield and sometimes plague infested—were appre-

ciably reduced in area. Between 1939-41 and 1949, the coffee-growing area in the State of Rio de Janeiro decreased from 160,000 to 51,000 hectares, but a slight recovery began to take place in the latter year and by 1954 it had risen to

57,000 hectares. In Minas Gerais, the plantation area decreased from 748,000 to 560,000 hectares. It is interesting to note that a reduction in area was nearly always accompanied by an increase in yields. (See table 97)

Table 97. Brazil : Area and yields of coffee plantations in various states

Period	São Paulo		Minas Gerais		Espírito Santo		Rio de Janeiro		Paraná		Total	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
1939-41 .....	1,275	500	748	243	230	399	160	220	133	443	2,646	394
1949 .....	1,322	369	560	388	228	505	51	680	242	621	2,538	421
1950 .....	1,407	334	571	377	220	387	56	486	267	758	2,663	402
1951 .....	1,415	337	588	385	232	421	56	643	292	594	2,738	394
1952 .....	1,430	360	607	292	240	295	56	624	332	793	2,823	399
1953 .....	1,459	322	624	382	244	407	57	548	372	542	2,918	380
1954 .....	1,464	334	637	368	251	393	57	461	383	345	2,916	356

Source : Ministry of Agriculture, Statistical Service.

Note.—(A) : Area in thousands of hectares.

(B) : Yields in kilogrammes per hectare.

As can be seen, those States which were traditional producers and reduced their coffee-growing area experienced higher yields. In São Paulo, however, the reverse is true : the cultivated area has increased and the yield is lower. The growing importance of the State of Paraná is worthy of mention. Its coffee-plantation area practically trebled during the period under review, while the average yield increased from 443 to 715 kilogrammes per hectare between 1939-31 and 1950-52. The decline in average yield which took place in 1953 and 1954 was due to bad weather conditions.

The present productive capacity of Brazilian coffee plantations is not known with precision, since no information exists as to the age of plantations in the older coffee-growing regions, the extent of new plantations (especially in Paraná), and the effective yields of these latter, which are subject to less favourable weather conditions.

With respect to the age-distribution of plantations in the traditional coffee-growing areas, it should be borne in mind that an improvement in yields may accompany the conservation of cultivated area, since it is known that the replacement of old plantations is being carried out on a more rational basis and that more productive varieties are being introduced. It is assumed, for instance, that production in the State of São Paulo can increase by as much as 20 per cent without an expansion of the present area. However, it should not be overlooked that some of this increase would result from more intensive cultivation, adequate use of fertilizers, irrigation, etc. In this case, account should be taken of the corresponding rise in current monetary costs and the subsequent increase in the elasticity of supply. Should prices fall, this proportion of the supply would contract.

Nor can a very clear picture be obtained of conditions in the new areas, which are situated mainly in the State of Paraná. Available information on the area covered by these new plantations is vague and contradictory. Data from the Ministry of Agriculture show that the number of coffee trees in production in Paraná rose from 124 to 234 million between 1948 and 1953. But these new coffee trees were planted before 1949, that is, before the recent price boom. It was in 1949 onward that planting was really intensified. Census data for 1950 show that the number of new and as yet

unfruitful plants had risen to 119 million. All these trees must then have been four years old at the most, and the majority were probably younger.

Although these data are clearly of limited value, they may serve as a basis for further assumptions. The increase in the number of trees between 1948 and 1953 appears to indicate that, in the period before the rise in prices during 1949, approximately 20 million trees were planted annually in Paraná, in addition to those intended for replacement purposes. If 119 million new trees existed at the end of 1950, it is likely that approximately 60 million were planted in the year immediately following the rise in prices.<sup>3</sup> The remainder would have been two to four years old and would have begun to bear fruit in the agricultural years 1950/51, 1951/52 and 1952/53.

On the assumption that the rate of planting was maintained at 60 million per annum, it is probable that 240 million new trees, including those for replacement, were added in the interim period between the rise in prices and the great frost of 1953. If this was so, the total number of trees in Paraná during 1953 must have been approximately 450 millions,<sup>4</sup> classified as follows :

	Millions
Bearing coffee in 1949 .....	150
New trees, planted up to 1949 .....	60
New trees, planted after 1949 .....	240
<b>TOTAL</b>	<b>450</b>

<sup>3</sup> Since, in 1950, the new trees were between one and four years old, and on the assumption that in the first three years 20 million were planted annually, in the last of these years, 1949/50, the number of trees planted would have reached 60 million.

<sup>4</sup> Studies carried out after the 1953 frost were used as a basis for much higher estimates than that given in the text. According to these studies the number of trees planted annually, from 1950 onward, amounted to at least 90 million. In this case, the number of trees existing at the time of the 1953 frost would have totalled about 570 million. This being so, it might be assumed that with very favourable weather conditions yearly production in Paraná could reach 12 million bags. The existence of as many as 680 million trees has been mentioned. However, in the absence of a detailed inquiry, an estimate has been adopted which is based on the few data that are more or less proven, such as statistics of the Ministry of Agriculture and the agricultural census of 1950.

The 1953 frost destroyed a considerable proportion of the newer plantations, and in 1955, when no definite information was yet available as to the recovery and re-planting of the areas affected, another frost caused new and serious damage to the plantations in Paraná. The productive capacity of these plantations over the next few years is uncertain. Any estimate must be based on mere conjecture. The theory can now be advanced that, provided there are no more frosts, in 1956/57 or 1957/58 the Paraná plantations will be able to exceed the average production of São Paulo during the last five years. Thus, given an average production in Paraná equivalent to that of 1952 (1,267 kg. per 1,000 plants), the 450 million trees would be able to produce 9.5 million bags of coffee. These data merely serve as a point of reference. What is now known about the plantations of Paraná is sufficient indication that their productive capacity will probably be seriously affected for two or three years to come.

Although unreliable from several aspects, the data given here are a starting point from which the following facts can be deduced :

(a) Brazilian coffee plantations are being rehabilitated or expanded, although the intensive frosts of 1953 and 1955 greatly affected their productive capacity. Once these adverse effects have been overcome, exportable harvests of 20-22 million bags are a definite possibility.

(b) Despite the great frost of 1955, there is nothing to indicate a shortage of supplies during the next few years. The carry-over from the 1953/54 and 1954/55 harvests is estimated at not less than 6 million bags. Even if the 1955/56 and 1956/57 harvests are as small as in 1953/54, this surplus would be sufficient to prevent a noticeable disequilibrium between supply and demand. However, *mutatis mutandis*, difficulties will not arise from disequilibrium caused by carry-overs from the next three harvests, including that of 1954/55.

(c) There is a potential disequilibrium in the market which may materialize before 1960. It is governed by the existence of large plantations in the State of Paraná which are approaching maturity, a process which is being disturbed and hindered by the recent frosts. Speculation is encouraged by the lack of precise information as to the extent and condition of these plantations.

A rapid review of the present status of the price problem is called for at this stage. Given the inelasticity of the demand for coffee, prices are affected mainly by fluctuations in supply. The Brazilian "price defence" policy mentioned earlier was based upon this elemental fact, which has been confirmed once more by recent experience. Thus, while retail coffee prices paid by the United States consumer rose by 90 per cent between 1947 and 1953 (58 per cent more than the average increase for consumer goods), annual per capita consumption increased from 7.8 to 7.9 kg. This does not exclude the possibility, which was apparently proven in 1954, that if prices are very high, demand begins to show a certain amount of elasticity. However, there is no doubt that at price levels similar to those at present prevailing (between 50 and 60 cents per pound for Santos No. 4), demand appears to be totally inelastic, at least in the principal market.

Demand for coffee is growing slowly and surely, in proportion to the increase in world population. In some regions, per capita consumption is also growing. This can be attri-

buted to an increase in the income of the population or to other factors. At all events, it must always be borne in mind that the growth of demand is a gradual process, and for this reason its influence on prices is of little significance.

The level of coffee prices will therefore be governed mainly by the actual or predicted fluctuations of supply. On the assumption that supply will undergo no basic modifications during the next three years, it is possible that prices will remain at their present levels.<sup>5</sup> This does not mean that such levels are necessarily a reflection of market equilibrium. They became operative after prices had fluctuated widely and are similar to those prevailing during the period of relative stability which followed the liquidation of Brazilian stocks in 1949. The essential point is the inertia of the price level when market conditions remain unchanged.

As changes will probably take place in two or three years' time, the stability of the market may be of short duration. This aspect of the problem is of fundamental importance, since it proves that coffee policy must be based on long-term considerations.

#### 5. POSSIBLE OBJECTIVES OF A COFFEE POLICY

From the preceding observations it is clear that in the case of Brazil the possibility of unilateral action in the coffee market no longer exists. In the past, the main purpose of Brazil's coffee policy was to defend a relatively high price level. Nowadays, the aim is to maintain the country's position in the world market. It is now only too clear that any defence of prices, although fully successful from the standpoint of achieving a short-term increase in income, will inevitably result in a loss of markets for Brazil.

On the other hand, the recovery of markets through the exclusion of competitors would appear fairly impracticable in Brazil's case and would have negative effects over both the short and the long term. Given the inelasticity of supply in nearly all producer countries and the inelasticity of demand in importing nations, a reduction in prices with competitive ends in view would merely involve a transference of income at the expense of Brazil as well as of the other exporting countries. Moreover, since Brazilian costs appear to be just as high as those of its principal competitors (they are probably increasing more rapidly), it is to be expected that a prolonged price decline would, in the long run, bring about a contraction in supply that would be greater in Brazil than in the other exporting countries.

If Brazil were to consider it essential to defend its position by means of a price war, and if such means were to produce entirely the contrary effect, it would not be surprising if the idea that any coffee policy must be based on an agreement among exporting countries were to gain ground.

The most important questions on which this agreement would hinge are the following : (a) world market quotas of main exporters; (b) stabilization of the price level; (c) financing of surpluses; (d) ways of expanding the world market.

The fixing of quotas is a problem which presents some difficulty in the establishment of criteria. It is known that Brazil's share of the world market has recently undergone a substantial decline, owing to weather conditions and to

<sup>5</sup> This study was written at the end of 1954, the three years will thus cover the period until 1957.



the unilateral price policy. However, the fall in Brazilian exports during 1954, although more pronounced than that of other exporters, coincided with a general contraction of world trade. If this abnormal period be discounted, the relative volume of exports approaches that of exportable production in Brazil.

The stabilization of the price level is another question which admits of no easy solution. It has already been noted that demand seems to be virtually inelastic within a fairly wide price-range. It would be without foundation to assert that such and such a price level would be the more suitable—namely, that it would better reflect the equilibrium between uncontrolled supply and demand. Experience shows that during the 1920's the control of supply affected prices, and that these latter were lower during the period 1930-49 owing to the considerable surpluses accumulated in Brazil. It is also known that when these surpluses were sold, prices adjusted themselves and remained more or less stable at the same level for more than three years, that is, until a sharp contraction of supply became likely. It might perhaps be alleged that from the end of 1949 to the beginning of 1953, prices to some extent reflected an equilibrium between demand and supply, since during this period, surpluses were neither liquidated nor accumulated to any great extent, there was no real shortage of the product, and the market operated with a minimum of interference. It would also be possible to cite contrary reasons—for example, that the likelihood of a liquidation of surpluses and a bad harvest in Brazil affected the price level at the end of 1949. However, in this particular field, it is not easy to find arguments which do not conflict. In cases such as this, the solution has always been to accept the price which was prevailing at the time when the agreements were made. For coffee, the favourable circumstance exists that the present price is almost equivalent to that prevailing in the period mentioned (1949-53).

The prospects for the capacity to import should now be considered in the light of the hypotheses formulated on Brazil's share in world trade and on the future level of coffee prices. This question is of fundamental importance to any programme for the economic development of Brazil. For an adequate statement of the problem, a certain amount of conjecture must first be made as to world demand for coffee during the future period under study. As a basis for calculation, recourse may be had to the projection of coffee demand in the United States which was recently made by A. Szarf and Pignolosa.<sup>6</sup> This projection is itself based on coefficients of income-elasticity and prices, on population growth and on a hypothetical stabilization of prices similar to that indicated above. According to this projection, absolute consumption in the United States will increase by 40 per cent between 1953 and 1957.<sup>7</sup>

On the basis of a hypothesis of linear growth, the increase between 1953 and 1962 would amount to 15 per cent. If consumption in all the other importing countries increases with the same intensity as in the United States—a pessimistic

hypothesis, since many of these countries have not yet regained the pre-war level—and if Brazil maintains its 1949-53 share of world trade,<sup>8</sup> by 1962 Brazilian exports will reach 18.9 million bags.

If the exports projected for 1962 are compared with those of 1954 (10.9 million bags), the result is an increase of 73 per cent, which is substantially greater than the increase in the over-all quantum of exports—51 per cent—projected in chapter III of Part One. It so happened that in 1954 coffee exports were abnormally low, and for this reason that year was excluded from the calculation of Brazil's share in the world market. On the basis of the 1953-54 average, the increase of coffee exports would amount to 43 per cent, an increment which is exactly equivalent to that of the over-all quantum of exports, according to the projection cited earlier in the text.

This assumption—exports of about 18.9 million bags at average current prices—is based on the capacity to import required for a development programme in accordance with the over-all plan outlined in Part One, and could quite easily become a reality, always provided that conditions as regards the coffee supply were favourable, and that minimum agreement between the main exporting countries were reached.

But it should be recalled that such favourable conditions may well have disappeared within two or three years. For example, it is possible that, within three years, the exportable surplus may rise to 20 million bags while Brazil's export quota is still about 17 million. If in five years Brazil has three large harvests—within the limits of current productive capacity—, by 1962 the surplus stocks may vary between 10 and 15 million bags, even though exports have remained at the normal levels envisaged in the above plan. There is thus a structural supply problem which must be carefully studied. If measures are not adopted sufficiently far ahead to neutralize the depressive action of the probable surplus, the price stabilization policy will meet with serious practical difficulties.

This problem is closely linked with that of the financing of stocks, to which an earlier reference was made. A policy designed to secure export price stability has its counterpart in another aimed at stabilizing the prices paid to the planter. In this way, a privileged situation may be established for a particular product and may lead to its wider cultivation, as occurred in the case of coffee in the past.

If the absorption capacity of the market is known and the possibility of a price war is excluded, a policy allowing the continued expansion of coffee cultivation when productive capacity is already excessive will completely defeat its own ends. The limiting of the capacity in question to the size of the potential market is a logical consequence of the stabilization policy on which the hypotheses of economic development are based. Nevertheless, experience has shown that this objective is by no means easy to attain.

Perhaps the key to the question lies in the possibility of forecasting the probable surpluses far enough ahead, and in combining the policy for financing production with that of discouraging its expansion. The financing of a large pro-

<sup>6</sup> See Food and Agriculture Organization, "Factors affecting United States Coffee Consumption" in *Monthly Bulletin of Agriculture Economics and Statistics*, Vol. III, No. 10, October 1954, pp. 6-10.

<sup>7</sup> The results obtained from this projection are somewhat inferior to those given in the study on the development prospects of the Colombian economy. However, since, in the case of Brazil, the procedure of formulating hypotheses was relatively more conservative, in the interests of compatibility the hypothetical expansion of world demand for coffee should perhaps be on a more modest scale.

<sup>8</sup> The average figure for Brazilian exports during the five-year period 1949-53 was 16.4 million bags; the peak was reached in 1949 (19.4 million) and the lowest point in 1950 (14.8 million). If the two extremes are discounted, the average figure falls to 15.9 million. On the basis of these data, the projection could be 18.3 million bags.

duction surplus constitutes first and foremost a problem of the internal stability of the system. The purchase of a surplus of 5 million sacks of coffee over a limited period of time necessarily produces a strong impulse towards inflation. If adequate compensatory measures are not taken—and such measures are difficult to put into practice in Brazil—the accumulation of coffee stocks will lead to sharp inflationary pressure. It is quite possible that a policy aimed at neutralizing this pressure may create conditions tending to eliminate the structural problem of the excess productive capacity.

What steps can be taken to avoid inflationary pressures resulting from the financing of coffee surpluses? In other words, how can the flow of income created by the aggregate purchase of the crop be prevented from exceeding the flow of income accruing from coffee exports? This is no new problem in Brazil, even if the circumstances in which it arose were different in the past. The substantial accumulation of stocks in the 'thirties was financed partly by more liberal credit and partly by a system of "sacrifice quotas", under which each planter handed over a share of his crop to the Government. As it was a period of depression, the expansion of credit assumed the characteristics of a timely compensatory policy.

Supposing the hypothesis of inflationary financing—unjustifiable except in very special circumstances—to be discarded, it would not be surprising if the idea of the sacrifice quota were reconsidered. Nevertheless, it should be recalled that while the surpluses of the 'thirties attained such large proportions as to exclude all possibility of their being utilized, the present situation suggests that probable future surpluses will be much easier to dispose of. Within certain limits, such surpluses are necessary for the price stabilization policy. Thus, in the case of the partial loss of the harvest, they can be used to prevent speculation and sharp rises in prices, which tend to cause an uncontrolled expansion of the plantations.

Reflections of this nature raise new aspects of the problem, especially the need to avoid encouraging marginal coffee

production during a period when surplus stocks must be purchased. In this respect, consideration has recently been given in Brazil to the possibility of paying planters only a part of the coffee price in cash and using the remainder to finance surpluses. It is felt in some circles that this solution would have the desired effect upon marginal production. From another point of view, the planters could recover that share of the price which had not been paid previously when the surpluses were sold.

This is not the appropriate place to discuss such a proposal in detail. The only reason for mentioning it is to emphasize how far the principle of coffee control has gained ground in Brazil and how great is the anxiety of some sectors to provide for financing methods which, like the one described, would not have inflationary consequences.

Finally, some reference should be made to the possibilities of expanding world coffee consumption, which are considerable, in relation both to traditional consumers and to the countries where this beverage is little known. From the moment it becomes apparent that a surplus exists in world coffee production, part of it could justifiably be used—as has been suggested on more than one occasion—to publicize the product in areas with a low consumption. The organization and financing of a campaign of this nature presupposes co-operation among the main exporting countries.

But it is in the regions which are traditional consumers of coffee that the possibilities for expansion are clearly substantial. Advertisement aimed at spreading the habit of coffee-drinking is almost non-existent if compared with the publicity given to other beverages, such as soft drinks and tea. It is not a question of giving information about coffee, but rather one of making it readily accessible in possible centres of consumption. This aspect of the problem should be carefully studied, and any practical action taken will require the mobilization of considerable financial resources. Here again no really positive results can be obtained without effective co-operation among exporting countries.

# STATISTICAL ANNEX

Table I. Brazil : Share of coffee in aggregate agricultural income

Year	Value of coffee production <sup>a</sup> (Millions of cruzeiros)	Value of aggregate agricultural production	Percentage of coffee production to total
1939	1,667	8,193	20.3
1940	1,378	7,804	17.7
1941	1,359	8,682	15.7
1942	1,334	9,156	14.6
1943	1,738	12,454	14.0
1944	2,393	17,622	13.6
1945	3,717	19,945	18.6
1946	5,336	26,047	20.5
1947	5,532	29,340	18.9
1948	6,451	34,306	18.8
1949	8,486	40,112	21.2
1950	15,885	51,544	30.8
1951	16,578	56,799	29.2
1952	19,021	69,229	27.5
1953	21,451	86,532	24.8
1954	20,162	93,065	21.7

Source : Ministry of Agriculture, Statistical Service.

<sup>a</sup> Price paid to the planter.

Table II. Brazil : Share of coffee in aggregate agricultural area

Year	Area under coffee (Thousands of hectares)	Aggregate agricultural area	Percentage of coffee to total
1939	3,042	13,839	22.0
1940	2,519	12,914	19.5
1941	2,378	13,320	17.9
1942	2,174	12,542	17.3
1943	2,341	13,793	17.0
1944	2,326	14,960	15.5
1945	2,382	15,276	15.6
1946	2,406	15,611	15.4
1947	2,415	15,854	15.2
1948	2,464	16,219	15.2
1949	2,538	17,021	14.9
1950	2,663	17,775	15.0
1951	2,738	17,873	15.3
1952	2,823	19,000	14.9
1953	2,919	19,603	14.9
1954	2,960	20,535	14.4

Source : Ministry of Agriculture, Statistical Service.

Table III. Brazil : Share of coffee in aggregate export value

Year	Value of coffee exports (Millions of cruzeiros)	Value of aggregate exports	Percentage of coffee to total
1939	2,234	5,616	39.8
1940	1,589	4,961	32.0
1941	2,017	6,726	30.0
1942	1,966	7,500	26.2
1943	2,803	8,729	32.1
1944	3,879	10,727	36.2
1945	4,260	12,198	34.9
1946	6,441	18,230	35.3
1947	7,755	21,179	36.6
1948	9,019	21,697	41.6
1949	11,611	20,153	57.6
1950	15,908	24,913	63.9
1951	19,448	32,514	59.8
1952	19,213	26,065	73.7
1953	21,696	32,047	67.7
1954 <sup>a</sup>	14,813	42,967	34.5

Source : Ministry of Finance, Statistical Service.

<sup>a</sup> Includes bonuses.

Table IV. Brazil : Share of coffee and agricultural production in the formation of income

Year	Income (Billions of Cruzeiros)	Value of agricultural production to income (Percentage)	Value of coffee production to income (Percentage)
1939	32.4	25.3	5.1
1940	34.8	22.4	4.0
1941	40.0	21.7	3.4
1942	45.2	20.2	3.0
1943	56.6	22.0	3.1
1944	73.9	23.8	3.2
1945	86.1	23.2	4.3
1946	111.4	23.4	4.8
1947	142.9	20.5	3.9
1948	159.7	21.5	4.0
1949	181.7	22.1	4.7
1950	211.5	24.4	7.5
1951	251.3	22.6	6.6
1952	299.0	23.1	6.4
1953	347.4	24.9	6.2

Source : Statistical Annex and table 1 in chapter I of Part One.

Table V. Brazil : Share of exportable coffee production

Year	Brazil	Other countries	Total	Percentage of Brazil to total
	(Thousands of 60 kg. bags)			
1925 .....	15,761	7,052	22,813	69.1
1926 .....	18,115	7,068	25,183	71.9
1927 .....	27,624	8,003	35,627	77.5
1928 .....	16,061	8,860	24,921	64.4
1929 .....	28,942	8,273	37,215	77.8
1930 .....	17,419	8,633	26,052	66.9
1931 .....	28,313	8,287	36,600	77.4
1932 .....	19,846	9,239	29,085	68.2
1933 .....	29,634	8,935	38,569	76.8
1934 .....	18,509	7,699	26,208	70.6
1935 .....	20,927	10,028	30,955	67.6
1936 .....	26,359	10,889	37,248	70.8
1937 .....	24,351	10,011	34,362	70.9
1938 .....	23,222	10,125	33,347	69.6
1939 .....	19,138	10,119	29,257	65.4
1940 .....	16,456	12,138	28,594	57.5
1941 .....	15,797	15,596	31,393	50.3
1942 .....	13,613	14,878	28,491	47.8
1943 .....	12,160	15,990	28,150	43.2
1944 .....	9,136	15,020	24,156	37.8
1945 .....	12,701	12,478	25,179	50.4
1946 .....	14,019	13,101	27,120	51.7
1947 .....	13,572	14,270	27,842	48.7
1948 .....	16,952	14,648	31,600	53.6
1949 .....	16,303	14,236	30,539	53.4
1950 .....	16,754	15,966	32,720	51.2
1951 .....	14,962	15,730	30,692	48.7
1952 .....	16,076	16,479	32,555	49.4
1953 .....	15,145	18,010	33,155	45.7
1954 <sup>a</sup> .....	13,900	18,450	32,350	43.0

Source : Instituto Brasileiro do Café.

<sup>a</sup> Estimate.

Table VI. Brazil : Share of exports in world coffee consumption

Year	Brazilian exports	World consumption <sup>a</sup>	Percentage of Brazilian exports to world consumption
	(Thousands of 60 kg. bags)		
1930 .....	15,288	25,729	59.4
1931 .....	17,851	27,947	63.9
1932 .....	11,935	24,560	48.6
1933 .....	15,459	26,318	58.7
1934 .....	14,147	25,292	55.9
1935 .....	15,329	27,110	56.5
1936 .....	14,186	28,478	49.8
1937 .....	12,123	29,894	40.5
1938 .....	17,113	30,013	57.0
1939 .....	16,499	28,728	57.4
1940 .....	12,046	22,504	53.5
1941 .....	11,052	19,550	56.5
1942 .....	7,280	16,210	44.9
1943 .....	10,112	20,212	50.0
1944 .....	13,555	22,705	59.7
1945 .....	14,172	23,994	59.1
1946 .....	15,505	26,391	58.7
1947 .....	14,830	27,533	53.9
1948 .....	17,492	30,339	57.6
1949 .....	19,369	32,911	58.8
1950 .....	14,835	29,310	50.6
1951 .....	16,358	31,429	52.0
1952 .....	15,821	31,964	49.5
1953 .....	15,562	33,771	46.1
1954 .....	10,918	...	...

Source : Instituto Brasileiro do Café.

<sup>a</sup> Excludes consumption of producing countries.

## Chapter III

### TRANSPORT

#### I. EVOLUTION OF TRANSPORT

##### 1. *The various means of transport in the pre-war period*

During the pre-war period, railways and coastal shipping constituted the basic means of transport for freight and passengers between the towns of Brazil. At that time, the motor vehicle was of little significance to the transport sector, and the aeroplane even less.

Railways have not increased in mileage to any great extent since 1939, but a review of the past situation will show why they form a much more cohesive system of transport today.

It has often been remarked that many railways were built in Brazil to provide areas of economic activity in the interior, particularly those producing export commodities, with

adequate means of transport. The fact that such areas were both scattered and isolated was one of the decisive reasons why the railways did not develop as an integrated national network, but as local and almost independent systems.

Such integration as existed, was purely regional. In most cases, each system was built around one or two ports, from which the trunk lines radiated fanwise.

Although the National Transport Plan adopted in 1934 established the bases for linking up the various zonal systems, progress towards the attainment of this objective was slow during that decade. In 1939, in fact, the Brazilian railway network was still divided into seven local systems, with few inter-connexions, and traffic from one to another was very light. (See table 98.)

Table 98. Brazil : Zonal railway systems existing in the pre-war period

<i>Principal railways of each system</i>	<i>Zone served</i>	<i>Principal ports of each system</i>
I. V. F. Rio Grande do Sul .....	Rio Grande do Sul	Porto Alegre
II. R. V. Paraná-Santa Catarina .....	Paraná Santa Catarina	Paranaguá
III. E. F. Santos Judai .....	São Paulo	
Cia. Paulista de E. F. } .....	Minas Gerais (west and south-east)	Santos
E. F. Sorocabana .....		
E. F. Noroeste do Brasil } .....		
Cia. Mogiana de E. F. } .....	Matto Grosso (south)	
IV. E. F. Central do Brasil .....	Minas Gerais (south-east)	São Paulo (south-east)
Rede Mineira de Viação .....	Minas Gerais	Rio de Janeiro
E. F. Leopoldina .....	Espírito Santo (south-east)	
V. V. F. F. Leste Brasileiro .....	Bahia Sergipe Piauí	Salvador
VI. Rede Ferroviário do Nordeste .....	Pernambuco Rio Grande do Norte Paraíba Alagoas	Recife
VII. Rede Viação Cearense .....	Ceará	Fortaleza

*Sources:* Official publications and the Economic Commission for Latin America.

Four products—lumber, coffee, cotton and sugar—contributed approximately one-quarter of the aggregate railway goods traffic. Because these four commodities were carried for a greater average distance than aggregate freight, they represented an even larger proportion of the kilometric traffic than of the tonnage. Apart from the products named, only a few others (petroleum, iron-ore and some building materials) were transported in quantities exceeding half a million tons annually. Taken as a whole, these commodities—including all building materials—amounted to less than 40 per cent of the volume of railway freight.

Goods were mainly transported over relatively short distances, the average being about 200 kilometres.<sup>1</sup>

Coastal shipping filled the gap left by the absence of an integrated railway network, forming a link between the different zones of the country and consequently between the various railway systems. For all practical purposes, the entire trade between the southern and the north-eastern States of Brazil was sea-borne, as well as most of the trade between

<sup>1</sup> There are indications that only a few products were transported for really long distances by land.

neighbouring States. The volume transported in this trade did not exceed 3 million tons annually, but the average run was several times longer than in the case of the railways.

During the 1930s, motor traffic was probably limited to towns and short-distance runs, where it competed with more primitive means of transport; except in small areas such as the district served by the Leopoldina Railway, it was not as yet a serious rival to the railways.

Aviation as a means of passenger transport was at that time in its infancy.

## 2. Traffic development in the post-war period

During the Second World War, the distribution of traffic among the various means of transport did not radically alter, although the railways played a still more predominant part in land transport.

Effective<sup>2</sup> and kilometric<sup>3</sup> traffic increased until the transport of goods stood a little higher and that of passengers much higher than before the war.<sup>4</sup> At the same time, motor transport made scant progress, because fuels and spare parts were in short supply. For various reasons, the increase in the goods carried by ship was only 15.2 per cent between 1939 and 1945.

Shortly after the Second World War, changes in the traffic structure began to occur with marked rapidity. As will be seen in greater detail at a later stage, the years 1946/52 were characterized, firstly by a substantial expansion of road passenger and freight transport and by a rise in the number of passengers carried by air; secondly by a relative stagnation and even a decrease in railway transport; and, finally, by a moderate increase in sea transport.

### (a) Rail traffic

The movement of goods and passengers will be considered separately. During the post-war period, except in 1952, effective goods traffic was maintained at a level lower than the peak reached during the Second World War. The decline was almost universal, since it affected all the rail systems except one.<sup>5</sup>

The evolution of kilometric traffic on Brazil's railways as a whole was exactly opposite to that of effective traffic, inasmuch as it continued to grow at the end of the war. For some railways (those which serve the States of Paraná, Santa Catarina and São Paulo), the growth of kilometric traffic was largely uninterrupted, while other systems displayed an erratic development with a slightly higher average than that of the war years.

If the increment in the volume of freight is compared with the number of tons per kilometre, it becomes clear that the expansion of kilometric traffic was due to the steady lengthening of the average distance covered by rail freight. How

great was this expansion can be appreciated from the fact that kilometric traffic reached 237 kilometres by 1952, whereas in 1945 it had not exceeded 199 kilometres. The origin of the increase in the average run lay not only in the incorporation of more remote areas into the country's economic life, but also in the growing competition from road haulage over short and intermediate distances.

The increase in the number of railway passengers should be emphasized. Even more remarkable is the part played by suburban passenger transport in this traffic. Effective and kilometric traffic, far from ceasing to expand in 1946, continued to increase until they reached their peak, the former in 1950 and the latter in 1951. By 1952, both had risen approximately 9 per cent in relation to 1946.

### (b) Road traffic

No statistical series exists to enable the development of traffic in this sector to be assessed accurately, with the exception of one for lorries licensed or in circulation.<sup>6</sup> According to these figures, the tonnage hauled by such vehicles practically doubled between 1946 and 1953. It is not possible to determine from the available information what share of this increase represents road transport over short distances or in towns.

If the changes in the traffic density on federal and state roads are examined, the expansion of lorry transport is seen to be greater than suggested previously. Table 99 shows that, at five check points on four federal highways, substantially larger increases were observed in the traffic density than in the number of lorries in the country,<sup>7</sup> and that, even at the points where the density rose least, the percentage of increase was still appreciable.

Table 99. Brazil : Index of daily average density of lorry traffic on federal roads and index of lorries in circulation, 1953  
(1948 = 100)

Federal highways	Check point	Index
Rio-Bahia .....	Teófilo Otoni	185.7
	Gov. Valadares	243.1
	Areal	527.3
Rio-Belo Horizonte .....	Paraibuna	280.3
	Itaipava	518.4
São Paulo-Curitiba .....	Aruba	176.1
Lajes-P. Alegre .....	Caxias do Sul	175.5
	São Leopoldo	416.2
Number of lorries .....		199.5

Source : Departamento Nacional de Estradas de Rodagem.

Whatever may have been the exact increase in the volume of transport, expert opinion is agreed that lorries have begun to compete with the railways in transporting all kinds of goods, including those usually considered as typical rail freight. The data in table 100 prove, at least in one specific case, that this judgement is correct.

<sup>2</sup> Effective traffic is measured in tons transported.

<sup>3</sup> Kilometric traffic is expressed in tons per kilometre.

<sup>4</sup> Kilometric traffic increased by 55.9 and effective traffic by 50.0 per cent between 1939 and 1945.

<sup>5</sup> The extreme example of the drop in freight volume took place in the rail system serving the State of Rio Grande do Sul. The difference between the maximum and minimum figures registered (for 1946 and 1952 respectively) was close to 25 per cent. Another railway in southern Brazil constituted a striking exception, since its effective traffic was reached in 1948, and has subsequently maintained a higher level than in any previous year.

<sup>6</sup> The accuracy of this series is examined in section III of the Appendix to this chapter.

<sup>7</sup> In the case of the index of freight transport, the relation of the number of vehicles to the volume of freight and to the tonnage per kilometre is examined.

Another aspect of the increased road transport which must not be overlooked is the rise in the average distance covered by lorries since 1946. In reality, there is no statistical evidence on this subject except data on the growing participation of lorries in inter-State trade.

Table 100. Brazil : Share of selected products in the freight tonnage transported by the Sorocabana Railway and by lorries operating on a parallel road  
(Percentage of total weight)

Product	Road <sup>a</sup>	Railway <sup>b</sup>
Sugar .....	1.5	1.0
Cotton .....	1.5	0.8
Potatoes .....	7.6	1.1
Lime .....	2.2	3.5
Coal .....	3.6	0.4
Beans .....	8.4	2.6
Gasoline .....	3.1	0.6
Lumber .....	2.1	0.8
Fuelwood .....	12.2	18.8
Maize .....	2.3	7.0
Stone .....	2.8	3.4
Bricks .....	2.6	0.9

Sources : Basic data obtained from a survey carried out by the Departamento Estadual de Estradas de Rodagem (São Paulo) and from the Report of the Sorocabana Railway for 1952.

- <sup>a</sup> 1953 data.
- <sup>b</sup> 1952 data.

### (c) Sea-borne traffic

Maritime freight transport increased, during the period 1946-52, at an annual rate of 4.5 per cent, despite the limited number of craft available. This progress certainly represented an appreciable improvement over the rate of growth during the previous seven years, but not in relation to the average rate of expansion during the last quarter of a century.

### (d) Distribution of traffic among the various means of transport

One estimate places the traffic volume handled by coastal shipping in 1950 at 8 billion ton-kilometres. In the same year, railways carried an identical load. If it is assumed that half the number of lorries in circulation are used for inter-urban freight transport and that the average volume of goods per lorry reaches 84,000 ton-kilometres annually (in accordance with the estimate in section IV of the appendix to this chapter), then the traffic volume of road freight transport is 8.1 billion ton-kilometres.

It is common knowledge that urban and inter-urban (or long-distance) transport by lorry expanded rapidly once the Second World War was over. There can be no doubt that the development of Brazil's economy provided the basic impetus to progress in the road transport sector. Nevertheless, the following factors certainly helped to give an additional stimulus to the expansion during 1946-52 : (a) the restricted transport capacity of the railways and coastal shipping; (b) the moderate increase in road transport freight rates, owing, among other causes, to the stability in the rate of exchange during this period; and (c) the development of areas not served by the railways—that is, where a gap in the railway network existed.

In sections I and II of the appendix to this chapter, the first two factors are examined in greater detail.

## II. PROJECTION OF THE VOLUME OF TRANSPORT

### 1. General considerations

It is a commonplace that the aggregate tonnage of goods hauled and the average distance over which they are moved are the immediate—though not the final—determinants of the volume of transport in a given country. The problem of calculating the future volume of transport may therefore be solved by projecting what have been called “immediate determinants”. Such projections demand an exact knowledge of the ratio, in the particular case under consideration, between the total tonnage hauled and certain basic variables of the system, and between these or other variables and the average length of haul.

Unfortunately, research in this field has not yet proceeded beyond the stage of generalizations. In most cases the problem has been solved by assuming that the volume of transport grows or diminishes with greater intensity than income, or, in other words, that the demand for transport, like that for other services, is elastic in terms of income.

In reality, a complete projection of the volume of transport would involve studies on the location of economic activity and on the interrelation of the volume (and structure) of domestic production of goods with the total tonnage hauled—studies which, by their nature and complexity, are outside the limited scope of this chapter. It was therefore decided to use the projection of the demand for transport<sup>a</sup> detailed in the following pages. The starting-point was the relation in Brazil, during the period 1939-53, between the traffic volume and certain variables which will be identified at the appropriate time.

The available data did not permit the kilometric traffic index of the country's various means of transport to be calculated. Instead, it was necessary to prepare and work with an index of effective traffic which is a less accurate measure of transport activities. This index was worked out by combining three series—goods tonnages transported

Table 101. Brazil : Index of the volume of freight transported  
(1939 = 100)

Year	Railway freight	Lorries in circulation	Coastal shipping freight	Total index
1940 .....	103.8	112.7	102.6	106.3
1941 .....	104.5	123.5	111.2	111.9
1942 .....	105.8	115.6	105.4	108.7
1943 .....	112.1	118.4	98.8	111.2
1944 .....	117.7	125.4	114.9	119.6
1945 .....	113.7	128.5	115.2	118.7
1946 .....	112.0	131.5	121.8	120.2
1947 .....	109.6	155.1	115.9	125.2
1948 .....	108.7	193.9	136.5	141.5
1949 .....	107.2	224.0	138.8	150.8
1950 .....	108.9	256.8	144.9	163.2
1951 .....	119.2	281.1	165.1	180.0
1952 .....	120.4	327.5	163.0	194.7
1953 .....	113.8	386.8	166.0	210.9

Sources : Estatística das estradas de ferro do Brasil, Departamento Nacional de Estradas de Ferro, Ministério de Viação e Obras Públicas, *Boletim de estatística e informações*, Comissão Executiva de Defesa da Borracha e Comércio de Cabaçagem do Brasil, Serviço de Estatística Econômica e Financeira, Ministério da Fazenda.

<sup>a</sup> The aggregate projection was restricted to the carriage of goods.

by rail;<sup>9</sup> the number of lorries in circulation; and cargo tonnage transported by coastal shipping. (See table 101.)

## 2. Evolution of the index of freight volume<sup>10</sup>

The freight volume rose almost continuously during the period 1939-52, at a moderate rate in the war years and with marked intensity during the post-war period. The average annual rate of increase was 5.3 per cent.

The relative increment between the first and the last years amounted to 94.7 per cent.

Table 102 shows that there is some relation between the variations in the index of freight volume and those of the indices of domestic production<sup>11</sup> and goods in circulation.<sup>12</sup> Two well-defined periods are apparent that—of the war, when the relation was less distinct, and the post-war years, when it was very clear.

Table 102. Brazil : Annual percentage variation of the indices of freight volume, domestic goods production and goods in circulation

Year	Volume of freight	Domestic goods production	Goods in circulation
1940 .....	6.3	-2.5	-4.1
1941 .....	5.3	7.9	7.0
1942 .....	-2.9	-5.8	-8.5
1943 .....	2.3	6.8	9.5
1944 .....	7.6	1.6	3.3
1945 .....	-0.8	2.2	1.9
1946 .....	1.3	11.7	11.9
1947 .....	4.2	1.8	9.6
1948 .....	13.0	7.1	3.6
1949 .....	6.6	2.2	3.0
1950 .....	8.2	10.9	10.8
1951 .....	10.3	3.0	10.3
1952 .....	8.2	5.6	1.8
<i>Average</i>			
1940-52 .....	5.35	4.04	4.62
1946-52 .....	7.40	6.04	7.29

Sources : Volume of freight : table 101; domestic goods production : agricultural and industrial production at 1949 prices; goods in circulation : domestic goods production plus imports at 1949 prices.

It may be seen that during the period 1939-52 the annual variation of the three indices followed the same trend, whether upward or downward, except in 1940 and 1945. The volume of freight index is also shown to have risen, on an average, at a higher annual rate than the other two over any part of this period which may fairly be considered representative. It may therefore safely be asserted that the elasticity of the freight volume was higher than unity in terms of domestic production, and close to it in relation to goods in circulation. Since it has previously been shown that kilometric traffic grew more than effective traffic, the inference may be drawn that in Brazil the elasticity of the demand for transport in terms of domestic production of goods or of goods in circulation exceeded unity in 1939-52 by a relatively wide margin,

<sup>9</sup> The basic data refer to thirteen railways, the traffic on which represents over 90 per cent of the total.

<sup>10</sup> See section III of the Appendix for comments on the method used to calculate the index of freight volume.

<sup>11</sup> This is an index of total real production of agriculture and industry.

<sup>12</sup> The term "goods in circulation" refers to the index formed by domestic production and the quantum of imports.

which, however, cannot be accurately determined. Moreover, the data accumulated demonstrated that the elasticity of the demand was greater in relation to the first variable, that is, domestic production of goods, than in relation to the second. (See again table 102.)

This conclusion is not surprising, at least in the case under review. It is well known that Brazil's centres of economic activity and population are situated on a fairly narrow coastal strip with many ports open to world traffic. For this reason, the average distance over which imported goods are carried from point of arrival to final destination is short.

Broadly speaking, if the distance covered is not to be greater in transporting a domestic product, particularly a manufactured article than in delivering a similar imported commodity, a number of conditions, which it is exceptional to find in conjunction, would have to be present. First, the centres of domestic production would have to be no farther away from the corresponding centres of consumption than are the ports receiving foreign merchandise, and, if possible, they should be even nearer. Moreover, the ratio between the volume of production at domestic supply centres and the consumption of the population groups concerned would have to be equal to or less than the ratio between the volume of goods from abroad arriving in each port and the consumption zone it serves. Finally, raw materials for industry and other activities should be available on the spot, so that no transport would be required in this connexion.

## 3. Effects of development upon transport

The steel mill at Volta Redonda provides an interesting—although extreme—example of the influence on the transport system exerted by import replacement. During the three-year period 1951-53, this mill utilized from 3.5 to 3.7 tons of raw materials to produce one ton of rolled products; and the average distance over which these raw materials were transported was more than 290 kilometres, so that each ton of rolled products manufactured at Volta Redonda represented an increase of more than 1,000 ton-kilometres in Brazil's total volume of transport. This figure shows the indirect impact on land transport only, since neither the shipping of domestic coal nor the transport of finished products by sea was taken into account. (See table 103.)

Table 103. Brazil : Rail transport of raw materials consumed at Volta Redonda

Raw materials	Consumption per ton of rolled products <sup>a</sup> (kilogrammes)	Average distance (kilometres)	Total transport at 1953 production <sup>b</sup> level of (millions of ton-kilometres)
Iron ore .....	1,585	425	243
Domestic coal .....	372	275	93
Imported coal .....	806	145	128
Smelting agents .....	480	160	27
Others <sup>b</sup> .....	184	200	13

Sources : Relatório da Directoria 1951, 1952 and 1953, Companhia Siderurgica Nacional; and Relatório de la Comissão Executiva do Plano Siderurgico Nacional 1940-41.

<sup>a</sup> Average for the years 1951-53.

<sup>b</sup> Excluding tin, zinc, fuel oil and sulphuric acid.

The only information on finished products refers to the geographic distribution, by large areas, of sales of steel and



blast-furnace by-products. Most of the steel—86 per cent in 1952—is normally absorbed by the Federal District and the States of Rio de Janeiro and São Paulo. Volta Redonda is 145 kilometres and 345 kilometres from the Federal capital and São Paulo respectively.

Even if a large share of the finished products dispatched to these destinations were for industries situated at intermediate points on the route from the mill to the cities of Rio de Janeiro or São Paulo, the average distance would probably not be less than 125 kilometres. Since sales to these cities and to the corresponding states amounted to 300,532 tons in 1951, the transport of rolled products must have amounted to at least 38 million ton-kilometres. If the ton-kilometres of products sold to other areas are added, the total rises to about 45 million ton-kilometres.<sup>13</sup>

The aggregate contribution of Volta Redonda to transport (at the 1952 level of production) was more than 550 million ton-kilometres, raw materials accounting for slightly over 505 million. If the same tonnages of rolled products had been imported, the corresponding volume of transport would have fluctuated between 10 and 15 per cent of the 1952 aggregates.<sup>14</sup>

Many examples could be given of the effect upon the demand for transport of substituting domestic production for imports, but a more detailed analysis is not justified at this stage. The basic question, which must be clarified, is that of the probable value of the coefficient of the elasticity of demand for transport, in terms of goods in circulation.

#### 4. The demand for transport

When the projection of demand for transport was mentioned earlier, it was shown that in recent years its growth was more intensive than that of goods in circulation. It was also noted that the value of the coefficient of elasticity could not be accurately assessed. Meanwhile, it may be assumed that this coefficient will tend to rise once domestic production begins to expand more markedly than imports. One aim of this study is to establish a coefficient of 1.3 in the elasticity of demand for transport services, in terms of goods in circulation. But this assumed value of the coefficient is very conservative; in fact, it would be more accurate to say that it is the absolute minimum.

Under the hypothesis of a minimum rate of growth it is foreseen that between 1953 and 1962 domestic production (at 1952 prices) will rise from 360.9 to 592.8 billion cruzeiros and that imports will increase from 55 to 59 billion. Goods in circulation will therefore expand from 415.2 to 651.8 billion cruzeiros, that is by 56.7 per cent, or at an annual rate of 4.5 per cent. If the elasticity of the demand for transport is 1.3, its annual rate of growth will probably be about 6 per cent. This problem being settled, there still remains the question of defining the rate or growth of the demand for the different means of transport.

This is one of the most difficult questions to solve because of its complexity and the lack of basic statistics. An objective estimate of the future evolution of partial demand would have to be based on a detailed investigation of the degree of competition among the various means of transport. *Inter alia*, a study would thus have to be made of the structure and level of existing rates, as well as of the composition of the loads hauled by each means of transport and of the distances covered. Furthermore, future developments in each form of freight transport would have to be projected. In practice, this projection would be the key to calculating the rate of growth of partial demand.

In a preliminary study such as this, for the sake of simplicity, work must obviously be based on the hypothesis that partial demand will grow at the same rate as aggregate demand. (See table 104.)

Table 104. Brazil : Annual rate of growth of transport  
(Percentages)

Year	1939-52	1946-52	Projection 1953-62
Rail loads <sup>a</sup> .....	2.30	2.0	6.0
Sea freight <sup>b</sup> .....	3.74	4.5	
Number of lorries .....	10.15	16.7	

Sources : Official publications and Economic Commission for Latin America.

<sup>a</sup> Ton-kilometres.

<sup>b</sup> Tons.

If this hypothesis is adopted, it must be recognized that the rate of expansion of road transport will decrease in coming years and that the reverse will occur for the railway and shipping sectors, as shown in table 104. It seems fair to add that such an assumption is not entirely improbable in view of the conditions under which road transport has developed and the changes which are likely to occur during the next ten years.

One of the main reasons for the expansion of road transport was the limitation of the effective transport capacity of the railway system and of coastal shipping. This stimulus will become weaker as the programmes prepared a short time ago for re-equipping and improving these two means of transport are implemented, a development which will probably cause a substantial increase in the goods capacity of both railways and coastal shipping before 1962.

An additional possibility is that freight tariffs by road will rise in the near future at a relatively higher rate than railway charges. Firstly, the investment planned for the railway sector will result in lower real costs or will help to prevent an undue rise in monetary costs.<sup>15</sup> In the lorry sector this phenomenon will not acquire comparable magnitude, even if the process of improving and paving Brazilian highways is accelerated.

Secondly, adjustments of the exchange rate since the establishment of a system for auctioning foreign exchange will tend to cause a relative increase in the real unit costs of motor transport. The changes which have occurred in the past few years have been substantial. To cite one example, dollar quotations for lorry imports rose from 18.72 to 151.40 cruzeiros

<sup>13</sup> This figure does not include sea transport of rolled products sold to the north-eastern and southern states, nor the transport of blast-furnace by-products.

<sup>14</sup> The calculation is based on the hypothesis that industries which consume steel are located in the same areas as at present, even when the steel used is imported, which is doubtful. A more rational assumption would reduce the transport content of imported rolled products even further.

<sup>15</sup> This also applies to investment in coastal shipping.

between 1952 and December 1954, while those for petrol increased from 18.72 to 88.72 cruzeiros between 1952 and March 1955. The modifications in the exchange rates applicable to various categories of imports which directly influence unit costs of road transport probably caused the latter to double between 1952 and the beginning of 1955. Cost increments in the railway sector arising from the same cause cannot have exceeded 25-30 per cent.

Even if the future growth of railway goods rates were assumed to outstrip that of unit costs, in other words, even if in the near future the gap observable in the post-war period between the former and the latter were to be bridged, the increase in railway rates would still be less than that of lorry tariffs, to judge by present experience. It is clear that if this prediction comes true, the competitive position of road freight transport will become weaker.

Finally, another element that will contribute to a greater expansion of railway freight traffic in 1952-62 is the relative increase in the flow of such commodities as raw materials for heavy industry, which, given their bulk and low value, can be better transported by rail.

### III. PROJECTIONS FOR THE RAILWAY SECTOR

#### 1. Demand for railway freight services

The annual average rate of growth of 6 per cent assumed in this study for the demand for railway freight services is

equivalent to the average rate of increase of the effective volume of freight calculated in partial projections by the Joint Brazil/United States Economic Development Commission. The method of calculation<sup>16</sup> differed from that used here.

The average annual rate of increase corresponding to the various projects of the Joint Commission was estimated by grouping individual projections of the volume of freight for ten of the thirteen main railways of Brazil. As the base year is not clearly identified in these projects, it was decided to make two calculations; one for 1951-56 and another for 1952-57. Results were virtually the same in both cases; for the first, the relative increase during the five-year period was 38.5 per cent and for the second, 39.7 per cent. (See table 105.)

The estimates of the Joint Commission cover effective traffic, that is tons of freight transported, and not kilometric traffic. None of these studies refers to the average distance covered, so that this factor was assumed as constant. Clearly, in this case the annual rate of growth estimated by the Joint Commission is equally applicable to both forms of transport. This justifies the comparison made, since the demand for transport, as noted earlier, is related to the volume of kilometric, not effective, traffic.

<sup>16</sup> This consisted in making separate calculations of the future volume of freight for each railway, on the basis of a projection of the tonnages available for transport of the most important freight items carried on each line.

Table 105. Projection of volume of rail freight  
(Thousands of tons)

Railways	1951	Projection for 1956	1952	Projection for 1957
Cia. Mogiana E. F. ....	1,107	1,807	994	1,694
E. F. Central do Brasil ....	4,540	6,640	4,396	6,496
E. F. Noroeste ....	780	1,130	790	1,140
E. F. Sorocabana ....	4,140	5,283	4,813	6,141
Leopoldina Railway ....	2,033	2,413	1,947	2,317
Rede Mineira de Viação ....	794	1,251	715	1,172
Rede Viação Cearense ....	351	351	308	308
R. V. Paraná-Sta. Catarina ....	1,992	3,078	1,985	3,071
V. F. Federal Leste Brasileiro ....	248	400	215	400
V. F. Rio Grande do Sul ....	1,579	1,979	1,420	1,820

Sources: Various projects prepared and published by the Joint Brazil/United States Economic Development Commission.

In accordance with the annual rate of increase in demand estimated in this study, the ton-kilometres of payload transported by the Brazilian railways will increase from 8.48 millions in 1952 to 15.20 millions in 1962. The rate of growth of ton-kilometre gross weight will probably be less intensive. This is because no constant ratio exists between payload and gross weight. Modifications occur when there is an increase or a decrease in the degree of utilization of the capacity of the goods trucks or when the former remains constant and the average capacity alters. The history of twelve Brazilian railway systems suggests that considerable changes in this ratio have taken place in the past.

In 1939, these twelve railways transported 1.27 ton-kilometres of deadweight per ton-kilometre of payload; by 1951 this ratio was 1.05 to 1. No precise data are available on the

average capacity of goods trucks and their degree of utilization over these years. Between 1930 and 1951, however, average capacity rose from approximately 21 to more than 27 tons, while the degree of utilization was intensified.<sup>17</sup>

The average capacity of goods trucks is tending to grow in Brazil. According to plans for rolling-stock purchases—some of which are already being implemented—this capacity will expand to about 33 tons. The effect of the change on the deadweight/payload ratio will be considerable, to

<sup>17</sup> In reality, the rate of relative increase was the same for the tonnage transported per goods wagon as for average capacity, from which it might be inferred that the degree of utilization was the same in both years. The average annual distance travelled by loaded goods truck, however, increased from 84,500 to 149,600 kilometres. This was the cause of the improvement in the degree of utilization.

judge both from past experience and from the specific example provided by one railway. In 1952, the goods trucks on this railway averaged 31.2 tons capacity and transported only 0.89 ton-kilometres of deadweight per ton-kilometre of payload.

In the light of these facts, it seems reasonable to assume that by 1962 the ratio of deadweight to payload will drop to about 0.85 to 1. From this coefficient it can be estimated that the goods services of the Brazilian railways will transport 28.1 billion ton/kilometres of gross weight in 1962.

## 2. Demand for railway passenger services

The projection of goods services must be completed with estimates of passenger transport to calculate railway traffic as a whole with a reasonable degree of accuracy. The problem

cannot be solved by applying the rate of growth already computed, since the same variables do not affect both types of traffic. Passenger traffic must therefore be projected separately.

For reasons which will become evident in the text, it is advisable from the outset to distinguish between suburban passenger traffic and passenger transport between towns. The bulk of suburban traffic is concentrated on the Central do Brasil system, or more accurately on its section linking Rio de Janeiro with surrounding urban districts. This railway transported 70 per cent of Brazil's suburban passengers in 1945 and 65 per cent in 1952. Next in importance are the Leopoldina Railway, which also services the city of Rio de Janeiro, and the Santos-Jundiaí Railway in São Paulo. These three together absorbed 90.9 of Brazil's aggregate suburban passenger traffic in 1945 and 88.8 per cent in 1952. (See table 106.)

Table 106. Brazil : Passenger suburban traffic on selected railways and other lines

(Millions)

Year	Rio de Janeiro				São Paulo		Rest of Brazil*	
	F. Central do Brasil		F. Leopoldina		Santos-Jundiaí		Others	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
1945 .....	148.6	2,832.3	31.0	200.4	13.5	129.0	19.3	267.6
1946 .....	158.7	3,153.7	30.2	301.6	12.0	114.6	21.2	288.5
1947 .....	172.8	3,365.7	25.5	255.4	13.2	125.9	23.4	326.6
1948 .....	179.0	3,485.8	23.3	233.1	19.5	186.7	22.7	330.5
1949 .....	194.4	3,770.2	25.9	277.9	21.6	201.3	23.6	354.8
1950 .....	189.5	3,666.9	28.3	306.2	24.1	243.8	24.3	370.2
1951 .....	177.1	3,496.7	29.2	315.1	26.3	268.0	25.8	389.9
1952 .....	161.5	3,109.4	30.5	334.6	28.8	296.3	28.8	417.7
1953 .....	157.5	3,400.1	33.0	365.3	32.6	361.4	29.1	447.2

Sources : Official publications and Economic Commission for Latin America.

(A) Passengers; (B) passengers-kilometres.

\* Includes the Corcovado Railway, which is in Rio de Janeiro.

Projections for the Central do Brasil and the Santos-Jundiaí Railways will not be presented at this point, since both will be examined later in some detail.<sup>18</sup> It is only necessary, therefore, to estimate the future volume of suburban traffic for the Leopoldina Railway and the other Brazilian railways.

The data in table 106 show that, after three years of recession and four of recovery, the number of suburban passengers transported by the Leopoldina Railway was practically the same in 1952 as in 1945. Nevertheless, the average distance (and therefore the passenger-kilometres) rose appreciably. These constant figures for traffic on the Leopoldina Railway were registered at a time when alternative means of transport, particularly motor vehicles, were expanding rapidly. Both in this case and in that of the Central do Brasil, this stagnation is attributable to restricted capacity. According to competent authorities, the main problem lies in the lack of passenger coaches on suburban lines, a difficulty which is being overcome.

No data are available on the number of passengers using the other means of transport to and from the suburbs served by the Leopoldina Railway. Without this basic information a reasonable hypothesis on the growth of traffic is all that

can be furnished. It was assumed that the population of the area which the railway serves will increase at the same rate as that of Rio de Janeiro between 1940 and 1950 and that the number of passengers will increase proportionately, that is, by 3 per cent annually. Thus suburban passenger traffic on the Leopoldina Railway will rise to 41.8 million by 1962. Given the same average run as in 1952, a volume of 460 million passenger-kilometres will result.

On the other railways, suburban traffic rose from 19.1 to 27.3 million passengers during 1945-52, or, in other words, at a rate of about 1.1 million passengers annually. As a first estimate, it will be assumed that expansion will continue during 1952-62 at the same rate as during the early post-war years. By the end of the period there will be 38.5 million suburban passengers travelling by those railways which were not studied separately. These projections, together with the calculations made for the Central do Brasil and Santos-Jundiaí railways, are outlined in table 107.

The estimated volume of traffic in terms of ton-kilometres of gross weight must now be defined.

In 1939, Brazilian railways transported 9.3 ton-kilometres deadweight per 10 passenger-kilometres. Since the average weight of a passenger is estimated at 70 kilogrammes, the

<sup>18</sup> See sub-section 7 in the present section, where demand for energy and lubricants is analysed, and, in particular, sub-section 5 in section V of the Appendix to this chapter.

Table 107. Brazil : Projection of suburban passenger traffic (Millions)

Railways	1952 Passengers	Projection 1962 *	
		Passengers	Passenger/ kilometres
Central do Brasil <sup>b</sup> .....	161.5	231.5	4,630.0
Santos-Jundiaí .....	28.8	55.0	610.0
Leopoldina .....	30.5	42.0	460.0
Others .....	27.3	38.5	686.0
TOTAL ...	248.5	353.5	6,386.0

Sources : Official publications and Economic Commission for Latin America.

\* The average distance covered in 1962 is assumed to be the same as in 1952.

<sup>b</sup> Includes traffic on electrified and non-electrified tracks.

ratio between ton-kilometre deadweight and ton-kilometre payload (for passenger service) was about 13.3 to 1 in that year. Some years later (1946) it had dropped to 10.2, largely as a result of more efficient utilization of passenger-coach capacity. In 1951, it rose again to 12.2. These ratios apply mainly to inter-urban passenger traffic, since the calculation excluded the Central do Brasil, the railway which carries most suburban passenger traffic. The ratio is lower when rail-cars or the so-called "electric train units" are used. The combination of isolated data made it possible to determine that in 1946 the ratio was 7 to 1 in the suburban service of the railway which employs this type of train.<sup>19</sup>

It is very probable that in the course of the next eight years all suburban passengers will travel in rail-cars or electric trains. If this objective is reached, it will be possible to maintain the ratio of deadweight to payload at 7 to 1. In this case, it is easy to calculate that suburban rail traffic will represent 3.09 billion ton-kilometres deadweight, which, added to the 440 million ton-kilometres of payload, will give a total of 3.53 billion ton-kilometres gross weight.

Table 108. Brazil : Inter-urban and suburban passenger railway traffic, 1945-52 \* (Millions)

Year	Suburban traffic		Inter-urban traffic	
	Passengers	Passenger/ kilometres	Passengers	Passenger/ kilometres
1945 .....	212.4	3,429.3	68.1	5,316.1
1946 .....	222.1	3,858.4	73.8	5,462.2
1947 .....	235.0	4,073.7	73.2	5,520.1
1948 .....	244.8	4,236.1	71.1	5,200.1
1949 .....	285.5	4,604.3	68.7	5,169.3
1950 .....	266.2	4,587.1	71.1	5,471.0
1951 .....	258.5	4,469.8	76.6	6,062.7
1952 .....	248.5	4,158.2	75.0	6,148.9
1953 .....	252.2	4,573.0	76.2	6,513.5

Sources : Various statistical publications of the Estradas de Ferro do Brasil, the Departamento Nacional de Estradas de Ferro, and the Ministério de Viação e obras Públicas.

\* Does not include thirteen railways whose aggregate traffic is insignificant.

The development of suburban passenger traffic was uneven during the post-war years. Although there was a substantial increase in the number of passengers during 1945-46, in the

<sup>19</sup> Utilization of train capacity, reasonable in 1946, afterwards became exceptionally high. It should be noted that reference is made to units in effective service and not to utilization of availabilities.

next four years the figures fell again to the 1945 level. This contraction was caused partly by increased competition from motor vehicles and airlines and partly by shortcomings in rail services. The recovery which took place after 1950 may be attributed to the fact that certain railways introduced modern rolling stock and faster trains; in other words, there was a modest attempt at remedying some of the deficiencies.

It may be assumed that the number of inter-urban passengers will increase by 2.5 million annually, a rate which is exactly equivalent to that of 1949-52. By 1962, the number of passengers will have risen to 100 million and the number of passenger-kilometres to 8.2 billion.<sup>20</sup>

The deadweight payload ratio will tend to decline as old passenger coaches are gradually replaced by the modern steel type; by 1962, it may even have fallen to 9 to 1. If this forecast proves correct, the railway inter-urban passenger services will carry 5.740 billion tons of gross weight.

### 3. The over-all demand for rail transport

To complete the projection for railway traffic, it was assumed that the volume of luggage transported will increase at the same rate as the number of passengers—namely, by 33.3 per cent—and that the deadweight payload ratio will as in 1946 reach 5 to 1, the lowest ever recorded in Brazil.<sup>20</sup>

It was further assumed that by 1962 livestock traffic will have increased to 4.7 million head,<sup>21</sup> the peak level for 1945-52, and that for each ton/kilometre of payload carried, 1.8 ton-kilometres of deadweight will be transported.<sup>22</sup>

Table 109. Brazil : Projection of railway traffic, 1952-62 (Millions of ton-kilometres)

	Payload		Deadweight	
	1952	1962	1952	1962
Goods .....	8,487	16,200	17,398	28,100
Passengers :				
Suburban .....	291	441	...	3,530
Inter-urban .....	430	574	...	5,740
Luggage .....	214	285	1,515	2,020
Livestock .....	498	589	1,648	1,650
TOTAL ...	9,920	17,089	...	41,040

Source : Official publications.

Table 109 summarizes the projections for railway traffic. If these estimates are to materialize, certain improvements will have to be made in fixed installations and in the availability of rolling stock and locomotives. Increased traffic will necessitate substantial investment (given existing conditions on Brazilian railways), and if this is not forthcoming, it is very probable that road transport will continue to expand at a rate comparable to that of 1946-52.

### 4. Estimate of locomotive shunting time

The projection of the number of locomotive shunting hours, a pre-requisite for calculating locomotive demand

<sup>20</sup> It was assumed that the average distance covered will be the same as in 1952—namely, 82 kilometres.

<sup>21</sup> Average distance run and average weight of livestock remain the same.

<sup>22</sup> The 1946 ratio of 1.94 to 1 was the lowest recorded during the period 1939-52.

and fuel consumption, can be based only on very scanty data. The sole item of interest is that from 1939 to 1946 locomotive shunting increased relatively more than the tons of gross weight transported. Although this fact refers specifically to the distance covered by locomotives, the same observation is applicable to the number of working hours.

If the ratio indicated in the previous paragraph is not the result of mere coincidence, at first glance it might be concluded that the number of shunting hours worked by the locomotives increases or decreases at the same rate, relatively speaking, as the gross kilometric traffic.

Statistics show that in 1951 ten railway companies spent 2.4 million hours in shunting operations. The distribution by type of locomotive, was as follows: diesel, 128,000 hours; electric, 153,000 hours; and steam, 2.2 million hours. The volume of traffic on the railways included in the sample represents about 65 per cent of the total for the country as a whole, a percentage which is assumed to be the same for shunting hours. According to this hypothesis, the time consumed in the latter operation by all railway locomotives amounted in the aggregate to 3.4 million hours. To judge from partial data, shunting occupied approximately the same amount of time as in 1952.

Between 1952 and 1962 the number of ton-kilometres of gross weight will increase by about 39 per cent.<sup>23</sup> On the assumption of an equivalent relative increase, total shunting hours will rise from 3.4 to 4.7 million.

#### 5. *Distribution of traffic and shunting among the different forms of traction*

##### (a) *Electric locomotives*

The volume of traffic which electric locomotives must handle grows with the electrification of additional lines, and, even when there is no development in this direction, the demand for rail services increases in areas where such traction is available. The probable effect of the first factor can easily be assessed, if electrification plans and the volume of traffic on the sections to be electrified are known. An evaluation of the influence of the second factor is a more complex matter, since the regional demand for transport must be projected.

As this problem cannot be thoroughly investigated, it was decided to examine the factors tending to delay or accelerate both the growth of traffic on some electrified lines and the electrification plans of the various railway companies. Section V of the Appendix provides details of the plans and analyses the factors influencing an increase in traffic. As regards the electrification programme, the best that could be postulated would be the electrification of some 916 kilometres in 1954–62, from a planned total of 1,694 kilometres.

To project the volume of traffic on those lines which are already electrified or which it is planned to electrify, although this is still uncertain, data are essential on the payload and gross weight for both goods and passenger traffic on each line. The statistics at present available are far from meeting these minimum requirements, as they refer only to gross weight kilometric traffic.

Since it is impossible to separate passenger from goods traffic, it was decided to apply the rate of growth which, in fact, should be used only for goods traffic, to the ton-kilometres of total gross weight. But, according to forecasts, the number of passengers and the gross weight will increase less than the volume of goods and the payload, respectively. This suggests that the method of projection leads to an over-estimate of the volume of the transport falling to the share of electric locomotives. Section V of the Appendix provides a basis for assessing the future traffic on electrified lines in Brazil. As will be seen in some cases, it was necessary to use indirect and conjectural methods of calculation. The following are the conclusions reached for each of the railways concerned.

On the *Santos-Jundiaí* Railway it was assumed that the volume of goods—excluding petroleum and its derivatives—will increase by 3 per cent annually; this percentage was applied to the gross weight transported during 1952 on those lines which are already electrified and those which it is planned to electrify. The figure of 900 million tons of gross weight which served as a basis for the calculation does not include gross weight in the transport of petroleum or in suburban passenger traffic. The latter will increase by 2.5 million passengers each year, reaching 53.8 millions in 1962. If the average distances covered remain constant (which is probable), the volume of transport will reach 553.6 million passenger-kilometres.

As regards the *Central do Brasil*, if it is recalled that this railway has already ordered the electric trains required to recover its 1949 capacity, it seems reasonable to assume that in 1957 (when these trains will enter service) the number of passengers will also regain the 1949 level. During the rest of the period—that is, until 1962—the number of passengers will increase by 3.4 per cent annually. Goods traffic was projected on the basis of somewhat inadequate data, since no information is available as to the density of traffic on the electrified lines, or on those in process of electrification. Nevertheless, a rate of growth of 6 per cent per annum was postulated.

In the case of the *Paulista* Railway, the annual rates of growth on the Jundiaí-Ronco line will not exceed 3 per cent. The increment will probably be more intensive on the Itirapina-Baurú-Marília line, since it serves an area which is undergoing rapid development. The traffic here should reach 1.05 billion ton-kilometres of gross weight, and will probably increase by 4 per cent annually.

A far from accurate estimate for the *Sorocabana* Railway suggests that by 1962 the volume of traffic on electrified lines will have risen to 3.36 billion ton-kilometres of gross weight.

It was calculated that the volume of gross weight on the *Leste Brasileiro* Railway will reach 135 million ton-kilometres in 1962, while a rate of growth of 6 per cent was postulated both for the *Mineira de Viação* and for the *Paraná-Santa Catarina* network. This assumption takes account of the fact that the electrified lines on these railways run through rapidly developing areas where the volume of freight transported is tending to increase substantially. Thus, it is estimated that the former railway will carry 525 million ton-kilometres of gross weight and the latter, 135 million.

To sum up, the estimates for 1962 show that electric locomotives will haul a total gross weight of 19.02 billion ton-kilometres.

<sup>23</sup> The calculation excluded from the totals concerned the ton-kilometres of gross weight corresponding to passenger traffic on electric trains.

(b) *Steam and diesel locomotives*

Section V of the Appendix presents the method used in projecting the volume of transport on steam railways for 1962. It is expected that there will still be about 515 locomotives which will transport 8.8 billion ton-kilometres of gross weight.

According to estimates, diesel locomotives will have to transport 16.455 billion ton-kilometres of gross weight.

(c) *Shunting services*

It is well known that for this operation diesel engines are relatively more efficient than steam locomotives. Hence the former will tend to be used more extensively for shunting, once ordinary traffic requirements have been met.

The plans for purchasing new equipment which have been published by some companies confirm this supposition; it is reasonable to assume that shunting services will be undertaken on all these lines by diesel engines, except in cases where it is planned to use electric locomotives.

The gross kilometric traffic handled by these last may well double between 1952 and 1962. On the supposition that shunting hours will rise at the same rate towards the end of the period, electric units will spend 300,000 hours in shunting while diesel locomotives will carry a work-load corresponding to 4.4 million hours. Section V of the Appendix deals with this topic in greater detail.

6. *Demand for locomotives and rolling stock*(a) *Locomotives*

Research in Brazil on the work of steam locomotives, as well as the experience of the railway companies, shows that their operating costs are substantially higher than those of diesel and electric engines. Everything suggests that during the period 1954-62 the Brazilian railways will replace the locomotives they have used in the past by diesel or electric units, as and when the older engines become obsolete. (See section V of the Appendix.)

Such a hypothesis leads to the conclusion that the demand for steam locomotives will tend to disappear. Therefore, the probable composition of the locomotive park in 1962 is determined by the number of worn-out or nearly worn-out engines in existence up to that date. On the basis of the hypothesis presented in the Appendix, in 1962 the steam locomotive park will be made up of those engines at present in service which were less than nineteen years old in 1950, as well as those purchased between 1951 and 1954. The approximate total will be 515 units.

As regards electric locomotives, an estimate of the probable composition of the park in 1962 (see the Appendix) was based upon assumptions of replacement needs and of the growth of traffic. It was thus calculated that the total demand, during the period 1953-62, will be 160 locomotives of different strength, of which thirty-four have already been purchased.

Nevertheless, it must be stressed that this calculation is valid only when the useful life of electric locomotives is assumed to be forty years. If it is only thirty years, the number of locomotives required will rise to 176, excluding of course, the 134 units already purchased. It should also be noted that no account has been taken of those electric trains for suburban passengers which the railway companies already possess or are thinking of acquiring.

The estimate of diesel locomotive requirements was based on the total ton-kilometres of gross weight to be transported in 1962. For this purpose, the present annual transport capacity of the locomotives was assessed by the method shown in the Appendix. Thanks to these basic hypotheses and to other assumptions, it was possible to estimate the demand for locomotives and the probable composition of the availability in 1962. It should be emphasized that the results of the calculation of demand are very similar to those obtained by the Joint Brazil/United States Economic Development Commission, varying only as regards shunting units.

(b) *Goods trucks*

According to calculations in section V of the Appendix, the railways will have to buy some 10,770 goods trucks to meet replacement requirements. Estimates of future demand are also given (36,757 trucks); these take account of the growth of traffic. The number of units which must be replaced and the goods trucks needed to allow traffic to increase give some idea of the total. In 1962 it will reach 47,527 trucks, which implies an annual demand of approximately 4,750 units.

7. *Demand for energy and lubricants*

In the pre-war period, the energy consumption of the railways amounted to 802.7 million kWh (1939), and in 1952 to 1.278 billions. These figures represent 5.4 and 5.2 per cent respectively of the national energy total. (See the Appendix.)

Nevertheless, a distinction should be made between the roles of the different sources of energy in this consumption. As may be seen in table XXII of the Appendix, in 1939 hydro-electric energy contributed 10.4 per cent, while coal, petroleum and fuelwood supplied the remaining 89.6 per cent. At that stage, diesel oil was not yet used in Brazil. The same table shows that the composition differed substantially in 1952: electric energy provided 21.2 per cent, diesel oil 11.3 per cent and other fuels 67.5 per cent.

During the period 1939-52, considerable changes also took place in the sources of energy used for steam traction, since the shortage of imported fuels increased dependence upon home supplies. In 1943, Brazil's own fuelwood and coal contributed as much as 89.2 per cent of the energy consumed by steam locomotives, while in 1939 they had provided only 65.2 per cent. The data in the Appendix show that the increment took place to the detriment of coal imports.

The projection of the energy demand is based on the ratio apparent for some of Brazil's railways between consumption of the various forms of energy on the one hand, and, on the other, the volume of transport handled and the shunting involved.

As regards electric energy, in 1962, Brazil's railway system should be able to count on 542 million kWh to transport 15.48 billion ton-kilometres. This total excludes passenger trains, which will represent 3.405 billion ton-kilometres, implying consumption of 95 million kWh. If the share corresponding to shunting is added, a grand total of 722.5 million kWh will be required in 1962.

To project the demand for diesel oil, a method similar to that used for electric energy was followed and it was calculated that by 1962 oil consumption will probably reach 245,000 tons, of which 132,000 will be devoted to shunting

and the remainder to the transport of passengers and goods. (See again section V of the Appendix.)

It was assumed that the fuel used for steam locomotives will be limited to fuelwood and petroleum, and that the consumption of fuelwood will increasingly be replaced by that of petroleum, the use of the former thus becoming restricted to railways situated in areas where such fuel is plentiful. It should be recalled that steam locomotives using fuelwood will carry 2.9 billion ton-kilometres of gross weight and that engines using petroleum will transport about 5.9 billions; in addition, the average consumption of petroleum per thousand ton-kilometres of gross weight is in Brazil about 40 kilogrammes, and that of fuelwood 0.9 cubic metres. In 1962, therefore, the consumption of these two fuels will be 236,000 tons and 2,610,000 cubic metres respectively. (See again section V of Appendix.)

Demand for lubricants was estimated on the basis of the changes in the composition of locomotive availability, that is, in the distribution of the volume of traffic among the different types of traction, the present coefficients for the consumption of lubricants being utilized in each case. The total thus obtained for 1962 was 13,300 tons, of which 570 tons will be consumed by steam locomotives, 12,400 tons by diesel traction and 400 tons by electric engines. (See again the relevant section of the Appendix.)

#### 8. Demand for rails and sleepers

The rails at present in existence on all lines used for traffic weigh approximately 2.2 million tons, excluding points, rails for shunting and so on. The projection was based on two hypotheses of the average life span of rails, and, in accordance with expert opinion, thirty and forty years were determined as the lowest and highest extremes. The normal demand for rails for replacement purposes was thus estimated as varying between 70 and 93,000 tons.

Furthermore, provided that the construction of new lines continues at the same rate as during the last twenty years, the additional demand will be for 13,000 tons. In consequence, total rail requirements will range from 83,000 to 106,000 tons annually.

Sleepers in use on the Brazilian railways in 1951 totalled 64 million units. If their average useful life is assumed to be eight to twelve years, it may be concluded that not less than 5.3 and not more than 8 million units become unserviceable each year. As the railway companies have plans for lengthening the present average life of the sleepers by at least 50 per cent during the next ten years, replacement needs will clearly decrease to a substantial extent. In addition, the railway companies aim at raising the number of sleepers per kilometre of permanent way. (See section V of Appendix.) When all these factors had been taken into consideration, and on the assumption that the lines in use will undergo the same degree of expansion as in 1951, it was deduced that the total number of sleepers will reach a figure somewhere between 64 and 71 million units in 1962.

### IV. PROJECTIONS FOR THE ROAD SECTOR

#### 1. Demand for lorries

##### (a) Replacement needs

For the sake of simplicity, it was felt desirable to establish from the outset the following working hypothesis: if the

transport capacity of the lorry park is to be maintained at a given level, the new units added in the course of each year must equal in number those which become obsolete. The criteria laid down for defining the obsolescence (or, alternatively, the useful life) of load-carrying motor vehicles clearly constitute the touchstone for calculating replacement needs.

The inadequacy of the available data precludes any empiric method of determining the average duration of a lorry in Brazil. Furthermore, expert opinion on this point is far from unanimous. There is strong disagreement not only as to the total distance which can be covered by load-carrying vehicles (or, in other words, their useful life in terms of kilometres) but also as to the average distance covered in a year.

Some maintain that "the useful life of a lorry in Brazil does not exceed five years in the conditions assumed here, namely an output of 100,000 ton-kilometres per lorry annually, which would require a daily run of 111 kilometres for a 6-ton lorry with a 50-per-cent tonnage utilization, or, in other words, a total run of 166,500 kilometres in the vehicle's five years of useful life".<sup>24</sup>

Others, while also assuming a useful life of five years, estimate an annual run of 75,000 kilometres, and 375,000 kilometres as the total ground covered.<sup>25</sup> In the existing literature on the subject under review or on related problems, reference is made to intermediate figures. Thus, in one case, total and annual runs are assumed to be 180,000 and 30,000 kilometres respectively,<sup>26</sup> while in another the corresponding estimates stand at 20,000 and 50,000 kilometres.<sup>27</sup>

It is interesting to note that, in spite of such discrepancies, the variations in the useful life attributed to lorries (in terms of years of service) range between fairly narrow limits, namely, four to six years. Thus among the available material only one source mentions a longer span (ten years).

A somewhat elementary procedure for checking these hypotheses consists in comparing the increase in the number of lorries in circulation over a given period with the number of vehicles purchased during the same lapse of time. Such a comparison suggests that in Brazil the average life of a lorry is longer than five years.

Between 1947 and 1952,<sup>28</sup> the number of lorries in circulation rose from 115,997 to 244,941, while the units imported

<sup>24</sup> See Estudos Diversos, *Comissão Mista Brasil-Estados Unidos para Desenvolvimento Econômico* (Rio de Janeiro, 1954) pp. 144 and 145.

<sup>25</sup> See Odor Dias da Costa "O Motor Diesel e sua Influência na Economia de Transporte Rodoviário" (The Diesel Engine and its Influence on Road Transport Economy), in the *Revista do Club de Engenharia do Rio de Janeiro*, March 1948.

<sup>26</sup> See Candido do Rego Chaves, "Estudo para a Avaliação do Custo do Transporte em Caminhões a curtas distâncias" (Assessment of Cost of Short-Distance Lorry Transport), in a special issue of the *Boletim "DER" do Depto. de Estradas de Rodagem de São Paulo*, special issue, January-March 1951, p. 62.

<sup>27</sup> See Jorge Moraes, "Custo dos Transportes Rodoviários e Ferroviários com Vistas ao Gasto de Divisas Estrangeiras" (Cost of Road and Rail Transport from the standpoint of Foreign Exchange Expenditure), in *Engenharia*, a periodical published under the auspices of the São Paulo Institute of Engineering, Nos. 86 and 88, especially page 171 of No. 88. It should be noted that the opinions on the length of useful life expressed in the text are based on hypotheses of the working conditions for lorries, which are not entirely uniform. Some of these opinions envisaged only the case of vehicles used for fairly long-distance transport.

<sup>28</sup> As from 31 December of the years mentioned.



amounted in all to 197,596 during the period 1948-52. If there was an increase in the park of 128,944 units, it is clear that rather fewer than 68,652 lorries were for replacement purposes. As this figure represents about half the number of load-carrying vehicles in existence at the close of 1947, it might be inferred that the average life of a lorry in Brazil is as much as ten years. Unfortunately the validity of this test is very limited, one reason—among others no less weighty—being that data on the number of lorries in circulation in 1952 may represent an over-estimate.

In face of the impossibility of determining the average duration of lorries with a reasonable degree of accuracy, it was decided to estimate replacement needs on the assumption that their useful life ranges from eight to ten years. This somewhat arbitrary supposition is tantamount to postulating that the annual renewal rate fluctuates between 10.0 and 12.5 per cent of the total in service.

In accordance with the previous estimate of the average mileage covered per year, the possible periods of usefulness just defined correspond to a working life in terms of distances covered ranging from 168,000 to 210,000 kilometres. In the United States, 200,000 kilometres<sup>29</sup> represent the generally accepted estimate of useful life, and in Brazil, more than one technical expert places somewhere between the limits mentioned the figures for the total distance that can be covered by a lorry before it is worn out. Finally, it is worth recording that one enterprise of long-standing experience in road transport calculates that the useful life of its vehicles—diesel lorries—is consistent with the working hypothesis adopted in this text.

Since lorries in circulation totalled 300,000 in 1954, the average annual replacement needs during the period 1953-62, on the assumption of a working life of ten years and a cumulative annual growth rate of 8.4 per cent for the park, are likely to be approximately 40,500 lorries. In accordance with the second hypothesis of an 8-year average duration, the number should reach 50,600 units.

The possibility that a smaller number of vehicles may be needed for the maintenance of the park must not be overlooked. This is bound to occur if the post-war tendency to purchase lorries with a higher transport capacity than those becoming obsolete persists. The process of replacing lorries of light or medium tonnage by heavier vehicles should be accelerated over the next few years as the country's road network improves. Meanwhile, it is impossible to calculate just how far this fact will affect the demand for lorries for replacement purposes, and it is for this reason that it was assumed from the outset that each obsolete lorry will be replaced by a new vehicle.

#### (b) Increased volume of traffic

The demand for lorries is ultimately a derived demand, and the factor which determines it—or which has a decisive effect on its level—is the volume of traffic. The projection

of this latter is consequently one of the essential bases on which to calculate the number of lorries that the country will need.

No projection of the over-all volume of traffic is, however, available, nor are there any means of establishing a well-grounded hypothesis in its place. It is true that in a previous section of this chapter it was assumed that the volume of transport to be met will increase at a cumulative annual rate of 6 per cent; but it should be emphasized that this supposition was based only on the case of inter-urban load-carrying traffic. Lorry transport for short distances or within urban areas was disregarded.

In view of this, the projection given here is based on the hypothesis that over the period 1953-62 the total availability of lorries will rise at an annual average rate of 8.4 per cent. If the trend visible in the last few years is maintained in the future, the number of diesel lorries brought into the park will increase faster than the park itself. It has therefore been calculated that the number of diesel lorries in service will reach about 70,000 by 1962. The great majority of these vehicles will probably be earmarked for inter-urban transport, in view of their suitability for this type of service.

Table 110. Brazil : Projection of the demand for lorries

Type of lorry	Stocks		Units to be purchased (1953-62) (Annual average)	
	1954	1962	For replacements	To cover increase in traffic
Gasoline- driven . . . .	285,000	503,000		
Diesel . . . . .	15,000	70,000		
TOTAL . . .	300,000	573,000	40,500 (10 years) 50,600 (8 years)	34,125

Sources : Official publications and Economic Commission for Latin America.

#### 2. Demand for tires

It would be a simple task to calculate the demand for tires for lorries if their average length of life and the distance covered annually were known. But both points are still a matter of conjecture, despite the fact that certain experts believe tires can last for 20,000 kilometres, while others suggest 25,000 or 30,000 to be a more accurate figure.

Given these discrepancies, it is not surprising that estimates of annual tire consumption per lorry differ widely from one another, or, in more concrete terms, range from a minimum of 5.32<sup>30</sup> to a maximum of 18 tires.<sup>31</sup>

A comparison of the tire availability with the number of lorries suggests that the minimum estimate comes closer to the truth. In fact, during the four-year period 1948-52 the average annual supply of tires rose to 870,000 units, when the average number of load-carrying vehicles in circulation

<sup>29</sup> There is a widespread impression that the useful life of a lorry is longer in Brazil than in the United States. The point of view expressed here is that a lorry continues in use for a longer time in Brazil than in the United States because the distance covered annually in the former country is considerably less. The total distance covered must be the same in Brazil, of perhaps less, on account of the technically inferior state of its highways, inadequate maintenance of vehicles, etc.

<sup>30</sup> See *Comissão Mista Brasil-Estados Unidos*, op. cit., p. 145.

<sup>31</sup> Average consumption assumed for 10-ton lorries used for relatively long-distance transport. See Odir Dias da Costa, op. cit.



stood at 219,300.<sup>32</sup> The apparent consumption per vehicle was approximately four tires.<sup>33</sup>

Table 111. Brazil: Availability of tires <sup>a</sup> and load-carrying vehicles <sup>b</sup> in circulation, 1948-52

(Thousands)		
Years	Tires	Vehicles
1949 .....	594.0	179.6
1950 .....	782.3	206.2
1951 .....	1,738.0 <sup>c</sup>	226.4
1952 .....	1,059.7	264.8

Source: Various numbers of the *Boletim de Estatística e Informações*, Comissão Executiva da Defesa da Borracha, Rio de Janeiro.

<sup>a</sup> Including tires for lorries, omnibuses, station-wagons, tractors, agricultural machinery, bulldozers and aeroplanes. Vehicles of the first three types absorb more than 90 per cent of the total number of tires.

<sup>b</sup> Including lorries, omnibuses and station-wagons.

<sup>c</sup> This figure is a partial estimate.

It is clear that consumption must have been greater if, as seems probable, the number of lorries in circulation is over-estimated in the existing series. On this hypothesis, the average consumption of four tires could be considered as an absolute minimum. Nevertheless, it is on this figure that the estimate of demand will be based.

In 1962, the lorries in circulation will total approximately 573,000. The level of tire consumption per vehicle assumed in the foregoing paragraph will give an aggregate consumption of 2.29 million units. As motor vehicles in Brazil use one inner tube to every 1.6 tires, the consumption of these will amount to 1.43 million units.

### 3. Demand for fuels and lubricants

#### (a) Petrol

The scanty information published on the fuel consumption of lorries suggests that they use from 0.33 to 0.5 litre of petrol per kilometre on long and medium-distance runs. It is, however, the data which are less significant—either because they refer to a very small number of lorries or because they were collected over a short period of observation only—that place consumption nearer to the higher limit of half a litre.<sup>34</sup> The more trustworthy information, on the other hand, indicates that 0.33 litre is the representative figure.<sup>35</sup>

On the basis of this rate of consumption per kilometre and the previous estimate of the average distance covered in a year by lorries used for inter-urban transport, the average annual consumption of petrol per vehicle can be calculated at approximately 11,300 litres.

It is a known fact that a lorry uses more fuel per kilometre for urban or short-distance than for inter-urban transport.<sup>36</sup>

<sup>32</sup> See notes <sup>a</sup> and <sup>b</sup> to table 111.

<sup>33</sup> If it is assumed that the lorries at present in existence in Brazil use on an average six tires of which the average duration is 30,000 kilometres, it may be concluded that, in accordance with apparent tire consumption, the average distance covered by a lorry each year is 20,000 kilometres.

<sup>34</sup> In two cases, a consumption of 0.4 litre or more was recorded. One of these cases reflects the experience of an enterprise owning six lorries during one year; the other, that of an organization using fewer lorries over an even shorter working period.

<sup>35</sup> Consumption calculated by the Cia. Mogiana de Transportes.

<sup>36</sup> Consumption is higher still when the average capacity of lorries used for short-distance transport is less than that of vehicles used for inter-urban transport.

Existing information suggests a consumption of 0.38 litre per vehicle per kilometre on service of this kind. The annual consumption per vehicle, however, is lower than 11,300 litres, because the average distance covered in a year by lorries used for urban or suburban transport is only a fraction of the distance run by vehicles on inter-urban service.

All available statistics emphasize this fact. A case in point is that of the vehicles—more than 200 in number—belonging to an enterprise<sup>37</sup> of which the requirements, over the whole period 1948-52, involved an average annual run of not more than 7,325 kilometres. A further instance worth quoting is that of the sixty-nine lorries belonging to another company, which during the year 1951 covered on an average 8,734 kilometres.<sup>38</sup>

Doubts may arise as to the value of these cases as representative examples, since both enterprises use their vehicles primarily for urban transport. It is in fact probable that the average distance covered by these lorries is unduly affected by transport conditions within the urban zone of large cities. It was therefore deemed wiser to assume a higher average run of 12,000 kilometres for lorries on urban and suburban service.

If 0.38 litre represent the consumption of petrol per vehicle per kilometre, the supplies for this distance involve an average annual consumption of 4,560 litres per vehicle.

Finally, the average annual consumption per registered lorry rises to approximately 7,260 litres if the following composition of the load-carrying motor vehicle park by types of service is assumed; 40 per cent for inter-urban and the remainder for urban or suburban transport.

This rate of average consumption may undergo modification in the course of the next few years under the influence of four main factors: higher average capacity of the lorries in circulation; longer average distance covered; changes in the proportion of the total number of vehicles used for urban service on the one hand and for inter-urban on the other; and, finally, technical improvements in the state of the highways, especially road-paving services. If the first two materialized they would tend to raise consumption, the third would cause an increase or a decrease according to the nature of the change, and the fourth would have a lowering effect.

Though any one of them may affect average consumption in a substantial degree, it was felt to be wiser to leave them out of consideration in view of the impossibility of forecasting their future trends with even approximate accuracy.

It was previously established that 153,000 of the 503,000 units which will constitute the availability of petrol-driven lorries in 1962 will be used for inter-urban service. The annual fuel consumption of these vehicles will amount to 1,730 million litres, if a unit consumption of 11,300 litres is assumed. By adding to this the 1.6 billion litres consumed by the remainder of the lorries, a total of 3.3 billion litres will be obtained—that is, 2.9 million tons of petrol.

#### (b) Diesel oil

The best available information suggests that the consumption of diesel oil per vehicle per kilometre is in the nature of 0.28

<sup>37</sup> Basic statistics of the Sorocabana Railway lorry service. See the *Relatórios* of this enterprise.

<sup>38</sup> *Relatório do Superintendente*, 1951. Cia. Mogiana de Transportes.

litre for relatively long-distance transport. The 70,000 diesel lorries which it is presumed will be in circulation by 1962 will consume 595 million litres of this fuel annually.

### (c) Lubricants

The average consumption of lubricants for each 100 kilometres covered on any type of service ranges from 0.8 to 1.0 litre. According to the calculations here, the average annual distance run by lorries amounts to 21,000 kilometres.

The average annual consumption of lubricants per vehicle should therefore be between 170 and 210 litres, in round figures.

If the average of these two figures is taken as the most representative value of the consumption of petrol-driven vehicles—and it is assumed, in default of more accurate data, that the average consumption of diesel lorries also stands at 190 litres—the aggregate consumption of lubricants will represent about 109 million litres in 1962.

## APPENDIX

### I. THE LIMITATION OF TRANSPORT CAPACITY

#### 1. General considerations

The nominal transport capacity of a railway line or system is determined by the nature of its availabilities of locomotives and rolling stock: number of locomotives, traction power, number and capacity of goods trucks, etc. The real or effective capacity depends upon the technical characteristics—lay-out, rails, etc.—of the lines. When these are unfavourable, as they are in Brazil, the efficiency of the equipment is a good deal less in practice than in theory. To the same degree, effective capacity differs from nominal capacity.

Two factors influence the decrease of effective capacity over a period of time—inadequate replacement of rolling stock and deficient maintenance of the permanent track.

When the rate of replacement is unsatisfactory, the average age of the machinery and equipment rises, or, more usually, the number of obsolete locomotives, coaches and goods trucks increases in relative terms. In either case, capacity is lowered, since a growing proportion of the potential time for servicing rolling stock must be devoted to repairs.

Inadequate maintenance of the road-bed and lines affects railway operations in various ways: for example, the speed of the trains is reduced. There is also a decrease in the volume of goods and the number of passengers that can be transported in a given time.

Lower effective capacity need not necessarily cause a decline in the volume of transport. In fact, this would occur only if the capacity were being fully utilized at the time when its reduction took place. When this is not the case, the volume of transport may increase while effective capacity is diminishing.<sup>1</sup>

#### 2. Evolution of the capacity and volume of transport

The Brazilian railway network was affected by some of the phenomena described above. During the period 1935–50, an average of forty-one locomotives was incorporated into the system each year.<sup>2</sup> Since there were 3,283 locomotives in 1930, it may be deduced that the average annual rate of replacement was 1.4 per cent. If this calculation is made on the basis of traction power,<sup>3</sup> a slightly higher rate is obtained, namely, 1.9 per cent.

At the latter rate, the whole park could be renewed in fifty-three years, an extremely long period if it is compared with the average useful life of the locomotives. The most optimistic estimates suggest a maximum life for locomotives of forty years, which means a minimum rate of replacement of 2.5 per cent annually.

<sup>1</sup> Broadly speaking, the increase is obtained at a higher real cost per unit transported—that is, per ton-kilometre or per passenger-kilometre.

<sup>2</sup> Average annual imports of locomotives of all types during this period. It was impossible to extend the calculation to 1930–34, because imports are shown in kilogrammes. In any case, the inclusion of the data for this five-year period would not have caused any radical change in the findings already presented.

<sup>3</sup> Strictly speaking, the calculation should be limited to traction power, since capacity is the important factor and not the total number of locomotives in service.

It is evident that locomotive capacity decreased because obsolescence outstripped the rate of renewal. To be more accurate, a process of disinvestment took place from the pre-war period until recent years, although over-all traction power apparently increased by 18 per cent between 1930 and 1950. The increase from 27.5 to 32.5 million kilogrammes<sup>4</sup> is in fact only nominal, since the share of obsolete locomotives (over thirty years old) in total traction power rose from 20 to more than 50 per cent.

Maintenance of the permanent way was also far from satisfactory. The number of rails and sleepers replaced did not cover minimum requirements. The average number of rails renewed every year during the five-year period 1925–29, was higher than at any comparable period subsequently. The situation as regards sleepers was not so serious. It is a fact, however, that the average number of units renewed annually during the period 1930–52 was the same as the average for the five-year period 1925–29, in spite of the increase in the length of track mileage which was effected in those years.<sup>5</sup>

Deterioration of the permanent way reached alarming proportions during the post-war period. It is calculated that in 1951 the weight of obsolescent rails, as yet unreplaced, varied between 424,000 and 462,000 tons, while the corresponding figure for sleepers was 3.1 million tons.<sup>6</sup> The deficit in the first case represented about a quarter of the total weight of all the rails in service on Brazilian lines in 1951, and in the second, about 5 per cent of all the sleepers in use.

Inadequate renewal of locomotives and the deterioration of the permanent way undoubtedly reduced the effective transport capacity of Brazil's railways. Although the scanty and unreliable data which exist do not permit the influence of these factors to be estimated accurately, they do suggest that the effective transport capacity declined by some 20–30 per cent.

This was no obstacle to the relatively vigorous growth of the volume of transport, at any rate up to the end of the war.<sup>7</sup> Since there was a subsequent stagnation during 1947–49, despite an intensive rise in demand and relatively low rail tariffs, it seems clear that the railways reached the limit of their effective transport capacity during the years immediately following the war.

Given the rail tariffs in force, it is difficult to estimate the additional volume of traffic which the railway system might have carried if the

<sup>4</sup> Approximate figures. The 1930 figure is based on data for 3,211 locomotives out of a total of 3,273; that of 1950 was obtained by estimating the traction power of some of the diesel and electric locomotives in service at that time.

<sup>5</sup> The data which serve as the basis for this statement refer to a sample formed by twelve of the thirteen largest railways in the country. The average number of sleepers laid annually during the five-year period 1925–29 was 3.7 million.

<sup>6</sup> See *Estudos Diversos* (Joint Brazil/United States Economic Development Commission), page 151, and "O Problema dos Trilhos" (The Track Problem), in *Boletim 1953 do Instituto Ferroviário de Investigações Técnico-Econômicas*, p. 57.

<sup>7</sup> The kilometric traffic of the railways increased by 66.1 per cent between 1929 and 1945, and by more than 100 per cent between 1930 and 1945, according to the index for the thirteen most important railways. It should be noted that in view of this increase the capacity of the railway system must have been considerably under-utilized at the end of the 1920s.

capacity had been available. Nevertheless, it is known that in 1951 some companies failed to transport goods whose total weight was 20 to 50 per cent of the freight volume carried by them in that year.

Finally, it must be emphasized that restricted capacity was not a problem common to all the railways of the country.

## II. EVOLUTION OF THE UNIT COST OF LORRY TRANSPORT

A relatively large proportion of the average cost per ton-kilometre of lorry transport has to be met with foreign exchange, which, according to present estimates and to independent information, covers some 15 per cent of the total.<sup>8</sup> Thus the rate of exchange exerts a direct, and not inconsiderable, influence upon the unit cost of goods transport by lorry.

During the period 1946–52, the rate of exchange remained constant and therefore tended to reduce the increase in the unit cost, as will be seen below. This stability was accompanied by an unequal rise in internal and external prices; in other words, prices of goods imported by Brazil rose considerably more than in their country of origin. Obviously, in these circumstances, the steadiness of the rate of exchange tended to moderate the increase in cruzeiro prices for imported commodities, particularly those which were almost or entirely unaffected by import restrictions. As petrol, lubricants and other cost components belonged to this category, the statement that the rate of exchange influenced the cost of road transport can be readily understood.

Another factor militating against an excessive rise in costs was the relative constancy of the specific taxes on petrol, lubricants, etc. To give an idea of the magnitude of these taxes, it suffices to point out that in 1952 they constituted no less than 10 per cent of the unit cost of goods transport by road. For the reasons adduced, this cost rose by only 53.5 per cent between 1946 and 1952, an increment which contrasts with increases of about 84 per cent in the prices of agricultural and industrial products,<sup>9</sup> and of 80 to 85 per cent in the unit cost of rail transport.<sup>10</sup>

There are reliable indications that charges for lorry transport kept parallel with the unit cost. If railway tariffs had increased at the same rate as the unit cost of rail transport, which did not in fact occur,<sup>11</sup> the competitive position of lorries would have become even stronger between 1946 and 1952.

This position was at least maintained,<sup>12</sup> even in zones served by railways with an unlimited transport capacity, because the increase in road transport charges was so moderate.

<sup>8</sup> See table VII in section IV of this Appendix.

<sup>9</sup> Calculations based on the price indices that can be deduced from the real production series and from the income of the agricultural and industrial sectors.

<sup>10</sup> The unit cost was obtained by dividing the total expenditure of the railways by the ton/kilometres of payload carried (passenger transport included). This is a very rough calculation, since the expenditure accounts of almost all the railway companies exclude depreciation charges, and are not confined to goods traffic.

<sup>11</sup> It is very difficult to construct an adequate index of railway tariffs from the available information. The most that could be done was to establish weighted indices of the kilometre rates (and not of the tariffs actually charged) for ten products. With 1946 as the base year, the increases observed in the rates for a 200-kilometre haul were as follows:

Product	1952 increase (percentages)
Cotton .....	15.9
Coffee .....	17.4
Beans .....	45.0
Wheat flour .....	45.5
Manioc flour .....	46.8
Lumber .....	48.2
Sugar .....	48.3
Jerked beef .....	116.7
Butter .....	171.9

The average increase in tariffs, to judge by these statistics and by other isolated data, was probably from 50 to 60 per cent between 1946 and 1952.

<sup>12</sup> In recent years, the competitive position of lorries has, to some degree, not been directly conditioned by the relative level of their freight tariffs. This does not imply, however, that higher prices, also in relative

## III. THE METHODOLOGY OF THE LOAD VOLUME INDEX

The weighting factor used was the number of persons employed, according to the 1940 Census, in connexion with each of the different means of transport included in the index.

The census figure for employment in road transport was adjusted by excluding from the total the number of workers employed in passenger transport. For this purpose it was assumed that the ratio existing in 1939 between load-carrying and passenger vehicles was also valid for the number of persons employed in each of these two categories of motor transport.

Similarly, the employment figure for the railways was corrected by deducting from the total the number of workers employed in the maintenance of the permanent way and in passenger transport. To make this latter adjustment it was assumed that the number of persons employed in passenger and freight traffic was proportionate to the ton-kilometres of gross weight transported by each of these two services in 1939.

The resultant weighting coefficients were as follows: for railways, 47.2 per cent; for road transport, 31.5 per cent; and for coastal shipping, 21.3 per cent.

The series relating to lorries in circulation may contain a considerable margin of error as regards the post-war years. The number of load-carrying vehicles in circulation is probably over-estimated, as will now be demonstrated.

As from 1946, inter-state trade by road entered upon a phase of intensive expansion. This led to a substantial increase in the number of lorries registered in one state, but also circulating in others. However, load-carrying vehicles which remain more than a fortnight within the borders of a state where they are not registered are subject to a fine.<sup>13</sup> To evade these legal sanctions and other disadvantages, an increasing number of owners decided to register their lorries in more than one state.<sup>14</sup>

The available evidence suggests that the duplications resulting from this practice were not eliminated when the series relating to lorries in circulation was established. If such an error does in fact exist, the index will tend to be too high. The lorry series was included for lack of better data, although it does not give an entirely faithful picture of effective or kilometric road freight traffic.<sup>15</sup> A long-term increase or decrease—particularly the former—in the load volume transported by road should be reflected in parallel, though not necessarily commensurate, changes in the number of lorries in circulation. To assume the contrary would be to admit the possibility that the lorry park is being under-utilized during lengthy periods.<sup>16</sup> Over the short term, however, there is no reason why there should be a close correlation between the volume of freight transported and the number of vehicles; the former may, for example, drop abruptly from one year to the next, without there being any variation in the number of lorries in service. Alternatively the vehicle park may for a short period increase more intensively than the load volume. Nor should it be overlooked that in certain circumstances there may be a rise in the number of lorries and their degree of utilization.

A good many lorries are used for short hauls. The series employed in calculating the over-all index should exclude these vehicles, because

### Footnote 12 (continued)

terms, for this type of transport would not have helped to neutralize some of its real or apparent advantages over the railways. It is clear that the relative tariff levels played an important role as a determining factor in traffic distribution only in areas where full use was not made of the railway system.

<sup>13</sup> The fine is also applicable to lorries which remain for forty-eight hours within the boundaries of towns in such states.

<sup>14</sup> The additional outlay involved in double registration is very low.

<sup>15</sup> This remark is valid irrespective of the possible error in the series itself.

<sup>16</sup> In abnormal conditions, like those of the 1940–45 period, phenomena such as those mentioned in the text may very well occur. In less adverse conditions, the under-utilization of equipment in an under-developed country, which is growing with some intensity, is not a usual occurrence; over-utilization is more frequent. In most cases, and particularly when the useful life of the equipment is limited, over-utilization for a relatively long period is impossible.

the type of service they render differs to some extent from that provided by other lorries, railways or coastal shipping. But for the time being the absence of statistics on the break-down of the number of lorries by types of service (during the period 1939-52) has made it impossible to introduce the proper corrections into the series.

Finally, it should be noted that the air freight index has been excluded from the aggregate index because its relative share of the total is still very small, despite the spectacular development of this type of transport during the post-war period. Obviously, had it been included, the over-all transport index would have shown a still more marked upward trend.

#### IV. ESTIMATE OF THE AVERAGE ANNUAL VOLUME OF INTER-URBAN LORRY TRANSPORT

##### 1. Annual average volume of transport

In order to estimate the volume of inter-urban lorry transport, the number of lorries used for this traffic and the ton-kilometres of goods transported on an average by each vehicle must be known. The latter information depends in turn upon a knowledge of the following factors: the average annual run and the average capacity of the lorries on inter-urban service, as well as the degree of utilization of this capacity.

##### 2. Average capacity

In mid-1953, 34.7 per cent of the 269,402 lorries in circulation in Brazil had a maximum capacity of 2 tons; 50.6 per cent had a capacity of between 2 and 5 tons, while the remainder could carry more than 5 tons.

The general impression is that most of the light lorries are used in urban or suburban traffic and the medium and heavy lorries for inter-urban service. Statistics of the daily traffic on twelve highways in São Paulo State to some extent confirm this assumption.

Table I. Brazil: Daily traffic according to size of lorry on 12 highways in the State of São Paulo

Year	Lorries			Percentage of total		
	Light	Medium	Heavy	Light	Medium	Heavy
1949 .....	443	3,998	277	9.4	84.7	5.9
1950 .....	746	4,647	238	13.2	82.6	4.2
1951 .....	908	5,428	262	13.7	82.3	4.0
1952 .....	...	...	...	...	...	...
1953 .....	1,328	6,877	295	15.6	80.9	3.5

Source: Departamento de Estradas de Rodagem, Secretaria de Viação e Obras Públicas, São Paulo.

As may be seen from table I, not less than 81 per cent of the lorries in circulation in this State during 1949-53 were medium-capacity vehicles. This type of lorry is used to a more marked extent than might be assumed from its relative share in the park. It is very likely, although not absolutely certain, that the phenomenon observed in São Paulo is fairly representative of conditions prevailing elsewhere in Brazil. According to expert opinion, most of the medium-sized lorries have a capacity of 5 tons. The average capacity of the lorries used for inter-urban freight services therefore probably varies between 4.5 and 4.8 tons.

##### 3. Degree of utilization

A survey made in São Paulo state during 1953<sup>17</sup> revealed that of the 35,568 lorries passing through check points on fourteen State highways, some 41 per cent, or 14,434 units, were empty. The remainder, according to another survey,<sup>18</sup> were transporting an average load of 5.1 tons.

<sup>17</sup> Survey made by the Departamento de Estradas de Rodagem, Secretaria de Viação e Obras Públicas, under the direction of Mr. Valdo Silveira. A sampling procedure was used to estimate the number of loaded and empty lorries which circulate on state highways. The findings of this survey had not yet been published in 1955.

<sup>18</sup> This survey, also made by the Departamento de Estradas de Rodagem, covered the following points: number of loaded lorries passing through check points during certain days of the year; the distance covered; the volume and kind of merchandise transported, and, lastly, the traffic routes. The findings of this survey were also still unpublished in mid-1955.

By combining these data with figures for average capacity, a utilization coefficient of about 65 per cent is obtained for the state of São Paulo. The national average is probably not so high, as will be explained below.

The ratio between empty and loaded vehicles reflects at least in part the degree of disequilibrium existing between the volumes of traffic flowing in opposite directions. As a general principle, subject to various reservations, it can be assumed that the proportion of empty vehicles is lower in those areas where there is less disequilibrium.

This is so in the state of São Paulo, where a better balance is maintained. In the other states of Brazil the number of empty vehicles in circulation will therefore be relatively higher and the coefficient of utilization less than 65 per cent. There is, however, no empirical basis on which to estimate the percentage of empty lorries in highway traffic, except in the state of São Paulo. It is therefore impossible to calculate the national coefficient of utilization with any degree of accuracy. It will be assumed, however, as a mere hypothesis subject to revision, that this coefficient is 55 per cent.

##### 4. Annual average run

As will later be seen, different estimates of the average annual run of lorries diverge widely from a minimum of 30,000 kilometres annually to a maximum of 74,000. In the practical experience of two transport companies, the average fluctuates around 20,000 and 25,000 kilometres respectively.

In actual fact, the final elucidation of this problem depends strictly upon the accumulation of empirical data. Speculation can at best lead to the establishment of more or less probable limits for the average run. The following considerations should be interpreted only as an initial attempt to define these limits.

Perhaps the best approach to the problem would be to consider the lorries' average hourly speed and period of effective service during the year. As to the former, it is a fact that the hourly speed on most Brazilian highways is still very low. According to information from companies operating on the highway linking Rio de Janeiro with São Paulo—one of the best routes—the average speed on such roads does not exceed 40 kilometres an hour. On others, for example, the Curitiba-São Paulo and Curitiba-Joinville roads, where technical conditions are more typical, hourly speed, which in 1949 was 20 kilometres, does not exceed 22 at present.<sup>19</sup> Finally, information supplied by a company operating with a limited number of lorries on the Gariara-Patos de Minas road in Minas Gerais, indicates that on this stretch of road the average speed is less than 20 kilometres per hour. In view of the scanty data available, it was thought advisable to assume that the average hourly speed of lorries in inter-urban traffic does not exceed 22 kilometres.

The maximum annual period of service attributed to lorries was 300 days, and the commonest 260 days, that is, a 5-day week with, according to estimates, a six-hour working day.<sup>20</sup>

Six hours of effective service on each of 300 days give a total of 1,800 hours annually; if the average speed is 22 kilometres per hour, this means that

Table II. Brazil: Estimates of the average volume of lorry freight (on inter-urban services)

	Estimate I	Estimate II
Average capacity of lorries on inter-urban service (tons) .....	4.5	4.8
Annual average run per lorry (kilometres) .....	34,000	40,000
Coefficient of utilization of capacity (percentage) .....	55.0	55.0
Ton/kilometres capacity per lorry .....	153,000	192,000
Ton/kilometres transported per lorry ....	84,000	106,000

Sources: Official publications and the Economic Commission for Latin America.

<sup>19</sup> See the section on road transport in the *Relatório da Rede de Viação Paraná-Santa Catarina*.

<sup>20</sup> Six hours of effective work are equivalent to about eight hours' use, including the time when the lorry remains stationary.

the average distance covered annually is about 40,000 kilometres. The distance covered in 260 days, given the same number of hours of daily operation, is therefore 34,320 kilometres.

A combination of these varying hypotheses gives the average volume of freight for inter-urban lorry transport. The first estimate is probably closer to reality. (See table II.)

The calculation of a realistic estimate of the number of lorries used on inter-urban freight transport is hampered by lack of basic information. It was therefore decided to assume that this service absorbs about 40 to 50 per cent of the park, and that all the light and 40 to 50 per cent of the medium-weight lorries are used only for inter-urban transport or for short hauls.<sup>21</sup>

#### 5. Estimate of unit costs for long-distance transport

More than one study is extant on the unit cost of lorry transport and on its share in direct foreign exchange expenditure. Such research is based on assumptions of the average distance covered, useful life, etc., which differ, sometimes appreciably, from those used in this report or from its findings. It was thus necessary to make adjustments based on a third series of estimates. The calculation below is simply an attempt to reach this objective.

Material from other sources was used liberally in all cases where more adequate information was lacking or when the data that were available were unsatisfactory. The figures are expressed in 1952 prices and the coefficients which were used to calculate the share of foreign exchange in unit costs are valid only for the period 1945-53.

Tables III to VIII provide a detailed list of the hypotheses and data on which the estimates were based.<sup>22</sup>

Table III. Brazil: Assumptions on which estimates of unit costs of inter-urban lorry transport are based

Type of lorry .....	Gasoline-driven
Capacity (tons) .....	4.5
Average useful life (kilometres) .....	187,000
Annual run (kilometres) .....	34,000
Degree of utilization (per cent) .....	0.55
Annual volume of transport (kilometres) .....	84,000
Average duration of a tire (kilometres) .....	28,000
Fuel consumption per 100 kilometres (litres) .....	33
Consumption of lubricants per 100 km (litres) .....	0.9

Sources: Official publications and the Economic Commission for Latin America.

Notes.—*Useful life.* The span of useful life postulated in this chapter is equivalent, as will be seen later on, to a total run fluctuating between 168,000 and 210,000 kilometres. For the estimating of costs, the average—180,000 kilometres—was used, reduced to 187,000 kilometres, in order to simplify calculations.

The other assumptions are not discussed here, as they are examined in detail in other sections.

Table IV. Brazil: Proportion of final sales price represented by foreign exchange expenditure

Products	Ratio (percentage of sales price)
Lorry .....	42
Spare parts .....	42
Petrol .....	38
Lubricants .....	29

Sources: Official publications and the Economic Commission for Latin America.

Notes.—These ratios broadly reflect the situation prevailing in Brazil from 1946 to 1952. All percentages, with the exception of the first, were taken from an article by Eduardo Celestino Rodriguez in the *Boletim do Departamento de Estradas de Rodagem*, Secretaria de Viação e Obras Públicas, São Paulo, December 1949. They were compared with data for later years before being used in this calculation.

The 42-per-cent ratio adopted for lorries was obtained by comparing the average c.i.f. price of these vehicles with the price paid by some transport companies which purchased 5-ton petrol units in 1951 or 1952.

<sup>21</sup> The second statement rests on the mid-1953 classification of lorries as light-, medium- and heavy-weight vehicles.

<sup>22</sup> These assumptions aim at reflecting the characteristics and conditions of inter-urban lorry transport service, that is, on medium and long hauls.

Table V. Brazil: Prices used in the calculation \*

	Specification	Price (cruzeiros)
Lorry .....	Unit	110,000
Petrol .....	Litre	1.90
Lubricants .....	Litre	6.65
Tire .....	Unit	2,128
Inner tubes .....	Unit	158
Insurance .....	Annual rate	2,750
Licence .....	Annual fee	1,332
Garage .....	Annual charges	3,260

Sources: Official publications and the Economic Commission for Latin America.  
\* For 1951.

Notes.—*Lorry:* Price estimated on the basis of value assigned at the end of 1951 to 5-ton petrol-driven lorries purchased by one company—Cia. Mogiana de Transportes—during that year.

*Petrol and lubricants:* Prices paid by one company (see Cia. Mogiana de Transportes, *Relatório do Superintendente*, 1951). The price of gasoline was checked and confirmed by the data appearing in the *Relatório* of the Conselho Nacional do Petróleo, 1951.

*Tires and inner tubes:* Unit price of tires for freight vehicles according to statistics published in the *Boletim da Comissão Executiva da Defesa da Borracha*, year IV, Nr. 5, 1952.

*Licence:* Fees charged in the Federal District for renewal of licences.

*Garage:* Annual expenditure per lorry in one enterprise. (See Joint Brazil/United States Economic Development Commission, *Estudos Diversos*, 1954, p. 144.)

*Insurance:* Estimate.

Table VI. Brazil: Estimate of annual cost, per lorry and per ton/kilometre of long-distance freight transport 1951 (Cruzeiros)

	Annual cost per lorry	Cost per ton-km.
Depreciation .....	18,000	0,214
Fuels .....	21,318	0,254
Lubricants .....	2,035	0,024
Tires and inner tubes .....	16,261	0,194
Repairs { Labour .....	13,200	0,157
Spare parts .....	11,000	0,131
Drivers .....	44,648	0,532
Garage, insurance, etc. ....	7,342	0,087
TOTAL ...	133,804	1,593
Incidental expenses .....	13,380	0,159
GRAND TOTAL ...	147,184	1,752

Sources: Official publications and the Economic Commission for Latin America.

Notes.—*Depreciation:* The calculation of this item is based on the assumption that the withdrawal value of a truck is equal to 10 per cent of its original price.

*Repairs:* It was assumed, firstly, that annual expenditure amounts to 22 per cent of the price of a lorry and, secondly, that 10 per cent represents the outlay for spare parts and 12 per cent for labour costs. This hypothesis on the amount and distribution of maintenance costs was taken from the survey made by Jorge Moraes, "Custo do Transportes Rodoviários e Ferroviários" (Cost of Road and Rail Transport), *Revista Engenharia*, São Paulo, December 1949. The author based this hypothesis on the experience of a single road transport company.

*Drivers:* According to the only reliable information to hand, expenditure on this item rose to 86,272 cruzeiros in 1951 per lorry manned by a driver and one assistant; but as many freight vehicles operate with a driver only, such expenditure was assumed to amount to 66 per cent of the above figure in 1951.

*Incidental expenses:* These were assumed to constitute 10 per cent of expenditure as given in the table.

Table VII. Brazil: Estimated foreign exchange expenditure per ton/kilometre, 1951 (Cruzeiros)

Depreciation .....	0,090
Fuels .....	0,096
Lubricants .....	0,007
Repairs (spare parts) .....	0,055
Incidental expenses .....	0,016
TOTAL ...	0,264

Sources: Tables II and IV of this annex.

Table VIII. Brazil : Index of the average cost of transport per ton-kilometre, 1946-52  
(1951 = 100)

Year	Price indices					Index of average cost per ton/kilometre
	Tires	Petrol	Lubricants	Spare parts	Wages	
1946 .....	63.2	83.4	79.9	60.7	62.2	71.4
1947 .....	63.2	87.3	93.0	65.9	69.1	75.9
1948 .....	69.5	93.9	102.3	67.6	72.7	79.7
1949 .....	75.1	101.1	98.7	80.0	87.1	89.3
1950 .....	78.1	99.4	85.0	87.3	92.1	92.1
1951 .....	100.0	100.0	100.0	100.0	100.0	100.0
1952 .....	112.2	107.2	109.8	108.2	113.1	109.6
1953 .....	127.9	133.7	94.4	122.0	137.6	128.3

Sources : Tires : Series of tire prices for freight vehicles published in the *Boletim da Comissão Executiva de Defesa da Borracha* Ano IV, Nr. 5, 1952, page 30.

Petrol : Average retail price in the Federal District. The annual price was calculated by weighting the different quotations for each year by the number of days they were operative. Basic data are to be found in the *Relatórios do Conselho Nacional de Petróleo*.

Lubricants and spare parts : Average import price. Original data from *Comércio Exterior do Brasil*, Ministério da Fazenda.

Wages : Average wage paid by the railways. This series coincides in general with the wages paid in industry according to *Conjuntura Econômica*, publication of the Fundação Getúlio Vargas, Rio de Janeiro.

Notes.—The index was prepared using the percentage of each item in the 1951 unit transport cost as a weighting factor. Data appearing in the second column of table VI were used for the calculation of these percentages.

It was assumed that the wage index reflects the increase in expenditure on both drivers' and maintenance workers' wages; and, finally, that the amount of depreciation remained constant during the whole period.

The index does not include such items as garage, insurance, etc., since the relevant series were not available.

#### V. PROJECTIONS FOR THE RAILWAY SECTOR

##### 1. Breakdown of demand for rail services

###### (a) Electric traction

Transport by electric locomotive will increase if the electric sections are extended. But even if no more lines are electrified, the demand for railway services will still rise in areas where this type of transport is available. The probable increase in volume is not difficult to assess, once the electrification plans of the railway companies and the present volume of traffic on the lines to be electrified are ascertained. However, the expansion of demand, in the second instance, is more difficult to evaluate, since a projection of the demand in the areas concerned is required.

As this problem cannot be properly investigated, it was decided to cast a superficial glance at certain circumstances that tend to retard or accelerate the increase of traffic on some electrified lines. The discussion in question is preceded by a short survey of the railway companies' electrification plans.

In 1951, the electrified section of the Brazilian railway network covered 1,305 kilometres,<sup>23</sup> most of the lines (70.5 per cent) being in the State of São Paulo. Between 1952 and 1954 a further 750 kilometres were electrified, so that the total now reaches 2,055 kilometres.<sup>24</sup>

As may be seen in table IX, it is planned to electrify a further 1,694 kilometres. This would imply a rate of electrification almost three times greater than that of the period 1938-54, when the annual increase was some 90 kilometres only. It is unlikely that the whole of the 1,694 kilometres will be electrified in less than ten years, as some of the projects do not enjoy a high priority in the investment plans of the railways concerned. This is true of the Paraná-Santa Catarina Railway, and the Rio Grande do Sul network. In both cases, more recent programmes, prepared by the Joint Brazil/United States Economic Development Commission, have suggested other solutions to the traction problem.

Attention should be drawn to the limited availability of electric energy which hampers the speedy execution of certain projects. In reality, more than one of the projects can be carried out only if substantial prior investment is made in the energy sector.

<sup>23</sup> This total includes 104 kilometres belonging to small railway companies, some of which carry passenger traffic only.

<sup>24</sup> This total includes lines where electrification has been completed but which are not yet in operation.

Table IX. Brazil : Rail electrification until 1951, enlargements 1952-54, and planned extensions

(Kilometres)

Railways	Length of electrified line, 1951	Increase 1952-54	Planned extensions
E. F. Central do Brasil .....	192	48	125
Cia. Paulista de E. F. ....	451	—	127
E. F. Sorocabana .....	311	173	310
E. F. Santos-Jundiaí .....	66	21	22
Rede Mineira de Viação .....	181	156	221
Rede Paraná-Santa Catarina ...	—	110	139
R. F. Leste Brasileiro .....	—	242	—
R. V. Rio Grande do Sul ....	—	—	700
Others .....	104	—	—
TOTAL ...	1,305	750	1,694

Sources : Official publications and Economic Commission for Latin America.

For these reasons, it is thought that at the most 916 kilometres of the planned total will in fact be electrified between 1954 and 1962. In other words, the present calculation is based upon the assumption that the plans of the two railways mentioned do not materialize.

Projects already under way are in very different stages of execution, as table X shows.

To project even approximately the traffic volume on lines that are or will be electrified, data on the payload and gross weight goods and passenger traffic of each are an essential pre-requisite. The figures obtained are far from satisfying these minimum requirements, as they all refer to gross weight kilometric traffic. (See table XI.)

Since passenger traffic could not be separated from goods traffic, it was decided to attribute to the ton-kilometres of total gross weight the rates of growth which should actually be applied to goods traffic. But, as already pointed out, forecasts suggest that the number of passengers and the gross weight will not increase as much as the volume of goods and the payload, respectively. Hence the procedure used for the projection probably involves over-estimation of the volume of transport to be handled by electric locomotives.

Table X. Brazil : Status of electrification work on railways

<i>Railways</i>	<i>Section</i>	<i>Distance (km.)</i>	<i>Status of the projects in mid-1954</i>
Central do Brasil ...	Mogi das Cruzes Roosevelt	36	Construction well advanced
	Barra do Prai-Tres Rios	89	Construction not yet begun but funds available
Santos-Jundiaí .....	Mauá-Paranapiacaba	22	Construction work will probably be completed in the second half of 1955
Paulista .....	Bauru-Marília	127	Preliminary work finished
Rede Mineira .....	Barra Mansa-Angra dos Reis	108	A hydroelectric power plant is being built to furnish energy for this and other branches
	Minduri-Ribeirão Vermelho	113	Being studied. The hydroelectric plant to provide energy is being built
Sorocabana .....	Bernardino de Campos-Assis-Prudente	336	The power station is in process of construction
			Work continues in the direction of Assis
			A hydroelectric plant is being built and two others are planned
	P. Altino-Evangelista de Souza Santos	111	Electrification work has not yet begun

*Sources:* Official publications and the Economic Commission for Latin America.

Table XI. Brazil : Traffic volume on electric lines and lines to be electrified, 1952  
(Millions of ton-kilometres of grossweight)

<i>Railways</i>	<i>Lines</i>			
	<i>Electrified<sup>a</sup></i>		<i>To be electrified<sup>b</sup></i>	
	<i>Passengers</i>	<i>Goods</i>	<i>Passengers</i>	<i>Goods</i>
Central do Brasil ....	220 <sup>c</sup>	1,250 <sup>d</sup>	—	1,350 <sup>d</sup>
Santos-Jundiaí .....	—	1,400 <sup>e</sup>	—	—
Paulista .....	1,497	1,942.6	—	300 <sup>d</sup>
Rede Mineira .....	14.5	92.6	48.8	137.4
Sorocabana .....	336	1,320.5	—	—
Paraná-Santa Catarina .	75	—	—	—

*Sources:* Official publications and the Economic Commission for Latin America.

<sup>a</sup> Includes only lines already electrified by 1951.

<sup>b</sup> Includes lines electrified between 1952-54 and lines to be electrified.

<sup>c</sup> Estimate, excluding suburban passenger traffic.

<sup>d</sup> Provisional estimate.

<sup>e</sup> Estimate based on incomplete data.

The calculations of future traffic on electrified lines in Brazil were based on the data given in the following pages. For most of these estimates indirect or conjectural methods had to be used.

**Santos-Jundiaí Railway.** The first outstanding feature of the statistical series of this company is that during the post-war period, only in 1951 was the goods volume larger than in 1939. Further, if petroleum and its by-products are excluded from the series, more goods were transported in 1939 than during any year after the war. It is true that in the period under review considerable changes in the composition of the freight took place; among these should be mentioned the higher proportion of the aggregate represented by those goods whose transport is most lucrative.

This phenomenon, which is of particular importance in another sector, has no great significance in relation to the problem dealt with here. The point to be emphasized at this stage is that the volume of solid goods transported has not expanded in recent years, and that if the total volume has risen, this has been mainly on account of liquid fuels. However, the transport of such products was transferred to the company's pipeline in 1952, and the railway thus lost those components of its goods traffic which had increased most rapidly during the last ten years and by 1951 had already represented a quarter of the aggregate tonnage transported by rail. In addition, the Santos-Jundiaí Railway was handicapped by a

number of obstacles which tended to hamper the expansion of its goods traffic. The most patent of these is keener competition from another line; and this situation will become still more acute when the Sorocabana Railway opens a loop-line route which is at present in the final stages of construction, and which will shorten the stretch between Santos and São Paulo from 223 to about 125 kilometres. Although this new line will be longer than the traditional route followed by the Santos-Jundiaí Railway, it has the advantage of being an adherence railway with a maximum gradient of 2 in 100. One 10-kilometre section of the Santos-Jundiaí line has an average gradient of 8 in 100, which necessitates relatively slow traction, so that the time taken to cover it is about the same as that required for a 50-kilometre stretch on an adherence railway.

Another obstacle to a greater volume of goods traffic is the keen competition of road transport, which will become more intensive as manufactured goods dispatched by sea from São Paulo to other parts of Brazil play an increasingly important part in the flow of trade between that city and the port of Santos. Hence the rate of growth of goods traffic on the Santos-Jundiaí Railway will probably be lower than the average for the railway network as a whole.

It was therefore assumed that the volume of freight—excluding petroleum and its derivatives—will increase by 3 per cent annually. This percentage was applied during 1952 to the gross traffic on the lines already electrified or to be electrified shortly. The estimated figure of 900 million tons of gross weight, which served as a basis for the calculation, excludes both petroleum<sup>25</sup> and suburban passenger traffic.<sup>26</sup>

The growth of passenger traffic to the suburbs will undoubtedly be very rapid. According to the company's own estimates, the number of passengers will increase by 2.5 million annually. Since this traffic represented 28.8 million passengers in 1952, by 1962, if the projection is confirmed, the total will reach 53.6 million. Providing that the average run does not change (as is probable), the volume of transport will stand at 553.6 million passenger-kilometres.

<sup>25</sup> In calculating the ton-kilometres of gross weight represented by liquid fuels the same average length of haul was assumed for these products as for total freight—i.e., 65 kilometres—and it was also taken into account that part of this run—30 kilometres—was over a section which is not to be electrified.

<sup>26</sup> This calculation was based on the ratio of 12 to 1 between deadweight and payload, recorded for inter-urban and suburban passenger traffic on this railway during 1951. It should also be borne in mind that all this traffic was concentrated on the lines which have been or will be electrified.



Lastly, it should be noted that this railway is planning to use special trains for suburban services. The ratio of deadweight to payload on this type of vehicle is 7 to 1, when capacity is reasonably well utilized. It is assumed that this will be the case on the Santos-Jundiaí Railway.

*Central do Brasil Railway.* For five years, it has been impossible to check the steady decline of suburban passenger traffic on this railway. Over this period, the number of passengers decreased at an average annual rate of 5.9 per cent.

The reasons for this decline have been frequently and carefully studied, and require no further discussion. For the moment it need only be emphasized that the loss of traffic is due to a reduction of the rolling stock on this service, in some cases through damage, on others because it is out of date or has not been duly replaced. According to expert opinion, this is the only possible cause, since the railway is the swiftest and cheapest of the various forms of suburban transport in Rio de Janeiro. Omnibus and other motor-vehicle fares are three to five times higher than those charged on the railway.

It is therefore clear that once the main cause of the decrease in traffic is removed, expansion is bound to take place. In other words, the number of suburban passengers carried on the Central do Brasil will substantially increase when more and better rolling stock is available, even if fares are raised considerably.

As this railway has already ordered the electric trains required to restore its capacity to the 1949 level, it is reasonable to suppose that, when this occurs in 1957, the same number of passengers will be carried as in 1949.<sup>27</sup> Similarly, it was assumed that during the remainder of the period the number of passengers will increase by 3.4 per cent annually. It should be stressed that between 1945 and 1951 this was the annual rate of growth for the number of suburban passengers in Rio de Janeiro carried by every means of locomotion—that is to say, by train, tram and omnibus.<sup>28</sup>

A small share of the suburban traffic uses a non-electrified line, and for this section the hypothesis was adopted that in 1957 the volume will reach the 1949 level of 13 million passengers annually. Hence it was assumed that after 1957 the volume will grow at a rate of 1 per cent per annum.<sup>29</sup>

Goods traffic was projected with very unsatisfactory data, since even its density on those lines at present electrified or in process of electrification is unknown. Such lines, however, are on routes where the volume of traffic will inevitably increase very rapidly. It is sufficient to point out that the Dom Pedro II-Barra do Piraí section is on the main line linking Rio de Janeiro with São Paulo and Belo Horizonte and that the section Barra do Piraí-Saudade is a continuation of the São Paulo branch line, while the Barra do Piraí-Tres Rios section is a prolongation of the first-named, on the trunk line to Belo Horizonte. Finally, the Roosevelt-Mogi das Cruzes line connects São Paulo with neighbouring towns.

In the preliminary study on the demand for transport of certain industries in the Paraíba valley<sup>30</sup>—an area which is served by all the lines on the central railway already electrified or to be electrified in the future—it was shown that the expansion programmes at present under way will require additional transport facilities for 2.1 to 5 million tons. If the entire increase

in the demand of these industries is met by the Central do Brasil Railway,<sup>31</sup> its railway traffic will perhaps exceed the 1950 level before 1958.

It is probable that goods traffic on these lines will increase during 1952–62 at a rate higher than the national average. In contrast, it is unlikely that passenger traffic will attain such a rapid rate of growth. As the relative influence of neither factor can be accurately determined, the hypothesis established was that total traffic (and in this case the gross weight) will increase by 6 per cent annually.

*Companhia Paulista de Estradas de Ferro.* Like the Santos-Jundiaí Railway, this enterprise is facing serious competition from road transport, particularly on its main line. Given the rapid improvement of roads in São Paulo State, such competition is bound to be increasingly severe. In addition, the railway will lose the transport of liquid fuels when the pipeline which at present runs between Santos and São Paulo reaches the towns in the interior. Finally, production of certain commodities which make up a large proportion of the freight carried—coffee, for example—is remaining stationary in the agricultural area through which part of the end of this line runs. The immediate prospects of an increase in such production are not very promising.

Presumably, therefore, the rate of growth of traffic on the Jundiaí-Rincao section will not exceed 3 per cent per annum. On this same line, the Campinas-Itirapina branch showed a rate of growth of only 3.18 per cent over the period 1934–51.

Traffic will probably increase faster on the Itirapina-Baurú-Marília line, which crosses an area in full process of development. The 4.5 per cent rate of growth postulated for traffic on this line represents, according to the present preliminary estimate, about 1.05 billion ton-kilometres of gross weight.

*Sorocabana Railway.* Available data is too scanty to permit an independent calculation of future traffic on this company's electrified lines. Use will therefore be made of a method based on the number of electric locomotives which the management plans to add to current stock before 1963. The proposal is to acquire forty-six new locomotives, as well as forty-four others of more than 2,200 h.p. If, in 1962, utilization of the locomotive park is the same as in 1951,<sup>32</sup> out of a total of ninety, fifty-six will be used for goods and passenger transport and sixteen for shunting, while eighteen will be idle.

In 1951, each locomotive providing effective goods and passenger transport hauled about 60 million ton-kilometres of gross weight. With the help of previous data, the volume of traffic on the electrified lines in 1962 can be estimated at 3.36 billion kilometres of gross weight.

A projection of the traffic on the electrified system of the Leste Brasileiro Railway was established in the same manner.

*Rede Mineira de Viação and Rede Paraná-Santa Catarina.* In both these cases it was assumed that the rate of growth will be 6 per cent annually, because the electrified sections of these two railways run through areas which are developing rapidly and where the volume of freight is tending to increase very quickly. The lines which have been or are being electrified on the Rede Mineira link the Volta Redonda iron and steel mill with the Port of Angra dos Reis, as well as with a number of towns and effective or potential sources of raw materials in the state of Minas Gerais.

The Paranaguá-Curitiba Section, on the Paraná-Santa Catarina Railway, connects the most important port in Paraná State with the interior. Traffic will probably increase intensively when construction of the Central do Paraná Railway, which will join up the north-east of this state with the port of Paranaguá by a much shorter route, is completed.

*Conclusions.* The preceding calculations suggest that the volume of traffic will, within eight years, reach 19.02 billion ton-kilometres of gross weight, representing 43 per cent of the estimated traffic volume on all the Brazilian railways. According to this projection (see table XII), the other types of traction will transport 25.255 billion ton-kilometres of gross weight in 1962.

<sup>27</sup> In 1949, almost 185 million passengers travelled in the suburban electric trains, and 18 million of these travelled free of charge. Although the projection refers to aggregate traffic, the rate of growth was applied only to the number of fare-paying passengers, since the number travelling free of charge will presumably remain constant. It was assumed that the average run would remain equal to the average for the period 1949–52 (19.3 kilometres) for all suburban passenger traffic. The statistics used in the calculation differ from those appearing in the text. The original aggregate figure was broken down.

<sup>28</sup> Not including passengers transported in small omnibuses, whose numbers probably increased at a more rapid rate than 3.4 per cent per annum.

<sup>29</sup> Rate of growth of population in the area served by the suburban lines of the Central do Brasil Railway during the period 1940–50.

<sup>30</sup> See Project No. 3 (Central do Brasil Railway) of the Joint Brazil/United States Economic Development Commission.

<sup>31</sup> The increase will be confined to those types of freight (minerals, cement, etc.) for which railway transport is more suitable.

<sup>32</sup> In 1951, nine locomotives were idle, eight were used for shunting and twenty-nine for goods and passenger transport.



Table XII. Brazil: Projection of volume of electric traction transport  
(Millions of ton-kilometres of gross weight)

Railways	1962
Santos-Jundiaí <sup>a</sup> .....	1,510
Central do Brasil <sup>a</sup> .....	8,145
Paulista .....	5,220
Sorocabana .....	3,350
Rede Mineira .....	525
Paraná-Santa Catarina .....	135
Leste Brasileiro .....	135
TOTAL ...	19,020

Sources: Official publications and the Economic Commission for Latin America.

<sup>a</sup> Data for the Santos-Jundiaí and Central do Brasil Railways include 310 and 3,095 million tons of suburban passenger traffic respectively.

#### (b) Steam traction

In 1962, according to the projection, the Brazilian railways will have about 515 steam locomotives in service. It is forecast that the characteristics of these locomotives (age, horse-power, etc.) will be very different from those of the engines at present in use.<sup>33</sup> For this reason it is not advisable to assess the average capacity of the units which will be in service in eight years' time on the basis of the average efficiency of Brazil's locomotives during any post-war year. The best means of determining this capacity is by using the data available on the steam locomotives of the Sorocabana Railway, which possesses a relatively large number of heavy engines that are in good condition and are utilized intensively.<sup>34</sup>

It is a common practice for railways to use certain locomotives for shunting and others for hauling loads. The problem is to ascertain how many are used for each activity. The conclusion was reached that 122 locomotives, which probably included the company's most up-to-date and powerful engines, are assigned to the transport of passengers and freight.

These locomotives hauled 2,357 billion ton-kilometres of gross weight, that is 19.3 millions per unit actually in service and 15.4 millions per existing unit.<sup>35</sup> On this basis it was assumed that the average transport capacity of the available locomotives in 1962 will be 17 million tons of gross weight.<sup>36</sup> Consequently, within the eight years envisaged, a total of 515 locomotives will be able to haul about 8.8 billion ton-kilometres of gross weight.

#### (c) Diesel traction

It is expected that diesel locomotives will be responsible for 16,455 billion ton-kilometres of gross weight in 1962. This figure was obtained by subtracting the share of electric and steam locomotives from the total volume of traffic.

To sum up, at the end of the period, that is, in 1962, railway traffic will be distributed by type of traction as follows:

Type of traction	Ton/kilometres of gross weight (billions)
Electric .....	19.02
Steam .....	8.8
Diesel .....	16.455

<sup>33</sup> For example, in 1962 the locomotives will have a minimum average traction power of 15,000 kilogrammes, as compared with an approximate average of 9,700 kilogrammes in 1951.

<sup>34</sup> The Sorocabana Railway at present owns twenty-one locomotives between ten and twenty years of age, and 109 units between twenty and thirty years of age; their average traction power is 14,792 kilogrammes.

<sup>35</sup> It is reckoned that about 20 per cent of the locomotive park remains idle during the year. The calculation was based on this assumption.

<sup>36</sup> This average traction capacity was attributed to the locomotives in question, since it was thought that they will have higher horse-power and traction capacity than those of the Sorocabana Railway.

## 2. Breakdown of shunting services by types of traction

Diesel locomotives are relatively more efficient than steam locomotives, especially for shunting. According to experience on railways in the United States,<sup>37</sup> one ton of diesel oil used for shunting in 1947 was equivalent to 18.8 tons of coal or to 11.6 tons of fuel oil used on the same service. For goods traffic, the corresponding proportions stood at 1 to 10.1 and to 5.9. Finally, for passenger traffic, one ton of diesel oil was equivalent to 9.9 tons of coal and 5.3 tons of fuel oil.

A similar comparison between diesel and electric traction shows that one ton of diesel oil represented 5,578 kWh for goods traffic, 4,717 kWh for passenger traffic, and 5,964 kWh for shunting. These results partially confirm the preceding figures.

The greater relative efficiency of diesel locomotives for shunting services leads to the conclusion that they will be used to a far greater extent for this work once the immediate traction needs for goods and passengers have been met. Programmes for the purchase of new locomotives published by some of the companies support this opinion, since they all envisage the almost exclusive use of diesel traction for shunting. Moreover, in one specific case this policy is even extended to the electrified sections of the railway concerned, where shunting is at present done by steam locomotives.

It is thus reasonable to assume that shunting will be carried out by diesel locomotives on all railways, except those that plan to use electric locomotives for this service.

The kilometric traffic of the electric engines will double between 1952 and 1962. As noted earlier, if shunting hours increase at the same rate, electric units will account for 300,000 hours of shunting time at the end of the period; in this case diesel locomotives will carry a work-load of 4.4 million hours.<sup>38</sup>

## 3. Composition of the park in 1962

### (a) Steam locomotives

Research in Brazil and the rail companies' own experience show that operation costs are considerably lower for diesel and electric than for steam locomotives. In some cases, the amount spent per unit transported by steam locomotives is twice as great as if diesel or electric locomotives had been used.<sup>39</sup>

It is true that the advantages obtained by using electric and diesel locomotives are not so great as the comparison of operation costs might suggest. But this does not imply that as regards total expenditure the disparity between steam traction on the one hand, and diesel or electric traction on the other, is insignificant.<sup>40</sup>

These facts suggest that in the period 1954-62, the Brazilian railways will replace steam by diesel or electric locomotives as and when the former become obsolete. This has been the policy adopted by a number of railways during the last five years.

If, then, it is assumed that the demand for steam locomotives will decline to zero, during the next eight years the decrease in the number of such locomotives will coincide with the degree of obsolescence of the units at present in service.

According to this hypothesis, the problem of the size and probable composition of the locomotive park in 1962 is confined to assessing the number of engines at present obsolete and of those which will become obsolete before the end of the period. This is no easy task, because more

<sup>37</sup> See Harold J. BARNETT, *Energy Uses and Supplies* 1937, 1947, 1965, a study published as Information Circular No. 7582 (October 1950) by the Bureau of Mines, Department of the Interior, Washington, D.C.

<sup>38</sup> The data on which this calculation was based excluded passenger transport services on electric trains.

<sup>39</sup> See Project 33 in the Annex to the Report of the Joint Brazil/United States Economic Development Commission. It should be noted that estimates of operation costs are based on 1951 prices for fuels, material and labour.

<sup>40</sup> Such expenditure includes amortization and payment of interest on the investment required for each type of traction.

than one criterion exists for appraising the obsolescence of steam locomotives.

The usual solution consists in establishing, on a more or less arbitrary basis, a certain period of useful life for the locomotives. In other words, the common practice is to show that a steam locomotive becomes obsolete after working for a given number of years. The difficulty lies in the fact that expert opinion on the length of useful life is not unanimous, although in the case of steam locomotives there is a fairly widespread belief that "it does not exceed thirty and only in exceptional instances reaches forty years."

If the 1950 park is studied from this point of view, it will be seen that more than half of the units in service were already out of date at that time. Thus, of a total of 3,644 locomotives, about 908 were of twenty to thirty years of age and 447 had been running twenty years or less.<sup>41</sup> The units included in these age groups represented less than 40 per cent of the total (37.5 per cent, to be accurate). More detailed information for 1949 shows that there were then 1,899 locomotives of more than forty years of age, while only 1,438 locomotives had been in service less than thirty-one years.

If the usual age limit of thirty years is adopted, the units aged between twenty-one and thirty years in 1952 will be obsolete before 1962, so that of the locomotives in the 1950 park, only some 380 units will still be fit for service by the end of the period.<sup>42</sup> Some experts maintain that the criterion of age as a measure of obsolescence has serious defects and may lead to fairly substantial errors. The Brazilian authority already cited asserts that this method of determining whether the locomotives are out of date is effective in a country where all the engines are of domestic production and the technical standard is uniform throughout, since locomotives built in the same year generally display similar technical characteristics.

According to the same source, "in countries where no uniform standard of technique exists, and especially in those where purchases of engines are almost always determined by considerations other than that of the best current techniques (as, for example, the unit cost, the form of payment, the time of delivery etc.) age alone is not a sufficient guide to the degree of obsolescence. This is because between 1900 and 1939, the largest and oldest producers of locomotives—i.e., Germany, the United Kingdom and the United States—used a great many different techniques".<sup>43</sup>

This study proposes a series of guiding principles, mainly of a technical nature, to replace the traditional criterion. According to the authors, the following should be considered obsolete: (1) locomotives whose boilers cannot withstand a pressure of 160 pounds per square inch; (2) locomotives of less than 250 h.p. for goods and passenger trains on 1-metre-gauge track; those of 400 h.p. or less for transport services on 1.60-metre-gauge track; and, for shunting on both gauges, those of less than 150 and 250 h.p. respectively; and (3) locomotives of the 2-4-0, 2-4-2, 2-6-0 and 4-4-0 types, when they are used for goods, not passenger transport, or when they are more than fifty years old.<sup>44</sup>

The application of such standards to the Brazilian railways produces very different results from those obtained by the conventional method. The research undertaken by the Railway Institute shows that of a total of 3,614 steam locomotives, 712 should be taken out of service. The remaining engines can be improved and modernized at a cost lower than that of the fuel which will be saved when the suggested technical improvements are introduced.

<sup>41</sup> Nevertheless, it should be noted that in the Annex to the Proceedings of the Ninth Plenary Meeting of the Instituto Ferroviário de Investigações Técnico-Econômicas (1950), the possible span of useful life is defined as forty years.

<sup>42</sup> Data taken from "Rejuvenescimento e Melhoria das Locomotivas a Vapor" (Modernization and Improvement of Steam Locomotives), Boletim do Instituto Ferroviário de Investigações Técnico-Econômicas, Vol. IV, No. 3, 1951.

<sup>43</sup> This figure was obtained by excluding from the total mentioned in the text, those locomotives that were nineteen to twenty years old in 1950.

<sup>44</sup> Boletim do Instituto Ferroviário de Investigações Técnico-Econômicas, op. cit., pp. 5 and 6.

<sup>45</sup> Ibid., Vol. IV, No. 2, 1952, minutes 32 and 34, pp. 11 et seq.

These two cases do not exhaust the list of criteria proposed for determining obsolescence, but they suffice to explain, without further illustration, the very different results obtained by applying such standards to the specific case of the steam locomotive park in Brazil.

Moreover, the formulation or selection of the best principles whereby to establish the degree of obsolescence of the type of locomotive considered here, would require very detailed research on the technical and economic factors involved in the problem.

As the primary object of this study is not to solve difficulties but to present them, and to provide examples of a method for projections, it will be assumed—without any implication of preconceived ideas on the subject—that the degree of obsolescence is assessed in terms of age and that the span of useful life is not longer than thirty years.<sup>45</sup>

In accordance with these assumptions the steam locomotive park in 1962 will consist of those engines at present in service which were less than nineteen years old in 1950 or which were purchased between 1951 and 1954, namely, an approximate total of 515 units.<sup>47</sup>

#### (b) Electric locomotives

The use of electric traction on Brazilian railways is a recent development except that two companies, the Paulista and the Rede Mineira de Viação, introduced it on some of their lines during the 'twenties. Many electric locomotives, therefore, are either nearly new or have been in service for only a few years. According to available data on the 1951 park, 122 units out of a total of 194 had been less than ten years in service, nine had been operating from eleven to twenty years, and the remainder for more than twenty years. (See table XIII for relevant details.)

Table XIII. Brazil: Distribution by age and power of electric locomotives more than 20 years old

Years of service in 1951	Locomotives	Horse-power	
		Continuous	Per horse-power hour
21 .....	9	2,210	2,500
22 .....	1	2,520	3,180
23 .....	22	3,880	4,280
24 <sup>a</sup> { .....	2	1,245	1,645
25 { .....	8	1,390	1,670
25 .....	1	1,950	2,165
	5	580	660
29 .....	4	1,480	1,680
	3 <sup>b</sup>	1,660	2,220
30 .....	8	1,480	1,665

Sources: Official publications and data supplied by the companies.

<sup>a</sup> An unspecified number of the locomotives in this age group are more than twenty-four years old.

<sup>b</sup> One or two of these locomotives are twenty-five years old.

Thanks to the homogeneity of the technical characteristics of those locomotives with the same number of years of service in Brazil, the age criterion can be used as a measure of obsolescence without the risk of error noted earlier in the text. Here again there is no conclusive information on the average useful life of electric locomotives, although there is some indication that it is about forty years.<sup>48</sup> Despite these indirect proofs, it was

<sup>45</sup> It was decided to accept only one hypothesis on useful life, to avoid unnecessary complications in the text and for the later calculations.

<sup>47</sup> Twenty-two steam locomotives were bought in 1951; 106 in 1952; five in 1953, and none at all during the first half of 1954.

<sup>48</sup> In the publication of the Instituto Ferroviário de Investigações Técnico-Econômicas which has already been mentioned, there is a table showing that the "possible length of life" of an electric locomotive is forty years. Again, of the plans published by the railway which owns most of the oldest engines in Brazil, not one envisages the replacement of the electric units. On the contrary, available information suggests that the company intends to continue using all the engines at present in service, among which forty-eight were twenty-five years old, or more, in 1954. This is a sign that, in the opinion of the company's experts, the average useful life exceeds thirty years.

thought best to adopt two working hypotheses on the average durations of electric units: one of thirty years and another of forty.

If the latter is the age limit, the locomotives more than twenty-eight years old included in table XIII—that is, thirteen or fourteen units—will have become obsolete before 1962. If the limit does not exceed thirty years, then sixty-three engines enumerated in the table will have to be withdrawn from service between 1954 and 1962.

In the absence of technical information, it is recommended that under either of the two hypotheses every obsolete unit should be replaced by a new locomotive of similar characteristics. It must be admitted, however, that this is the merest simplification, since a correct estimate of locomotive requirements can be made on the basis only of the work done by the obsolete engines, and not of their number.

Some of the figures shown in table XIV are copied from the estimates of locomotive requirements published in the railway companies' own electrification programmes. This is true of the data for the Sorocabana, Leste Brasileiro and Paraná-Santa Catarina railways.

Table XIV. Brazil: Demand for electric locomotives, 1953-62

	Locomotives	Horse-power (continuous)
E. F. Central do Brasil .....	41	4,470
	14	1,240
Cia. Paulista de E. F. ....	8	3,000
	1	1,660
	12	1,480
E. F. Santos-Jundiaí .....	6	3,000
E. F. Sorocabana .....	44	2,200
E. F. Leste Brasileiro .....	10 <sup>a</sup>	
Rede Mineira de Viação .....	10 <sup>a</sup>	900
Rede Paraná-Santa Catarina .....	14 <sup>a</sup>	
TOTAL ...	160	—

Sources: Data supplied by the railway companies.

<sup>a</sup> These locomotives have already been purchased and are in the possession of the railways concerned.

Other projections in this table were completed by introducing into the companies' calculations the changes required by traffic estimates. For example, the available information on the Rede Mineira's traction material needs relates only to the lines already electrified in 1954.

Finally, the Central do Brasil, Paulista and Santos-Jundiaí Railways form a special category, since the projections for these were calculated in accordance with the method and premises outlined at a later stage.

The latter as well as some of the former, corrections are of very limited value, because only one determinant of the demand for locomotives was considered—the volume of traffic. In a thorough study on traction requirements the influence of other factors, such as the gauge, length and radius of curves of the tracks where the locomotives are to operate, the type of brakes installed on rolling stock, and the daily flow of traffic, would have to be taken into account.

Electric locomotives haul only some of the inter-urban freight and passenger trains which circulate on the electrified lines of the Central do Brasil. Requirements, however, were calculated on the assumption that electric engines will haul all the traffic on these lines and on the tracks to be electrified during the period under discussion.

It has already been pointed out that by 1962 traffic on these lines will rise to about 5.05 billion tons gross weight, that is, rather more than four times the volume hauled by the electric locomotives available in 1952<sup>40</sup> (fifteen engines of 4,470 h.p. and five of 1,240 h.p.).

At first glance it seems reasonable to assume that the number of locomotives will increase in proportion to the expansion in the volume of

traffic.<sup>40</sup> There is, however, strong reason to believe that this hypothesis is unrealistic. That section of the Central do Brasil system which is yet to be electrified is technically superior to the lines already electrified. And it is well known that the characteristics of the track on which the locomotive runs are a decisive determinant of its effective transport capacity.

The technical advantages of the section in question will enable locomotives to transport a volume at least one-third greater than on the track, now electrified. In other words, the same number of locomotives as at present will be able to haul about 1.6 billion ton-kilometres gross weight on the lines in process of electrification. Since the estimated volume of traffic on these latter will amount to about 2.4 billion ton-kilometres gross weight by 1962, the railway will have to possess thirty locomotives—twenty-three of 4,470 h.p. and eight of 1,240 h.p.—to cope with this service.<sup>41</sup> To these must be added the engines required by the railway to meet growing traction demands on that section of the main line which is already electrified. By 1962, traffic will have risen to 2,631 billion ton-kilometres of gross weight in contrast with 1.2 billion in 1952.<sup>42</sup> If locomotive efficiency is assumed to be constant, then the Central do Brasil will have to maintain forty-four electric locomotives on this stretch of the line, or twenty-four more than in 1952. According to the present hypotheses, eighteen will be of 4,470 h.p. and the remainder of 1,240 h.p.

The sum of the two partial results indicates that the Central do Brasil will have to enlarge its park by forty-two locomotives of 4,470 h.p. and fourteen of 1,240 h.p.

The estimate for the Paulista Railway was made on the basis of two facts: the first, that a 3,000 h.p. electric locomotive hauls about 73 million ton-kilometres gross weight annually,<sup>43</sup> and the second, that the increase in the traffic on the electrified sections will be 1.7433 billion ton-kilometres of gross weight in absolute terms.

In actual fact, the transport capacity attributed to the 3,000 h.p. units is an over-estimate in the present condition of the track on 130 kilometres of the Paulista Railway trunk line;<sup>44</sup> but as this part of the permanent way is to be relaid shortly, it was calculated that capacity will rise to the level indicated.

Technical improvements on a section of the main line will also affect locomotive requirements, since they will mean an increase—estimated at 32 per cent.—in the capacity of the units at present in service. This implies that once the line is relaid, the Paulista Railway will be able to transport about 4.6 billion ton-kilometres of gross weight with the same number of locomotives, instead of 3.4767 billion as in 1952. With more locomotive capacity available, the traffic volume to be hauled by new units will decline to 620 million ton-kilometres of gross weight, a work load with which 3,000 h.p. locomotives can deal.

The projection for the Santos-Jundiaí Railway was made in a similar way. The volume of traffic estimated for its electrified sections will rise to 1.51 billion ton-kilometres by 1962, while the locomotives at present in service will be able to haul, working at full capacity, about 1.1 billion

<sup>40</sup> This assumption can be justified only on the premise that the locomotives in service at present are operating at full capacity. Information is not available on this and other subjects to disprove or confirm such a statement.

<sup>41</sup> Obviously, the number and power of the locomotives to be purchased cannot be determined by so simple a method. The solution to this problem must be based on a thorough study of a series of technical factors. This projection, therefore, should be interpreted only as a general indication of the size of the demand.

<sup>42</sup> This was not in fact the volume of traffic on this line but the transport effected by electric locomotives.

<sup>43</sup> On the Santos-Jundiaí Railway, fifteen locomotives of 3,000 h.p. transported an average of 72.4 million ton-kilometres of gross weight in 1953.

<sup>44</sup> In 1951, the locomotives at present in service on the Paulista line hauled an average of 69.2 million ton-kilometres of gross weight, and it is estimated that they will be able to transport much more when the track is re-laid. The average motive power of the twenty-five locomotives exceeds 3,000 h.p. by an ample margin.

<sup>40</sup> They included one locomotive of 700 h.p., probably used for shunting.

ton-kilometres gross weight.<sup>55</sup> The balance to be transported with new engines will therefore be 410 million—that is, the volume that six 3,000 h.p. units can haul.

In brief, the railways will have to incorporate into their park all the locomotives listed in table XIV, except, of course, the thirty-four already purchased. It should be stressed that the estimate is valid only on the assumption that the average life of electric traction units is forty years. Under the hypothesis that the average useful life is only thirty years, 176 locomotives would have to be purchased, as against only 126 when a life of forty years is postulated.

The composition of the 1962 locomotive park is shown in table XV. This table excludes the electric suburban passenger trains which the railways at present own or propose to acquire. Of the 156 units whose purchase had been programmed in recent years, 100 have already been bought.

Table XV. Brazil: Probable composition of the electric locomotive park in 1962

Horse-power (continuous)	Locomotives
More than 4,000 .....	61
3,500 to 3,999 .....	22
3,000 to 3,499 .....	29
2,500 to 2,999 .....	91
2,000 to 2,499 .....	9
1,500 to 1,999 .....	4
1,000 to 1,499 .....	41
Less than 1,000 .....	65
Unknown .....	19 <sup>a</sup>

Sources: Official publications and Economic Commission for Latin America.

<sup>a</sup> Includes seven locomotives with a gauge of less than 1 metre and twelve engines belonging to small companies.

#### (c) Diesel locomotives

It was previously stated that by 1962 diesel locomotives will have to haul traffic representing about 16.5 million ton-kilometres gross weight. The problem, therefore, is to calculate the number of engines required for this work-load. In fact, all that is needed in order to estimate, albeit approximately, the traction material requirements, is information on the average transport capacity of diesel locomotives of a given horse-power.

Data on the capacity of diesel locomotives are not very plentiful, because, until recently, Brazilian railways had relatively few of these engines in service. Table XVI summarizes the most significant data that could be assembled on this subject. Statistics for the first three railways refer to transport by diesel locomotives during 1952; the remainder indicate the transport capacity attributed by the companies' experts to the engines of the horse-power given which they suggest the railways should acquire.

These figures suggest that the effective and estimated transport capacity rise considerably from one instance to another, partly on account of differing lay-out and general condition of the permanent way on the several railways and partly because of disparities in the power of the engines in service or whose purchase is recommended.

Despite the wide range of examples, however, the general conclusion can be drawn that an average transport capacity of 40 million ton-kilometres of gross weight, per available locomotive of 1,000 h.p. or more, represents a reasonable estimate. This figure shows that 410 diesel engines will be required for goods and passenger transport.

In order to calculate the total 1962 park, the locomotives needed for shunting must be added. Unfortunately, lack of adequate information on the annual hours of service of the diesel locomotives at present used for shunting prevents any accurate calculation of the number of locomotives that will be required by the end of the period. It can be assumed, however, that each unit in effective service will work 6,120 hours, that is, eighteen

Table XVI. Brazil: Effective diesel locomotive capacity (ton-kilometres gross weight) and estimated capacity of locomotives recommended for purchase<sup>a</sup>

Railways	Locomotives	Horse-power	Annual haulage capacity per locomotive (Millions of ton-km.)
<i>Locomotives in service<sup>b</sup></i>			
Paulista .....	10	1,600	36.9
Santos-Jundiaí .....	12	1,000	48.0
Sorocabana <sup>c</sup> .....	37	...	29.8
Weighted average <sup>d</sup> .....	—	1,300	43.0
<i>Locomotives whose purchase is recommended<sup>e</sup></i>			
Leopoldina .....	26	1,750	32.0
Paraná-Santa Catarina .....	20	1,400	28.8
Rio Grande do Sul .....	13	1,600	53.1
	4	600	23.5
Sorocabana .....	21	1,600	66.8
Weighted average .....	—	1,500	42.8

Sources: Railway publications, direct information and projects of the Joint Brazil/United States Economic Development Commission.

<sup>a</sup> Basic data appear in the projects prepared by the Joint Brazil/United States/Economic Development Commission. But the problem considered in these projects differs from that examined here. The Commission's experts were faced with determining the number and type of locomotive required to transport a given volume of freight and passengers over a specific distance.

<sup>b</sup> Annual capacity is the effective transport by diesel locomotive in service in 1952.

<sup>c</sup> The horse-power of these locomotives is unknown, but data on engines under repair seem to indicate that twelve were of 1,200 h.p. and twenty-five of 800 h.p.

<sup>d</sup> Estimate.

<sup>e</sup> The haulage capacity of the locomotives whose purchase is recommended refers to the total number of machines and not to those in service.

hours daily for 340 days in the year.<sup>56</sup> In support of this hypothesis it should be noted that in 1952 the average working time of sixty diesel locomotives on the Sorocabana Railway was 6,188 hours; to judge from incomplete data, the figure was even higher for the ten engines of the Santos-Jundiaí Railway in 1953.<sup>57</sup>

The break-down of shunting time by types of traction showed that diesel locomotives will have to account for 4.4 million hours of such service. Under the hypothesis in the preceding paragraph, 719 engines would be sufficient to carry out this shunting work. In practice, however, more locomotives will be needed, because the railways must always keep some units in reserve to ensure the efficient operation of the park.

It is estimated that under the most favourable circumstances, not less than 5 per cent of the available locomotives—that is, thirty-eight units—should be out of service.

Consequently, by 1962 the Brazilian railways will need a minimum of 757 diesel shunting engines.

The co-ordination of this projection with that outlined in the preceding pages justifies the statement that by 1962 the diesel engine park will comprise 1,167 locomotives. Up to the end of 1954, a relatively high number of diesel locomotives (412 to be exact) had been purchased.<sup>58</sup> The balance represents the equivalent of 755 units,<sup>59</sup> most of them for shunting services, as will be seen on page 127.

<sup>56</sup> In the annex to Project 36 of the Joint Brazil/United States Economic Development Commission, a greater degree of utilization was assumed for a specific case than that suggested in the text (see page 34 of the mimeographed version of the document in question). Clearly, if the work-load assumed for shunting engines is under-estimated, for the same reason and to the same degree requirements will have been over-estimated.

<sup>57</sup> These locomotives were not used for shunting, and only some of the diesel engines on the Sorocabana Railway were turned to this purpose.

<sup>58</sup> The total includes engines which have been purchased but which may not have been delivered as yet to the railways.

<sup>59</sup> The balance should be calculated after deducting from the park locomotives which will become obsolete during the selected period. This correction was not made because there were very few diesel engines

<sup>55</sup> In 1953, the volume transported amounted to 1.086 billion tons.

Table XVII. Brazil: Power of diesel locomotives purchased or planned to be purchased

(Units)

Horse-power	Number in December 1951	Purchased or brought into service, 1952-54	Purchase recommended*
2,250 .....	—	3	7
1,900 .....	—	13	—
1,600 .....	12	153	94
1,500 .....	12	—	—
1,400 .....	—	—	32
1,200 .....	15	—	9
1,000 .....	48	—	22
750 .....	—	—	31
660 .....	70	12	—
480 or less .....	27	40	6
Unknown .....	7	—	—
TOTAL ...	191	221	201

Sources: Official publications and projects of the Joint Brazil/United States Economic Development Commission.

\* By the Joint Brazil/United States Economic Development Commission.

Within certain limits, the sphere of utilization of a diesel engine is not defined by its power. It is even more evident that engines of a given horse-power (for example 660 h.p.) can be used, under certain circumstances, as efficiently for shunting as for other types of haulage. Broadly speaking, units up to 750 h.p. can be considered as suitable for shunting and the remainder for goods or passenger transport.

According to this principle, 156 units<sup>60</sup> of the 412 locomotive engines included in the park belong to the first group and 256 to the second, as the former have a maximum of 660 h.p. and the latter a minimum of 1,000 h.p.

It has already been pointed out that by 1962 the Brazilian railways will need in all 757 locomotives for shunting, and as at present they have only 156, the implication is that these railways must purchase 599 additional locomotives in the course of the eight years under consideration. Similarly, it can be deduced that the freight and passenger engines to be purchased number 154 units.

It is interesting to note that this figure differs by only ten units from the recommendation of the Joint Brazil/United States Economic Development Commission for the purchase of engines of 1,000 or more h.p.

The similarity between the estimate in the present report and that of the Commission justifies the use of the latter as the basis for a more detailed

Footnote 59 (continued)

over ten years old in 1952. According to data available for that year, there were twelve nine-year old, four eleven-year old and three thirteen-year old locomotives.

<sup>60</sup> Includes seven engines of unknown horse-power.

projection of the demand for locomotives and the composition of the park in 1962. In fact, the only important change introduced into the Commission's estimate refers to shunting units. The results obtained by combining both projections are summarized in table XVIII.

Table XVIII. Brazil: Demand for diesel locomotives in 1955-62 and probable composition of the park in 1962

Horse-power	Demand for locomotives in 1955-62	Probable composition of the park in 1962
2,250 .....	7	10
1,900 .....	—	13
1,600 .....	94	259
1,500 .....	—	12
1,400 .....	32	32
1,200 .....	9	24
1,000 .....	22	70
750 .....	31	31
660 and less .....	570	726
TOTAL ...	765	1,177

Sources: Economic Commission for Latin America and Projects of the Joint Brazil/United States Economic Development Commission.

#### (d) Goods trucks

On 1 January 1950 the Brazilian railways possessed 59,829 goods trucks with an aggregate capacity of 1,573,034 tons.<sup>61</sup> Two years later there were 58,167 goods trucks in circulation,<sup>62</sup> whose aggregate capacity is not known. It was also impossible to determine the distribution of the units by the type of materials used in their construction. According to a sample covering 65 per cent of the park, more than one-third (or to be accurate, 35.5 per cent) of the trucks were made of wood, a similar percentage of steel and the remainder of both materials. (See table XIX.)

If this sample is representative, it may be assumed that in 1951 the railways owned some 20,650 wooden trucks with a capacity of 387,665 tons. According to expert opinion,<sup>63</sup> trucks made of this material should be classified, except for a few cases, as obsolete equipment. They will, therefore, have to be replaced by new trucks.

The average capacity of the rolling stock to be replaced is 18.7 tons. The new units will almost certainly have a higher capacity, probably of about 36 tons.<sup>64</sup> It may therefore be assumed that each new truck will replace 1.9 obsolete units. According to this coefficient, the railways will have to purchase about 10,770 wagons to meet replacement needs.

<sup>61</sup> Information from *Inquéritos Especiais — Viação Férrea, Recenseamento Geral de 1950*.

<sup>62</sup> See *Comissão Mista Brasil-Estados Unidos, Estudos Diversos*, p. 53.

<sup>63</sup> See *Comissão Mista Brasil-Estados Unidos, op. cit.*, p. 54.

<sup>64</sup> Most of the goods trucks whose purchase was recommended by the experts of the above-mentioned Commission have this capacity.

Table XIX. Brazil: Number and capacity of trucks on eleven railways\* classified by type and construction materials, 1951

	Number of trucks			Capacity (tons)		
	Wood	Steel infrastructure	Steel	Wood	Steel infrastructure	Steel
Bocars .....	4,491	5,108	7,536	84,919	131,385	272,096
Gondolas .....	3,051	2,139	4,164	65,605	56,998	153,161
Flatcars .....	2,183	1,941	1,102	46,973	52,207	39,361
Stockcars .....	2,213	998	255	41,666	27,105	7,355
Other types .....	1,522	1,016	158	13,552	18,013	3,873
TOTAL ...	13,460	11,202	13,215	252,715	285,708	475,846

Sources: Official publications.

\* The eleven railways included are: Leopoldina, Mogiana, Rede Mineira, Aramquara, Central do Brasil, Viação Férrea do R.G. do Sul, Noroeste do Brasil, Santos-Jundiaí, Paulista, São Luiz-Terezina and Central do Piauí.

The volume of goods—including livestock—will increase from 8,985 billion ton-kilometres in 1952 to 15,785 billion in 1962. In absolute terms, the increment in goods traffic between these years will be about 6.8 billion ton-kilometres. The problem is now to calculate the number of railway trucks required to deal with the additional volume of transport.

In 1951, average truck capacity stood at 26.3 tons, while the payload transported amounted to 576 tons per truck. The payload carried per average ton of capacity was therefore 21.9 tons. In 1930, the only year for which it was possible to obtain data, the ratio between payload transported and tons of capacity was practically the same: 22.5 to 1.

It has already been stated that the average capacity of the new trucks will be 36 tons. On the assumption that the ratio will remain constant at a level of 22 to 1, the average weight transported annually by each new truck will be 792 tons. If by 1962 the average distance that this volume is transported is the same as in 1952, namely 233 kilometres, each truck will average volume of transport equal to 185,000 ton-kilometres.<sup>65</sup>

In order to transport 6.8 billion additional ton-kilometres, it would be necessary to enlarge the park by 36,757 new trucks. These units plus those required for replacement represent total truck requirements of 47,527 units, the annual demand being approximately 4,750 trucks.

#### 4. Energy consumption on the railways

The calculation of energy consumption on the railways raises the problem of selecting the rates of efficiency which must be applied in order to reduce the calorific value of the various fuels to kilowatt-hours.

Firstly, it should be stressed that it is inadvisable to apply the energy rates utilized in the chapter on energy when this type of consumption is to be measured, because they do not represent the thermic efficiency of the various types of railway locomotives. In reality, by utilizing for conversion into kWh the two rates proposed in the chapter cited, the energy which could be obtained by the alternative use of electricity and the fuels consumed by the railways would be estimated,<sup>66</sup> not the energy actually consumed in the railway sector.

In order to calculate this figure, other coefficients must be applied. On the basis of the data available, it was considered that the following are the most satisfactory: fuelwood, 2.8 per cent; domestic coal, 3 per cent; imported coal, 3.4 per cent; fuel oil, 4.5 per cent; diesel oil, 28 per cent, and electric energy, 65 per cent.

The consumption of energy by the railways, according to these rates, amounted to 802.7 million kWh in the pre-war period (1939), and to 1,277.9 millions in 1952. These figures represented 5.4 and 5.2 per cent of the national total, respectively.

The importance of the railways as consumers of certain fuels was greater than their share in total energy consumption would indicate. Indeed, in 1939 the railway sector absorbed more than half of the domestic and imported coal used in Brazil and 10.1 per cent of the fuelwood. But the

Table XX. Brazil: Share of railways in national fuel consumption (Percentages)

	1939	1952
Diesel oil .....	—	4.4
Fuel oil .....	1.8	13.5
Domestic coal .....	53.2	72.0
Imported coal .....	54.6	20.6
Fuelwood .....	10.1	14.0
Electric energy .....	5.4	5.8

Sources: Joint ECLA/BNDE Group, and data published by the Departamento Nacional de Estradas de Ferro.

<sup>65</sup> In 1951 the figure registered was 134,327 ton-kilometres and in 1930, 84,454 ton-kilometres.

<sup>66</sup> The various fuels and the electric energy used for traction were equivalent (at the rate of 5 per cent for fuelwood, 20 per cent for other fuels and 100 per cent for electric energy) to 2.9 billion kWh in 1939 and 3.8 billion in 1952.

railways accounted for only an insignificant share of aggregate liquid fuel consumption. In the course of time, the proportion of the various fuels and electric energy used by the railways gradually increased, except in the case of imported coal. (See table XX.)

#### (a) Development of energy consumption

A comparison between the index of the energy consumed by twelve railways and the fare-paying kilometric goods and passenger traffic on these lines<sup>67</sup> indicates that from 1940 to 1942 the unit consumption of energy was consistently higher than in 1939, except in two specific years. If the comparison is extended to thirteen railways (the twelve mentioned above plus the Central do Brasil), the results are no longer the same because the last-named railway (which substantially affects the aggregate unit consumption) remained considerably below the 1939 level throughout this period. This may not accurately reflect the facts; it is possibly a consequence of the values assigned to the conversion coefficients utilized for calculations.<sup>68</sup>

In any case, a comparison of the aggregate consumption of energy series with that of ton-kilometres of payload might, under certain circumstances, be misleading, because the payload is only a part—the smallest, in fact—of the total hauled by the locomotives; in addition, the deadweight transported does not always increase at the same rate as the payload.

To obtain a precise idea of the development of energy consumption it is necessary to compare the aggregate consumption series with another for ton-kilometres of gross weight, taking care to exclude from the former the consumption which represents shunting. Another solution would be to convert shunting time to its equivalent in ton-kilometres of gross weight, so as to provide a homogeneous series representative of the over-all work of the locomotives, and therefore comparable with that of aggregate energy consumption.

Neither of these two adjustments can be made, for lack of sufficient data. Moreover, they cover only twelve railways. Although figures on unit consumption of energy based on uncorrected series have only a limited value, they are presented here as being not wholly devoid of interest. (See table XXI.)

Table XXI. Brazil: Energy consumption per thousand ton-kilometres of gross weight on twelve railways

Year	kWh
1939 .....	39.3
1943 .....	42.7
1946 .....	48.0
1951 .....	44.1

Source: Official publications and data supplied by the railway companies.

According to the above data, energy consumption per thousand ton-kilometres of gross weight rose between 1939 and 1951 from 39.3 to 44.1 kWh, that is, by 12.2 per cent, or somewhat more than was indicated by a comparison with the payload for kilometric traffic.<sup>69</sup> It is impossible to

<sup>67</sup> Both this index and that of the thirteen railways are shown in table G of the Statistical Annex. The comparison could also be made by taking as a point of reference a payload index constructed by reducing the various components of railway traffic to ton-kilometres. In the specific case under review, the index thus prepared does not differ to any great extent from that used in the text.

<sup>68</sup> For example, if the conversion coefficient of imported coal had been over- or that of fuelwood under-estimated, or both, a substantial drop in the consumption of the former, concurrent with an increase in the latter, would obviously make the total consumption of energy appear less than it would have been in reality. This was precisely what happened in the thirteen railways included in the sample, particularly the Central do Brasil: consumption of imported coal dropped sharply, while that of fuelwood increased.

<sup>69</sup> The deadweight, and consequently, the gross weight increased less than the payload.

determine with accuracy what would be the effect of including the Central do Brasil Railway in the sample.

In any case, it may safely be asserted that unit consumption of energy in 1951 was substantially the same as in 1939. Moreover, available data show that in the post-war period such consumption was slightly higher than in the years preceding the Second World War.

Two factors probably favoured the maintenance of a higher consumption level than in 1939: <sup>70</sup> the continued use of most of the locomotives which, at the beginning of the war, were already obsolete; and the relative increase in the volume of passenger traffic.<sup>71</sup> Until 1952, the addition of new locomotives to the park had been carried out on a very modest scale, so that the favourable impact of this process upon the unit consumption of energy had not yet offset the influence of negative factors.

It is quite likely that in 1954 energy consumption per ton-kilometre of gross weight may have stood at a lower level than in 1939, as a consequence of the addition of diesel and electric engines to the park.

#### (b) Contribution of the various sources of energy

In the railway sector it is advisable to distinguish between the substitution process which occurs among the different sources of energy for steam transport (to be called the direct substitution process) and that which takes place when one type of traction is replaced by another—for example, steam by diesel, or the latter by electric traction, etc.<sup>72</sup>

Both processes affected Brazilian railways in 1939–52. In the first stage, direct substitution was more important, while in the second phase, although the original process did not cease, indirect substitution predominated.

In 1939, not less than 10.4 per cent of the energy consumed by the railways was of hydraulic origin. The remainder represented the sources used by steam traction, particularly fuelwood and coal.<sup>73</sup> Four years later, the share of hydroelectric power in total consumption was practically unchanged, as was also that of the other sources taken as a whole. (See table XXII.)

Table XXII. Brazil : Share of the various sources of energy in aggregate consumption of thirteen railways  
(Percentages)

Year	Hydroelectric energy	Diesel oil	Coal <sup>a</sup> , fuel oil and fuelwood
1939 .....	10.4	—	89.6
1943 .....	11.5	—	88.5
1945 .....	14.3	1.2	84.5
1946 .....	14.2	4.0	81.8
1951 .....	20.6	9.8	69.6
1952 .....	21.2	11.3	67.5

Source : Economic Commission for Latin America.

<sup>a</sup> Domestic and imported.

Among these latter, substitution became intensive, since the scarcity of imported fuels increased the dependence of steam transport on domestic sources. Thus in 1943, fuelwood and domestic coal accounted for 89.2 per cent of the energy consumed by steam locomotives, while in 1939 they had not contributed more than 65.2 per cent. The progress made by these two sources was at the expense of imported coal. (See table XXIII.)

<sup>70</sup> Fluctuations in the amount of shunting may also have exerted some influence, but no definite pronouncement can be made on this subject on the basis of available information.

<sup>71</sup> Consumption per ton-kilometre of gross weight is greater—to judge from incomplete data—in passenger than in goods services.

<sup>72</sup> One of the characteristics distinguishing one process from the other is that the former requires only modest investment to enter operation, while the latter (in most cases) requires substantial initial investment in special material and expert personnel.

<sup>73</sup> The energy consumed by these thirteen railways in 1939 and 1952 accounted for 95.2 and 90.1 per cent respectively of aggregate consumption in the railway sector.

Table XXIII. Brazil : Share of fuels used for steam traction in aggregate energy consumption of thirteen railways

Year	Fuelwood	Coal		Fuel oil	Total for group (Millions of AWh)
		Domestic (Percentages)	Imported		
1939 ...	54.3	10.9	33.9	0.9	685.3
1943 ...	71.0	18.0	10.8	0.2	754.5
1946 ...	65.5	12.6	19.3	2.6	822.7
1950 ...	57.5	19.2	13.3	10.0	772.2
1951 ...	56.7	19.7	11.7	11.9	791.6
1952 ...	54.1	23.3	6.6	16.1	777.8

Source : Official publications and the Banco Nacional do Desenvolvimento Econômico.

During 1944–45, imported coal consumption recovered slightly, but its respective group continued to lose ground to other sources, such as diesel oil and hydroelectric energy. This process began in 1946, as shown by the fact that between 1946 and 1952 the contribution of hydroelectric and diesel energy rose from 183 to 374 million kWh, while that of fuelwood, coal and fuel oil fell from 883 to 778 million kWh. The share of the two former sources in the aggregate energy consumption of the railways therefore expanded from 10.4 to 32.5 per cent, while that of the remainder dropped from 89.6 to 67.5 per cent. Among the types of fuel used by steam locomotives, however, an increase in the energy obtained from fuel oil and domestic coal was more than offset by a decrease in the share of fuelwood and imported coal.

The changes that occurred during the period 1939–52, taken as a whole, can be summarized under the three following heads : first, the substantial increase—both in absolute and relative terms—in the contribution of hydroelectric energy and diesel oil, as a result of the more widespread use of locomotives dependent on these forms of energy; secondly, the decrease in the relative share of aggregate consumption represented by the sources of energy for steam traction; and lastly, the almost complete replacement of imported coal by its domestic counterpart and to a still greater extent, by fuel oil.

The reasons for this third development should be examined. The ousting of imported coal is not a recent phenomenon, since incomplete data available for the thirties show that it lost ground to fuelwood when the devaluation of the cruzeiro made coal relatively more expensive. By the end of that decade the cost of the energy provided by imported coal was already higher than that of energy from other sources. In 1939, the cost of 100 kWh from various sources was as follows : from imported coal, 56.7 cruzeiros; from domestic coal, 44.6; from petroleum, 28.0 and from fuelwood, 22.1 cruzeiros.<sup>74</sup>

After the outbreak of the war, prices of domestic fuels tended on the whole to rise more rapidly than those of imported fuels. In twelve years (1939–51), the average cost of fuelwood increased four-fold and that of domestic coal to an even greater extent, in comparison with increments of 208.7 and 143 per cent in the price of imported coal and fuel oil.<sup>75</sup> As a result of these changes, fuel oil became the cheapest source of energy for steam traction and domestic coal the most expensive, followed very closely by imported coal.

The fluctuations of these four fuels suffice to explain the partial replacement of foreign coal by fuel oil, but not the shift from the former to domestic coal. If relative prices had been the only determining factor

<sup>74</sup> As regards petroleum, the c.i.f. price was taken as a basis for estimate, since the price from railway statistics was hardly representative, because the companies consumed only a small volume of fuel oil in 1939. To standardize the data, whenever necessary, the c.i.f. price was used. As additional expenditure must be added to this price to calculate the price actually paid by the railways, the cost of fuel oil was in fact greater than indicated. For fuelwood the position is somewhat similar, since the price mentioned by the railways does not include carriage over their own lines.

<sup>75</sup> These statements would undergo no radical modification if the corrections strictly required were introduced. According to railway statistics, for instance, the drop in the relative price of fuel oil was greater than that shown in the text.



in the distribution of consumption among the different sources of energy, the railways would probably have ceased to burn coal. Its more intensive use was in fact due to the Government's policy of encouraging domestic coal production.

It is interesting to note that the changes described above meant that the railway section became less dependent upon foreign energy sources. While in 1939, 31.2 per cent of the energy consumed by the railways was supplied by imported fuels, in 1952 foreign sources accounted for only 26.6 per cent.

#### 5. Future demand for energy

The projection of the demand for electric energy, diesel oil and other fuels is based on the ratio noted on some Brazilian railways between the consumption of these types of fuel and the volume of transport and shunting. The other basis for the projection is the estimated work-load for each type of locomotive.

The solution suggested for this problem is not the only one, nor necessarily the most accurate, but it is the simplest and the most consistent with available data. At all events, probable sources of error should be explained.

Some of the factors on which energy consumption per unit of transport depends are purely local, that is, not typical of the railway system as a whole. Any generalization on the consumption of energy is therefore hazardous if it is deduced from the experience of a few companies only. The estimates given here are based on the meagre data available for two railways, some of whose characteristics are rather exceptional, and whose incidence upon total energy consumption cannot be assessed.

##### (a) Projection of demand for electric energy

The consumption of electric energy per thousand ton-kilometres of gross weight on goods trains varies between 30.5 and 31.0 kWh, according to statistics for 1951 and 1952 published by the Sorocabana Railway. This same company's consumption for an equal volume of transport on passenger trains amounted to 43.0 kWh. Data for the Santos-Jundiaí Railway confirm the preceding figures; during the same two years, average consumption per thousand ton-kilometres of gross weight transported on goods, passenger and mixed traffic trains varied between 33.7 and 36.2 kWh.

To judge from the experience of these two companies, about 35 kWh are required for freight and passenger trains to haul one thousand ton-kilometres. A simple calculation shows that the Brazilian railways will need 542 million kWh by 1962 to transport the 15.48 billion ton-kilometres that will represent the aggregate load for all types of trains, with the exclusion of suburban passenger traffic.<sup>76</sup> This last would have to transport 3.405 billion ton-kilometres of gross weight, or their equivalent, i.e., 4.76 billion passenger-kilometres. On the basis of somewhat inadequate data, it was calculated that energy consumption per thousand passenger-kilometres on trains of this type is about 20 kWh, so that total energy consumption for suburban passenger transport will be about 95 million kWh.

It is difficult to assess the consumption of the shunting services because no statistics are available on consumption per hour of work of electric shunting locomotives. The only available data show that consumption per locomotive hour on the Sorocabana Railway amounts to approximately 285 kWh. But the engines used by that company are unusually high-powered, and their hourly consumption does not therefore provide a satisfactory point of reference. With this reservation, and in default of more adequate information, an hourly consumption of 285 kWh for shunting was assumed.<sup>77</sup>

The 300,000 hours of shunting carried out by electric locomotives in 1962 would raise consumption to 85.5 million kWh, which, together with the figures resulting from other partial projections, gives an aggregate consumption of 722.5 million kWh. This energy will be entirely of hydroelectric origin, since the only line which will draw on a different source—the Leste Brasileiro Railway—was excluded from the estimate.

<sup>76</sup> Transport on the Leste Brasileiro Railway was also excluded from the total.

<sup>77</sup> The calculation would be easier if the average power of shunting locomotives and their probable degree of utilization were known.

Some railway companies, however, among them the Rede Mineira de Viação and the Rede Paraná-Santa Catarina, plan to use groups of diesel generators as reserve plants.

##### (b) Projection of demand for diesel oil

By a procedure similar to that outlined above, it was estimated that by 1962 diesel oil consumption will amount to 247,000 tons, of which 132,000 will be used for shunting and the remainder for freight and passenger transport.

It was possible to base partial projections on the calculation that diesel oil consumption is about 7 kilogrammes per thousand ton-kilometres of gross weight transported and about 30 kilogrammes per shunting hour. But both figures are approximations based on the experience of two companies. On one line—the Santos-Jundiaí Railway—the average diesel oil consumption per thousand ton-kilometres of gross weight was 6.8 kilogrammes for the period 1949–52, while on another—the Sorocabana Railway—it was 7.5 and 6.2 kilogrammes in 1951 and 1952.<sup>78</sup> On this latter, consumption per locomotive hour in the same two years was 31.7 and 30 kilogrammes respectively.<sup>79</sup>

##### (c) Projection of demand for steam traction fuel

The high degree of substitution possible among fuels for steam traction converts the relative costs of the energy generated from fuelwood, coal and petroleum into a basic determinant of the demand for all these fuels. The projection must therefore be based on a forecast of the evolution of costs.

Available information and known methods of analysis do not permit this problem to be solved with a satisfactory degree of accuracy. Consequently, only the most recent fluctuations in the prices of these fuels will be examined, together with the general trend characteristic of such prices and therefore of the cost of energy from the sources under consideration.

From 1951 until 1953, the downward trend of imported fuel prices became more marked. To judge by foreign trade statistics, the c.i.f. price of fuel oil dropped by 9.4 per cent in these two years, while that of coal declined 31 per cent. During the same period, the price of domestic fuels—fuelwood and coal—continued to rise.<sup>80</sup>

The modified exchange rates applied in 1953 to imported fuels ended a process which had been particularly pronounced since the end of the war. The relative position of domestic fuels improved substantially during 1954, since the exchange rate for petroleum and imported coal rose from 18.62 cruzeiros per dollar to 30.72 cruzeiros—that is, by 64.1 per cent.<sup>81</sup> Because of these adjustments, fuel oil was replaced by fuelwood as the cheapest source of energy for steam traction<sup>82</sup> and imported coal became the most expensive fuel.

These changes clearly show that exchange policy plays a decisive role in the present context. It must therefore be emphasized that the projection of demand given here is based on the assumption that the exchange rate will be periodically modified to bring it into line with the over-all level of domestic prices. In other words, the possibility of the cruzeiro's being either over-valued or under-valued during the next eight years was discarded.

<sup>78</sup> Excluding consumption on shunting services.

<sup>79</sup> The average horse-power of the diesel locomotives of the Sorocabana Railway in 1951 and 1952 was fairly low, but was higher than that of the engines normally used for shunting.

<sup>80</sup> The price at the collieries rose from 185 cruzeiros per ton in 1951 to 200.6 cruzeiros in 1953, that is, by 8.4 per cent.

<sup>81</sup> During the first half of 1954 a surcharge of 7 cruzeiros per dollar was established; this later rose to 10 cruzeiros and during the last quarter to 12.

<sup>82</sup> This and other comparisons of the same type disregard the fact that the use of fuelwood involves the railways in heavier subsidiary expenses per unit of energy than that of other fuels. Such outlay is due, for example, to the greater number of halts which the locomotives must make to take in fuel supplies. In fact, these subsidiary expenses should be considered as part of fuelwood costs, but they were excluded because it was impossible to assess their book value.



The behaviour of coal and fuelwood prices was very similar during the period 1939-52. Both rose at least as much as the over-all price level. In the future, it would not be surprising if the price of fuelwood increased more rapidly than that of other fuels, since the forest reserves which lie closest to the centres of railway consumption will be exhausted. Prospects are more favourable for domestic coal, as the implementation of the existing investment programme in this sector will cause higher productivity throughout the coal production processes. The price of coal will therefore probably rise less or decline more than the general price level.

It has already been pointed out that, by the end of 1954, energy derived from fuelwood cost the railways less than that obtained from domestic coal. Meanwhile, it is open to doubt whether higher productivity will lower coal prices enough to enable this source of energy to compete with fuelwood for railway use. The difference in the cost of energy from these two types of fuel is so great that it could hardly be eliminated in the course of eight years.<sup>82</sup> For a similar reason, it may be assumed that fuel oil will maintain its position as the cheapest imported source of energy.

Should the exchange rate follow the behaviour pattern described, it would appear that competition between fuels for steam traction will be confined to fuelwood and fuel oil. In fact, the former will even tend to lose ground to the latter, if its price rises more than the over-all price level. Fuelwood consumption will probably be restricted to railways located in areas where this source of energy is in plentiful supply.

According to an incomplete estimate, steam locomotives on railways consuming fuelwood will transport about one-third of the ton-kilometres of gross weight assigned to this type of engine in the traffic projection. In other words, steam locomotives operating on fuelwood will haul about 2.9 billion ton-kilometres of gross weight, while locomotives running on fuel oil will haul about 5.9 billions.

Since the average consumption of fuel oil per thousand ton-kilometres of gross weight in Brazil is about 40 kilogrammes, it may be assumed that consumption by the railways will amount to about 236,000 tons by 1962. Similarly, an aggregate fuelwood consumption of 2.61 million cubic metres may be calculated on the assumption of an average of 0.9 cubic metre per thousand ton-kilometres.

#### (d) Conclusion

Table XXIV sums up the results of the partial projections of the railways' demand for energy. These calculations do not include the demand arising from traffic carried free of charge on the railways.

Table XXIV. Brazil: Projections of railway demand for fuels and hydraulic energy

Sources of energy	Unit	1962	Projection for 1968
Fuelwood .....	1,000 m <sup>3</sup>	10,942	2,610
Domestic coal .....	Ton	1,079,789	—
Imported coal .....	Ton	197,097	—
Fuel oil .....	Ton	273,605	236,000
Natural gas .....	1,000 m <sup>3</sup>	—	...
Diesel oil .....	Ton	38,769	247,000
Hydraulic energy .....	1,000 kWh	375,287	722,500

Source: Official publications and ECLA.

#### 6. Demand for rails and sleepers

The objective here is to determine the annual demand for rails and sleepers to meet normal renewal requirements. The problem of exceptional needs arising from insufficient replacement during the last twenty years is therefore outside the scope of this analysis. The calculation of the demand for replacement depends on two fundamental factors: the number of rails and sleepers at present in use; and the estimated useful life of such material. As no authoritative information exists on the latter point, it was considered advisable to base the projection on more than one hypothesis of the average life of rails and sleepers.

<sup>82</sup> Energy obtained from domestic coal costs about 30 per cent more.

#### (a) Rails

In 1951, the existing rails on 90.6 per cent of the lines used for traffic, i.e., 33,387 kilometres, weighed two million tons. (See table XXV). Since no precise information is available as to the remainder of the track—2,439 kilometres of 1-metre gauge line and 1,019 kilometres of still narrower gauges—it was decided to assume an average weight of 24.6 kilogrammes per metre for rails on the 1-metre-gauge and of 17 kilogrammes for those on the 0.76 and 0.60-metre-gauge lines.<sup>84</sup>

Table XXV. Brazil: Length of the lines of 25 railways and total weight according to type, 1951

Type of track (kg per metre)	Length (kilometres)	Total weight (thousands of tons)
20,000 .....	4,628	190.4
24,654 .....	12,655	624.9
32,045 .....	8,619	542.8
37,105 .....	4,698	350.0
44,645 .....	1,416	134.5
50,349 .....	1,273	112.4
55,756 .....	639	71.2
TOTAL ...	33,928	2,026.2

Source: Original data from the Departamento Nacional de Estradas de Ferro and the railway companies.

NOTES.—The various types of rails were grouped in the categories which appear in the table. When the type of rail did not exactly correspond to one of these groups, it was included in the category which it most closely resembled. The estimate of total weight was made on the basis of original data. The data refer to twenty-five railways, the rails of which could all be classified into the different types used on main and branch lines, except in the case of the Rede Mineira de Viação, for which only 2,577 kilometres out of a total of 3,980 could be so classified. Total length of lines used for traffic during 1951 amounted to 33,387 kilometres, including only 2,577 kilometres of the Rede Mineira. The difference between this total and that of the table is because the figures for lines used for traffic only count double-track lines once.

The data given in table XXV indicate that the rails on all tracks under traffic in Brazil weighed 2,026,000 tons, or, by rounding, 2 millions.

The above figures do not include the weight of rails on sidings, shunting lines, etc. This omission is insignificant because such rails are often those discarded from main and branch lines.

The average useful life of the rails on any section is a function of three variables, among others:<sup>85</sup> the type of rail, the density of traffic and the number, length and radius of the curves. A calculation of the average duration must therefore be based on detailed information on the three factors mentioned above. Since adequate data are not available, it was decided to omit these estimates and to project rail requirements on the basis of two hypotheses of their average useful life. The age limits—thirty and forty years—were established in accordance with the opinion of railway experts.

If the type of rail in use does not change, about 55,000 to 73,000 tons will be required to cover normal replacement needs. For various reasons—for instance, the increased use of heavier locomotives—some or all of the obsolete rails will probably have to be replaced annually by others of a more robust type. It is difficult to forecast the effect of this factor upon annual rail requirements, but it may be considerable, as will be seen below.

In 1951, the average weight of existing rails stood at 29.1 kilogrammes per metre. It would not be surprising if, at the end of a complete replacement cycle, this average should rise to 37 kilogrammes per metre. On this assumption, the annual average demand for renewal will vary between 70,000 and 93,000 tons of rails. If construction of new lines proceeds at

<sup>84</sup> This is the weight of rails on the 1-metre gauge lines with least traffic, on which least data were available.

<sup>85</sup> Other factors of certain importance affect average duration, such as the lubrication of rails on curves. It is estimated, however, that the variables mentioned in the text are, broadly speaking, the most important.

the same pace as during the last twenty years—that is, at a rate of 175 kilometres annually—additional demand will rise to about 13,000 tons, always assuming that the average weight of the rails will remain at 37 kilogrammes. Aggregate rail requirements will therefore vary from 83,000 to 106,000 tons annually.<sup>86</sup>

(b) *Sleepers*

It is generally assumed that in 1951 the average number of sleepers per kilometre of track on the Brazilian railways ranged from 1,400 to 1,700 units. More definite data on 25,729 kilometres of line<sup>87</sup> show that the average per kilometre amounted to 1,539 sleepers. (See table XXVI.) If this average is applied to the 2,888 kilometres of branch line and the 13,604 kilometres of main line for which information is not available, the conclusion is reached that the sleepers in use on Brazilian railways totalled 64 million units.

Table XXVI. Brazil: Number of sleepers used on selected railways, 1951

Railways	Sleepers	
	Total (thousands units)	Average (per kilometre) *
E. F. Central do Brasil .....	6,201	1,582
E. F. Leste Brasileiro .....	4,045	1,582
R. F. do Nordeste .....	2,724	1,482
Rede Mineira .....	6,770	1,593
V. F. R. Grande do Sul .....	5,848	1,632
E. F. Sorocabana .....	4,278	1,536
E. F. Nordeste .....	3,013	1,639
C. Mogiana de E. F. ....	3,506	1,571
R. V. Cearense .....	2,393	1,499
E. F. Goiás .....	820	1,614
TOTAL ...	39,598	1,539

Sources: Departamento Nacional de Estradas de Ferro and Joint Brazil/United States Economic Development Commission.

\* These railways included a total of 25,729 kilometres, of which 23,426 were main lines and 1,592 branch lines.

The present average duration of the sleepers is in practice short. Three contributory causes are: the increasing use of sleepers made of inferior wood; the lack of stone ballast on half the lines under traffic; and, finally, the widespread use of sleepers which were not treated before being laid. Projected measures to remedy these defects will probably be applied in the course of the next ten years. According to expert opinion, one effect of such programmes will be to prolong the average life of the sleepers by at least 50 per cent. Thus, renewal requirements will decrease appreciably. As the railways also intend to raise the average number of sleepers on main lines, and even on some branch lines, to 1,800 per kilometre,

<sup>86</sup> This estimate excludes requirements arising from lack of replacements during the last twenty years. According to the Joint Brazil/United States Economic Development Commission, the rails needed to meet this deficit amount to 579,884 tons.

<sup>87</sup> This total represents both main and branch lines. The latter were included because the replacement requirements for sleepers on these lines cannot be met with material discarded from the main lines.

the total number in use in Brazil will also be higher.<sup>88</sup> The effect of this measure on replacement requirements will be the opposite of that produced by increasing the average duration, though of a less pronounced nature.

7. *Consumption of lubricants*

A diesel locomotive's consumption of lubricant per ton-kilometre of gross weight or per shunting hour is six or seven times greater than that of a steam locomotive, which in turn far exceeds that of electric locomotives.

The probable replacement of steam locomotives by diesel and electric units will tend, on the one hand, to bring about a relatively greater increase in the consumption of lubricants than in traffic, and, on the other, to produce the opposite effect. The present aim is in fact to determine the net effect upon the consumption of lubricants of the changes in the composition of the locomotive park, or rather, in the distribution of the traffic volume among the various methods of traction.

In 1951, steam locomotives of the Sorocabana Railway used an average of 0.064 kilogramme of lubricant per thousand ton-kilometres of gross weight transported. Consumption was slightly higher in 1950, standing at 0.068 kilogramme. On the basis of these data, it was considered reasonable to estimate the consumption of lubricants by steam locomotives at 0.065 kilogramme per thousand ton-kilometres.<sup>89</sup>

It was calculated that, for the same amount of work, diesel locomotives use an average of 0.42 kilogramme of lubricants.<sup>90</sup> Experts maintain that for shunting, the hourly consumption of these engines is about 1.25 kilogrammes. The corresponding figures for electric traction are 0.02 and 0.08 kilogramme respectively.<sup>91</sup>

Table XXVII. Brazil: Projection of the demand for lubricants, 1962  
(Tons)

Type of traction	Demand
Steam .....	570
Diesel .....	12,400
Electric .....	400
TOTAL ...	13,370

Sources: Economic Commission for Latin America.

<sup>88</sup> The average number of sleepers per kilometre of track will probably rise from 1,539 to 1,700. The total will therefore increase from 64 to about 71 million sleepers on an aggregate length of track—including branch lines—equivalent to the lines under traffic in 1951.

<sup>89</sup> Consumption was calculated as follows: in 1951, steam locomotives worked 532,754 hours out of a total of 963,325 hours for all traction services. The aggregate consumption of lubricants rose to 304,490 litres, that is, 3.16 decilitres per hour. On this basis it may be inferred that consumption on such services was 168,350 litres, or about 151,515 kilogrammes. By dividing this figure by the ton-kilometres of gross weight hauled by steam locomotives, the consumption given in the text was obtained. According to another source, consumption stood at 0.06 kilogramme. See Joint Brazil/United States Economic Development Commission Projects, Vol. V, Annex 1 (*Viação Ferro do Rio Grande do Sul*).

<sup>90</sup> Joint Brazil/United States Economic Development Commission, *op. cit.* It should be noted that the consumption on one Brazilian railway was double that shown above; but the importance of this figure is slight, as it refers to only a few locomotives during their first few months of service.

<sup>91</sup> Approximate estimate.

## STATISTICAL ANNEX

Table A. Brazil: Indices of payload traffic  
on 13 principal railways  
(1939 = 100)

Year	Passengers	Livestock	Goods and luggage	Total
1925	63.1	77.7	72.0	70.0
1926	65.1	78.8	72.8	71.1
1927	69.9	84.8	77.6	75.9
1928	79.7	91.6	76.0	77.4
1929	83.2	85.9	82.1	82.5
1930	78.4	68.2	66.1	69.2
1931	74.8	82.0	64.1	67.3
1932	73.8	75.6	63.2	66.2
1933	81.5	79.9	68.2	71.9
1934	84.3	88.9	69.4	73.7
1935	89.2	94.3	79.7	82.5
1936	88.3	99.4	89.4	89.4
1937	88.9	99.4	95.8	94.2
1938	91.8	95.0	101.6	99.0
1939	100.0	100.0	100.0	100.0
1940	102.5	108.5	103.8	103.6
1941	112.6	110.2	104.5	106.7
1942	117.6	120.5	105.8	109.2
1943	133.7	113.8	112.1	117.5
1944	144.6	103.0	117.7	123.8
1945	150.0	118.9	113.7	122.8
1946	157.7	123.4	112.0	123.6
1947	164.4	118.0	109.6	123.4
1948	168.5	109.2	108.7	123.5
1949	178.9	111.5	107.2	125.0
1950	180.5	117.8	108.9	126.8
1951	179.1	116.9	119.2	133.9
1952	171.8	104.4	120.4	132.6

Table B. Brazil: Indices of payload traffic  
on 12 principal railways  
(1939 = 100)

Years	Passengers	Livestock	Goods and Luggage	Total
1925	68.1	64.4	69.4	69.0
1926	70.9	69.5	72.4	72.0
1927	72.7	74.1	76.1	75.3
1928	77.2	82.7	74.0	74.9
1929	83.2	79.7	80.7	81.1
1930	77.1	61.3	64.8	67.2
1931	72.1	78.1	63.4	65.7
1932	70.9	76.1	63.9	65.7
1933	75.4	79.7	69.6	71.1
1934	81.3	89.6	71.8	74.4
1935	90.6	100.1	81.6	84.0
1936	89.2	99.8	90.0	90.2
1937	91.1	96.5	92.9	92.6
1938	95.0	89.8	97.9	97.1
1939	100.0	100.0	100.0	100.0
1940	102.6	107.9	100.5	101.1
1941	107.2	110.7	104.9	105.6
1942	109.2	122.8	105.5	106.8
1943	123.8	115.4	111.5	114.3
1944	141.6	102.6	118.2	122.4
1945	148.1	118.4	113.5	120.9
1946	151.2	122.7	111.5	120.1
1947	146.0	118.3	106.3	115.2
1948	148.5	108.4	105.3	114.8
1949	154.0	109.5	104.5	115.0
1950	164.2	117.1	106.2	118.7
1951	177.8	115.9	117.9	130.3
1952	182.4	102.0	120.0	132.3

Sources: Official publications and Economic Commission for Latin America.

NOTES.—1. The thirteen railways included in the indices are: Rede Mineira de Viação, V.F. do Rio Grande do Sul, E.F. Central do Brasil, E.F. Sorocabana, Rede de Viação Paraná-S. Catarina, Companhia Mogiana de Estradas de Ferro, Rede de Viação Federal Leste Brasileiro, Companhia Paulista de Estradas de Ferro, E.F. Santos a Jundiaí, E.F. Noroeste do Brasil, Rede Ferroviária do Nordeste, E.F. Leopoldina e a Rede de Viação Cearense. Indices for twelve railways exclude the E.F. do Central Brasil.

2. In preparing the indices, the criterion was adopted of weighting the percentage share of each item in total traffic expenditure in the base year (1939). In the calculations for the thirteen railways, the weighting was as follows: passengers, 24.65 per cent; livestock, 3.26 per cent; goods and luggage, 72.09 per cent.

3. Effective traffic of the thirteen railways, in absolute terms, during the base year was as follows: passengers, 78.2 million, livestock, 3,682,100 head; goods and luggage, 26,645,400 tons.

Source: See table A.

NOTES.—1. See note 1 and 2 to table A.

2. The weighting in this case was as follows: passengers, 20.8 per cent; livestock, 3.4 per cent; goods and luggage, 75.8 per cent.

3. Effective traffic of the twelve railways, in absolute terms, during the base year was as follows: passengers, 72.1 million; livestock, 3,182,300 head; goods and luggage, 22,771,300 tons.

Table C. Brazil : Indices of payload/kilometric traffic  
on 13 principal railways  
(1939 = 100)

Year	Passengers	Livestock	Goods and luggage	Total
1925	70.5	59.8	60.7	63.1
1926	70.6	54.2	80.0	62.4
1927	72.3	55.6	68.6	69.1
1928	81.1	62.7	72.9	74.6
1929	83.2	57.9	76.2	77.3
1930	74.7	45.3	60.8	63.7
1931	68.5	59.5	59.3	61.6
1932	66.5	62.3	55.3	58.3
1933	71.4	66.1	59.2	62.4
1934	73.1	74.5	62.3	65.4
1935	78.8	80.2	71.6	73.6
1936	83.0	84.7	83.4	83.3
1937	87.9	94.5	93.8	92.3
1938	93.6	94.6	102.4	100.0
1939	100.0	100.0	100.0	100.0
1940	110.2	108.7	103.6	105.4
1941	120.5	108.2	109.4	112.1
1942	114.8	119.7	108.4	110.3
1943	133.7	110.6	115.8	120.0
1944	149.8	108.9	119.6	126.7
1945	155.9	127.0	119.1	128.4
1946	165.6	140.3	119.9	131.8
1947	170.1	138.1	120.6	133.4
1948	169.0	127.9	124.4	135.5
1949	172.7	132.4	124.8	136.9
1950	177.5	144.0	129.0	141.4
1951	185.5	149.9	142.2	153.1
1952	180.9	133.6	140.2	150.0

Source : See table A.

NOTES.—See notes 1 and 2 to table A.

Kilometre/traffic, in absolute terms, during the base year was as follows : 5,406.4 million passengers/km; 1,020.7 million animals/km; and 5,342.8 million tons/km, of goods and luggage.

Table D. Brazil : Indices of payload/kilometre traffic  
on 12 principal railways  
(1939 = 100)

Years	Passengers	Livestock	Goods and luggage	Total
1925	73.3	50.9	56.8	59.8
1926	72.7	49.8	57.2	60.1
1927	72.4	54.3	64.8	66.1
1928	79.6	62.2	68.9	70.0
1929	84.5	57.2	70.9	73.3
1930	73.6	41.5	56.8	59.7
1931	63.8	59.5	56.6	58.3
1932	60.0	61.2	57.8	58.4
1933	62.0	68.9	61.5	61.9
1934	65.9	76.7	67.2	67.2
1935	76.5	86.4	74.0	75.0
1936	84.3	85.5	84.0	84.0
1937	92.6	89.6	89.4	90.1
1938	95.0	85.7	96.8	96.0
1939	100.0	100.0	100.0	100.0
1940	100.7	106.9	100.4	100.7
1941	103.5	108.8	105.9	105.4
1942	108.3	124.5	105.6	106.8
1943	128.8	112.8	112.0	115.6
1944	153.5	108.2	118.1	125.1
1945	163.7	128.9	117.5	127.4
1946	165.1	139.3	117.3	128.0
1947	157.4	139.1	115.8	135.2
1948	156.6	127.2	122.1	129.5
1949	155.2	129.2	122.9	129.8
1950	165.6	144.7	129.2	137.3
1951	186.9	151.2	144.0	153.2
1952	192.0	131.9	142.6	152.4

Source : See table A.

NOTES.—See notes 1 and 2 to table A and note 2 to table B.

Kilometre/traffic, in absolute terms, during the base year was as follows : 2,831.1 million passengers km; 834.4 million animals/km; and 4,207.8 million tons/km of luggage and goods.

Table E. Brazil : Railway fuel consumption according to type of fuel, 1939-52

Year	Solid fuels			Liquid fuels		Electric energy (million kWh)
	Firewood (million m <sup>3</sup> )	Domestic coal (thousand tons)	Imported coal (thousand tons)	Diesel oil (thousand tons)	Others *	
Thirteen railways						
1939 .....	8.3	425.7	749.1	—	11.8	121.7
1940 .....	8.7	463.2	625.0	—	5.0	122.4
1941 .....	9.4	499.2	495.1	—	3.7	131.7
1942 .....	10.8	704.9	279.7	—	2.3	149.6
1943 .....	11.9	776.5	262.1	—	3.0	150.5
1944 .....	11.9	841.4	384.8	1.4	3.7	163.6
1945 .....	12.2	751.5	500.9	3.6	9.7	218.3
1946 .....	12.0	593.6	512.8	11.7	38.0	219.5
1947 .....	11.5	592.3	584.0	14.7	79.6	242.3
1948 .....	10.4	771.1	444.1	21.3	77.0	277.6
1949 .....	9.7	821.0	382.5	27.6	85.1	306.9
1950 .....	9.9	845.2	331.0	32.7	141.1	330.2
1951 .....	10.0	891.6	298.2	32.6	171.0	361.6
1952 .....	9.4	1,033.8	164.6	37.9	227.4	375.3

Table E. Brazil : Railway fuel consumption according to type of fuel, 1939-52 (continued)

Year	Solid fuels			Liquid fuels		Electric energy (million Kwh)
	Fuelwood (million m <sup>3</sup> )	Domestic coal (thousand tons)	Imported coal (thousand tons)	Diesel oil (thousand tons)	Others <sup>a</sup>	
Twelve railways						
1939 .....	8.2	329.9	225.4	—	4.2	77.8
1940 .....	8.5	351.7	194.6	—	4.6	80.2
1941 .....	9.1	340.3	126.5	—	3.4	88.0
1942 .....	9.8	463.9	83.3	—	2.0	103.0
1943 .....	10.7	538.2	51.3	—	1.6	99.6
1944 .....	11.2	560.7	152.1	—	3.7	110.1
1945 .....	11.7	581.9	153.8	1.0	4.9	159.7
1946 .....	11.6	508.3	205.6	1.0	11.4	153.9
1947 .....	11.1	499.5	280.6	3.7	40.6	171.9
1948 .....	10.0	598.7	209.3	9.2	38.6	184.8
1949 .....	9.3	594.6	190.9	12.1	41.4	203.1
1950 .....	9.5	591.2	176.8	16.7	64.9	217.2
1951 .....	9.4	580.1	178.6	18.5	117.5	255.3

Sources : Departamento Nacional de Estradas de Ferro and annual reports of the railways.

<sup>a</sup> Mainly fuel oil.Table F. Brazil : Railway fuel consumption according to type of fuel, 1939-52  
(Millions of kWh) <sup>a</sup>

Year	Solid fuels			Liquid fuels		Electric energy	General total
	Fuelwood	Domestic coal	Imported coal	Diesel oil	Others <sup>b</sup>		
Thirteen railways							
1939 .....	372.1	74.5	232.2	—	6.5	79.1	764.4
1940 .....	393.2	81.1	193.7	—	2.8	79.6	750.3
1941 .....	424.1	87.4	153.5	—	2.0	85.6	752.6
1942 .....	487.8	123.4	86.7	—	1.3	97.2	796.4
1943 .....	535.7	135.9	81.3	—	1.7	97.8	852.3
1944 .....	537.0	147.3	119.3	4.7	2.0	106.4	916.7
1945 .....	548.9	131.5	155.3	12.2	5.3	141.9	995.1
1946 .....	538.9	103.9	159.0	40.3	20.9	142.7	1,005.6
1947 .....	516.7	103.7	181.0	50.5	43.8	157.5	1,053.1
1948 .....	468.6	134.9	137.7	73.4	42.3	180.4	1,037.4
1949 .....	435.2	143.7	118.6	95.0	46.8	199.5	1,038.7
1950 .....	444.1	147.9	102.6	112.5	77.6	214.6	1,099.4
1951 .....	449.1	156.0	92.4	112.1	94.0	235.0	1,138.7
1952 .....	420.8	180.9	51.0	130.1	125.1	243.9	1,151.8
Twelve railways							
1939 .....	371.0	67.7	69.9	—	2.3	50.6	551.5
1940 .....	383.2	61.6	60.3	—	2.6	52.1	559.7
1941 .....	411.0	59.6	39.2	—	1.9	57.2	568.9
1942 .....	442.9	81.2	25.8	—	1.1	66.9	618.0
1943 .....	481.4	94.2	15.9	—	0.9	64.7	657.1
1944 .....	503.0	98.1	47.1	—	2.0	71.5	721.8
1945 .....	525.3	101.8	47.7	3.3	2.7	103.8	784.6
1946 .....	521.3	88.9	63.8	3.3	6.3	100.0	783.6
1947 .....	499.3	87.4	87.0	12.8	22.3	111.7	820.7
1948 .....	452.0	104.8	64.9	31.5	21.2	120.1	794.4
1949 .....	420.4	104.1	59.2	41.5	22.8	132.0	779.9
1950 .....	426.8	103.5	54.8	57.6	35.7	141.2	819.5
1951 .....	424.4	101.5	55.4	63.7	64.6	166.0	875.5

Sources : See table E.

<sup>a</sup> Conversion bases into kWh were as follows :

Fuelwood (1 cubic metric) = 45 kWh

Domestic coal (1 ton) = 175 "

Imported coal (1 ton) = 315 "

Diesel oil (1 ton) = 3450 kWh

Fuel oil (1 ton) = 555 "

Electric energy (1 kWh) = 85 per cent efficiency

<sup>b</sup> Mainly fuel oil.

Table G. Brazil : Indices of payload/kilometre traffic and energy consumption on twelve and thirteen railways

(1939 = 100)

Year	Twelve railways			Thirteen railways		
	Traffic	Energy	Ratio	Traffic	Energy	Ratio
1940 .....	100.7	101.5	100.8	105.4	98.2	93.2
1941 .....	105.4	103.2	97.9	112.1	98.5	87.9
1942 .....	106.8	112.1	105.0	110.3	104.2	94.4
1943 .....	115.6	119.1	103.0	120.0	111.5	92.9
1944 .....	125.1	130.9	95.6	126.7	119.9	94.6
1945 .....	127.4	142.3	111.7	128.4	130.2	101.4
1946 .....	128.0	142.1	111.0	131.8	131.6	99.8
1947 .....	125.2	148.8	118.8	133.4	137.8	103.3
1948 .....	129.5	144.0	111.2	135.5	135.7	100.1
1949 .....	129.8	141.4	108.9	136.9	135.9	99.3
1950 .....	137.3	148.6	108.2	141.4	143.8	101.7
1951 .....	153.2	158.7	103.6	153.1	149.0	97.3
1952 .....	152.4	163.8	107.5	150.0	150.7	100.5

Source : See table A.

NOTE.—See tables C, D and F.

Table H. Brazil : Traction power of steam locomotives according to age

(Tons)

Railways	Age									Total traction power
	Up to 5	6-10	11-15	16-20	21-30	31-40	41-50	More than 50	Age unknown	
R. F. Nordeste .....	—	27	—	—	179	164	589	95	—	1,054
V. F. F. Leste Brasileiro .....	222	57	147	—	246	548	94	85	10	1,209
E. F. Vitória a Minas .....	—	—	358	—	107	73	84	—	—	622
E. F. Leopoldina .....	463	230	124	33	573	448	280	462	6	2,619
E. F. Central do Brasil .....	—	17	230	43	1,460	2,796	817	1,038	220	6,621
R. Mineira de Viação .....	—	16	31	—	916	202	52	245	254	1,716
E. F. Santos Jundiaí .....	—	—	157	313	352	330	488	268	—	1,908
Cia. Paulista de E. de Ferro .....	—	—	92	—	464	510	132	764	40	2,002
E. F. Sorocabana .....	—	101	253	—	1,793	490	389	154	—	3,180
E. F. Araraquara .....	—	—	75	—	241	169	14	—	—	499
E. F. Noroeste do Brasil .....	210	—	359	—	548	164	158	17	—	1,456
R. V. Paraná-Santa Catarina .....	347	149	88	5	511	456	143	134	—	1,833
V. F. Rio Grande do Sul .....	—	—	134	28	954	446	573	206	15	2,356
Cia. Mogiana de E. de Ferro .....	198	—	117	—	256	606	143	477	53	1,850
SUB-TOTAL ...	1,240	597	2,165	422	8,600	7,402	3,956	3,945	598	28,925
Rede V. Cearense .....	—	51	136	27	304	104	6	24	4	656
E. F. Sampaio Correia .....	—	18	—	—	10	59	34	2	—	123
E. F. Nazaré .....	—	—	—	—	101	47	—	—	48	196
E. F. Goiás .....	—	34	40	45	76	—	—	—	—	195
E. F. D. Terceira Cristina .....	—	46	65	39	33	—	—	9	—	192
SUB-TOTAL ...	—	149	241	111	524	210	40	36	52	1,362
Others .....	—	34	102	37	227	231	190	58	347	1,226
TOTAL* ...	1,240	780	2,508	570	9,351	7,843	4,186	4,038	997	31,513

Source : See table E.

NOTE.—The total excludes the tractor power of the following locomotives :

21-30 years : 2

More than 50 years : 17

31-40 years : 5

Age unknown : 84

Table I. Brazil : Number of steam locomotives according to age, 1950

Railways	Age								Total
	Up to 5	6-10	11-15	16-20	21-30	31-40	41-50	More than 50	
R. F. Nordeste .....	—	3	—	—	20	22	83	19	147
V. F. F. Leste Brasileiro .....	2	8	12	—	35	69	12	13	155
E. F. Vitória a Minas .....	—	—	27	—	16	10	15	—	68
E. F. Leopoldina .....	39	27	9	4	71	55	43	78	327*
E. F. Central do Brasil .....	—	2	9	3	127	220	68	161	687
R. Mineira de Viação .....	—	2	3	—	110	36	11	60	262
E. F. Santos-Jundiaí .....	—	—	10	26	20	21	50	36	163
Cia. Paulista de E. de Ferro .....	—	4	—	—	36	61	12	90	210
E. F. Sorocabana .....	—	5	20	—	132	41	48	27	273
E. F. Araraquara .....	—	—	3	—	19	21	2	—	45
E. F. Noroeste do Brasil .....	12	—	25	—	56	23	28	5	149
R. V. Paraná-Santa Catarina .....	25	14	7	2	54	48	24	22	196
V. R. Rio Grande do Sul .....	42	—	10	2	81	47	91	43	319
Cia. Mogiana de E. Ferro .....	12	—	8	—	24	70	21	75	214
SUB-TOTAL ...	132	65	143	37	801	744	508	629	3,195
Rede V. Cearense .....	—	6	13	4	44	16	1	5	90
E. F. Sampaio Correia .....	—	2	—	—	2	11	7	1	23
E. F. Nazaré .....	—	—	—	—	13	6	—	—	23
E. F. Goiás .....	—	3	3	7	11	—	—	—	26
E. F. D. Tereza Cristina .....	—	5	6	3	6	5	—	2	29
SUB-TOTAL ...	—	16	22	14	76	38	8	8	191
Others .....	—	4	10	4	31	40	35	13	228
TOTAL ...	132	85	175	55	908	822	551	650	3,614

Source: *Rejuvenescimento e melhorias das locomotivas a vapor*, Boletim do Instituto Ferroviário de Pesquisas Técnico-Econômicas Vol. IV, Nr. 3, 1952.

\* Includes twenty-one fixed site locomotives.

## Chapter IV

# PROJECTION OF THE DEMAND FOR ENERGY

### I. INTRODUCTION

This chapter contains as complete an inventory as possible of the energy consumed in Brazil during the period from 1939 to 1954. It outlines the relative importance of the different means for producing energy, emphasizes the share of imports in the total and analyses the supply of the principal sources of energy, special attention being paid to the possibility of their expansion.

An attempt will then be made to project the demand, taking into account the probable growth of the different consumer groups. A comparison of the projected demand with the potentialities of the various sources is the departure point for the establishment of an investment policy in this sector and also acts as a basis for a preliminary estimate of those imports which serve to provide energy.

A study of the energy sector reveals many problems connected with units of measurement and efficiency coefficients. Various solutions are possible, depending upon the targets it is hoped to attain. This chapter includes all energy sources of any significance and the only items excluded are those elements of animal, human and hydraulic energy which are not transformed into electricity.

The question of how to measure the energy used by the economy leads to a series of difficulties which, in view of statistical limitations, cannot always be overcome. On the initial assumption that energy is the capacity to produce work, it is clear that the ideal method of measuring the energy used in any economic system is to express it in terms of its final utilization. Technical progress is introducing growing efficiency into final utilization, and is enabling a constantly greater volume of products to be obtained per unit of energy consumed. Nevertheless, the obstacles to this method of measuring energy in its final stage are insuperable in practice and they become almost insoluble in under-developed countries, characterized as they are by a heterogeneity of equipment and the co-existence of machinery representing different stages of technical progress.

Another way of measuring energy consumed is to assess the amount reaching the final consumer, in other words excluding that used in production by the energy sources themselves and in other operations which take place before final delivery to the consumer. In short, the idea is to measure net as distinct from gross energy consumption, a concept which is also useful in general economic analysis.

In order to render the various types of energy homogeneous and to reduce them to kWh, an average efficiency co-efficient of 0.2 is assumed for all fuels. As is well known, fuels used in the production of heat give much higher yields (between 50 and 70 per cent); on the other hand, others have lower average yields,—for example, 2 per cent in the case of locomotives driven by fuelwood, 5 per cent in the case of coal-fired locomotives and 18 per cent in motor-cars.

Special consideration was given to fuelwood in this inventory because for many years it was the principal source of energy in Brazil. In contrast to most countries, where it is used almost exclusively as a source of heat, fuelwood is widely employed in Brazil for the production of motive power and electricity. While in many countries it represents a residual source of no commercial importance, in Brazil it competes with other fuels and is submitted to a permanent substitution process. When it is considered that fuelwood has only minimum efficiency as a source of motive power and electricity—either because technological adaptation to the use of this source is lacking or because the equipment utilizing it is generally the oldest and most worn-out—it will be seen that its replacement by other fuels will contribute to an increase in the real consumption of energy.

This problem is of prime importance to a study of the development of energy consumption during the period under consideration. During its first phase—the war years—there was both an absolute and a relative increase in fuelwood consumption, which rose from 88.4 to 137.0 million cubic metres. In the second phase the opposite was true, the use of fuelwood falling in 1954 to levels lower than those of pre-war days, while the consumption of liquid fuels rose almost sixfold. This large-scale replacement of wood is an indication of fundamental changes in the efficiency rate corresponding to the employment of fuels, since the fuelwood for which other sources are being substituted is mainly that which is used in the production of motive power and electricity. In this connexion it is sufficient to observe that one calorific unit of diesel fuel used in locomotives has an efficiency almost nine times greater than one unit of fuelwood.

In the light of the foregoing considerations, an efficiency coefficient of 0.05 has been used for fuelwood. If the coefficient applied to the remaining fuels had been employed in calculations on fuelwood, the per capita consumption of energy in Brazil today would be lower than during the war years.

The application of this different coefficient ultimately represents an attempt at a partial approximation in the measurement of energy at its final stage, i.e., as energy actually utilized. Notwithstanding the limitations inherent in this method, such an attempt renders the statistical data more appropriate for economic analysis.

### II. GROWTH OF AGGREGATE CONSUMPTION

Total energy consumption expanded from 18,405 million kWh in 1939 to 42,295 millions in 1954. The increase was thus 130 per cent, representing an annual rate of 5.7 per cent (3.2 per capita). The rate of growth was much more rapid during the most recent period. (See table 112.)

The growth of energy consumption is mainly determined by higher real incomes and by changes in the structure of production. Much of the energy absorbed by a community



Table 112. Brazil: Increase in energy consumption  
(Percentages)

Period	Absolute increase	Annual rate of growth	Per capita rate of growth
1940-54 .....	130	5.7	3.2
1940-46 .....	18	2.8	0.5
1947-54 .....	91	8.4	5.9

Source: Tables 125, 126 and 127.

reaches the end consumer directly and must therefore be considered as a consumer product. Such is the case of the electric energy used in households, petrol consumed by private cars, etc. Another considerable share is absorbed by production, processing and the transport of goods. Lastly, there is the energy consumed in the production of such services as communal transport, entertainments, etc.

Chart I compares the index of the growth of energy consumption with indices of the gross product and the total expenditure on consumption. These three indices show a very similar development, despite the fact that in recent years (since 1950) some disparity can be observed. It is expected that, over the long term, energy consumption will expand less than the gross product, given the greater output of useful work per unit of energy consumed which results from technological progress. In reality, one of the forms taken by the latter is increased efficiency in energy utilization. Such a phenomenon becomes evident in the economy as a whole through a persistent decline in the consumption of energy per unit of production. However, there are certain special aspects which vary in accordance with the stage of development and the consequent structural modifications.

A preliminary general observation must be made on the substitution of inanimate for animate energy. The mechanization of transport and agriculture, attendant upon the initial and intermediate stages of development, results in an apparent increase in energy consumption per unit of product. This phenomenon could be observed in the United States between 1880 and the end of the 'twenties. After the stage of substituting inanimate for animate energy was passed, it was noted that a persistent reduction in energy consumption per unit of product took place, owing to the greater efficiency resulting from technical progress.

There are also other factors which influence the relationship between energy consumption and the gross product. In Brazil, one of them is the weakness of the export sector and industrialization. Exports fundamentally consist of a wide range of agricultural products. The corresponding energy consumption per unit of product is thus very low, even more so because the principal type of energy consumed by agriculture, solar energy, is not computed. This means that a reduction in the contribution of the agricultural sector to an economic system entails a rise in energy consumption per unit of product.

In the present development stage of the Brazilian economy, several factors are simultaneously tending to increase, and others to diminish, the consumption of energy per unit of product. On the one hand, there is the substitution of inanimate for animate energy, the weakness of the export sector and industrialization; on the other, technical progress exists, which raises efficiency in the utilization of energy.

The change observed from 1950 onwards is possibly due to an increase in the energy directly consumed by the population, a phenomenon linked with the considerable rise in consumer expenditure, and in particular with the substantial increase in the number of passenger cars. As mentioned elsewhere in this study,<sup>1</sup> the exceptional upswing in the number of motor-cars in Brazil during the last five years was a consequence of the exchange policy in force at that time. One of the resultant distortions in the economic system was the increase in energy consumption per unit of income. Nevertheless, this situation may persist during coming years, since development will impose structural modifications on the Brazilian economy which will tend to increase energy consumption per unit of product.

### III. RELATIVE IMPORTANCE OF THE VARIOUS SOURCES

From the viewpoint of sources utilized, there have been fundamental changes between 1939 and recent years. Of the 18,405 million kWh consumed in 1939, 70.5 per cent came from solid fuels and 17.1 per cent from liquid fuels, while the remaining 12.4 per cent were of hydraulic origin. Of the 12,984 million kWh resulting from the use of solid fuels, 72.6 per cent were derived from fuelwood, lignite and sugar-cane bagasse. These three sources of energy thus contributed rather more than half the total supply. The situation was unchanged during the war years, these sources contributing 51.4 per cent of the total, as compared with 51.2 in 1939. From 1946 onwards there was a great change in the structure of supply. As early as 1947 the share of these three sources fell to 36.4 per cent, dropping even further to 27.6 in 1954.

Of the three solid fuels mentioned, the greatest reduction was that of fuelwood, the consumption of which fell to 14 per cent between 1939 and 1954, its share in the total being reduced from 40 to 15 per cent. Lignite also lost ground, since its consumption increased by only 83 per cent, while the rise in total consumption was 130 per cent. But sugar-cane bagasse improved its share since consumption rose by 160 per cent.

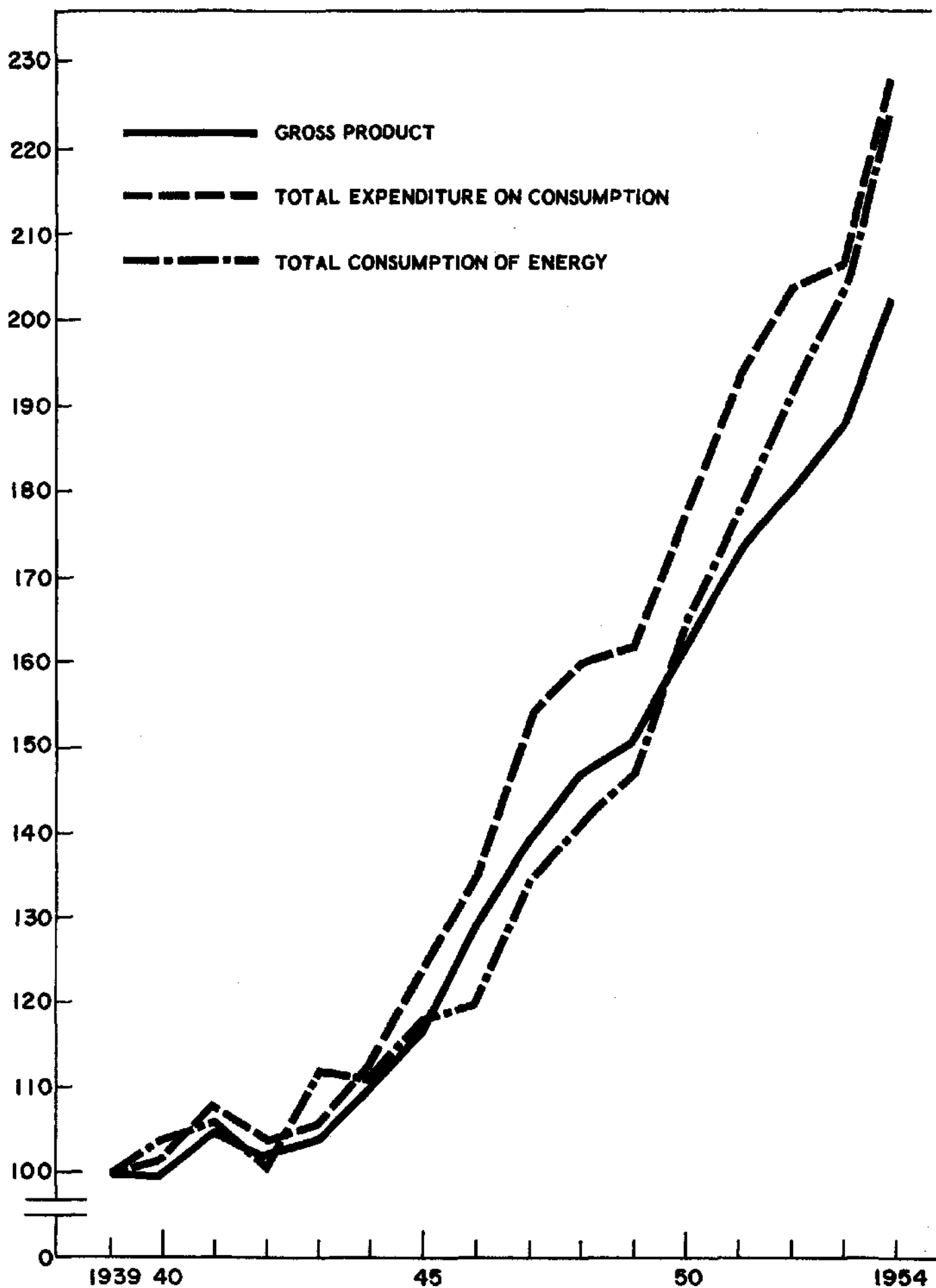
If solid fuels are considered as a whole, it will be seen that the growth between 1939 and 1954 was only 17 per cent, a little less, therefore, than that of all the three previously mentioned sources, which amounted to 24 per cent. This was caused by the small increase in coal consumption, which reached only 15 per cent.

Whereas the consumption of solid fuels remained practically stationary over the entire period from 1939 to 1954, that of liquid fuels increased sixfold, rising from 3,157 to 18,817 million kWh. The share in total consumption grew from 17.1 to 44.4 per cent, while that of hydroelectric energy increased from 12.4 to 19.6 per cent, which implies an increase or 267 per cent in consumption.

The most significant fact is the large-scale substitution of liquid for solid fuels. This phenomenon is linked with technical progress and is also more clearly evident in the United States. But it is not only a matter of technological orientation, since relative prices are largely the cause of this substitution. Fuels, liquid and solid, are mainly used to drive static and mobile machinery. In the latter case the advantage of liquid

<sup>1</sup> See chapter III of Part Two.

Chart I. Brazil : product, consumption and the demand for energy  
(1939 = 100) Natural scale



fuels, which are used in internal combustion engines, constitutes a technologically proven fact: it is not possible to utilize solid fuels in aircraft and motor-cars. But as regards static machinery of large dimensions, the cost factor or some other element of an economic character predominates. Thus it is that the competition of fuel oil and diesel oil with solid fuels is in many ways a different phenomenon from the competition of petrol. While it is true that the consumption of this latter grew less than that of fuel and diesel oil, it is also true that it increased four and a half times more than that of solid fuels. Relative prices are largely the cause of this substitution of petrol for solid fuels.

Moreover technological development is constantly permitting greater reductions in the production costs of liquid fuels and thus increasing their competitive capacity. This, however, was not the most important factor in determining relative prices, which were the result of the exchange policy. As imported products, liquid fuels benefited considerably by the stabilization of the exchange rate from 1939 onwards. Although the price of fuelwood rose between 1939 and 1951 by 325 per cent<sup>2</sup> and that of domestically produced coal by 225 per cent, the average price of imported liquid fuels increased by only 64 per cent. This fact in itself will largely explain the degree of substitution which took place.<sup>3</sup>

The extent to which energy sources can be replaced from domestic production is a question of major significance to a development programme. As first presented, the problem is purely technical, for example, not all the sources of energy can be equally easily transported and electric energy can be transmitted only within certain limits. In addition, liquid fuels may be used to produce mechanical energy through the heating of boilers—in the same way as solid fuels—and to drive internal combustion engines.

Once the technical limits of the substitution process are defined, the problem of energy supply is then presented in economic terms which are not always easy to define; some energy sources are imported while others are available in Brazil, so that the respective costs may develop differently and are not always comparable from every aspect. Another factor hampering cost comparisons is the volume of initial investment. A hydroelectric plant demands much greater initial investment per kW than a thermoelectric plant. However, the terms of the problem are different if consideration is given to the economy as a whole, to the investment required for the production and transport of the fuel, and to the expansion of the exportable production with which it is intended to pay for imported fuel. If increased purchases of fuel abroad lead to a reduction of other imports, the investment required to raise domestic production as a means of offsetting the reduced imports must not be overlooked.

It is clear that a comparison of the aggregate investment for two power plants, one based on thermal energy and the other on hydroelectric sources, is no simple matter. Let it be assumed that, once the two calculations have been made, the conclusion is reached that the hydroelectric plant is cheaper, but requires greater initial investment. In this case, the problem of the shortage of capital must be borne in mind.

Finally it remains to be seen what part of the operating costs must be covered by foreign exchange, since the proportion may be high in the case of the thermal plant.

In Brazil, given the prospects of a relative decline in the capacity to import, it is usual to lay the main emphasis on the need for intensified utilization of hydraulic resources. Although there is wide recognition of this need, experience during the last ten years shows that hydroelectric energy has largely been replaced by liquid fuels. This substitution is obvious in the case of urban transport in cities such as Rio de Janeiro and São Paulo, where electric tramways have given way to motor buses. The trolleybus, which is probably the appropriate vehicle to replace out-of-date tramways, is used in small numbers in São Paulo, and more recently in Niterói and Belo Horizonte. The phenomenon is not restricted to urban transport. As already stated, the substitution of thermal for hydroelectric energy is often taking place irrationally, mainly because of the inadequate supply from the latter source.

The internal or external origin of the energy consumed is the next problem. In 1939 energy from imported sources amounted to 5,593 million kWh, or 30.4 per cent of total consumption. During the war years this share declined, falling to 18.7 per cent in 1944. From 1946 onwards, owing to greater substitution, the share of imported energy gradually increased, reaching 47.9 per cent in 1954. Thus dependence on imports rose significantly during this period. During the Second World War it was found possible to replace imported coal by lower-quality domestic coal and by fuelwood. On the other hand, the importance of motor buses in urban transport was relatively slight and a similar situation prevailed in the case of inter-urban lorry transport. At present the situation is very different, since for those railways possessing diesel engines the conversion process is not feasible, while urban transport is mainly based on internal combustion engines; in addition, inter-city highway transport already outstrips rail transport so far as load volume is concerned.<sup>4</sup> A fresh fall in petroleum imports—such as that which occurred in 1941 and 1942—would entail consequences whose gravity can hardly be assessed.

#### IV. PROJECTIONS OF DEMAND

In view of the many substitution possibilities for sources of energy, forecasts of demand are almost inseparable from a study of supply potentialities. In this sector, more than in any other, the policy as regards supply is the basic factor governing development. The price of energy is not a dominant factor in the formation of industrial costs, particularly when the profit margin is high. This can easily be confirmed by the present stage of Brazil's industrial development, because factories in one and the same branch utilize forms of energy whose prices vary between 1 and 5.

Although the price is not a decisive aspect of the problem, the availability of energy is fundamental. Where a factory produces energy for its own consumption there is an enormous increase in capital requirements. While this is justifiable to some extent in the case of a large enterprise, the same is not true of small and medium-scale companies. It is the essential reason why the supply of energy is a dynamic factor in the development process, that is to say one of the elements governing the real demand for energy.

<sup>4</sup> See chapter III of Part Two.

<sup>2</sup> According to the price paid by the railways.

<sup>3</sup> Reform of the exchange system at the end of 1953, and the readjustment of the exchange rate at the beginning of 1955 in particular, had the effect of partially correcting this distortion.

The projection of demand for energy must consequently be based on the assumption of an elastic supply. Assuming that the supply is not a limiting factor, given a certain hypothesis for the growth of the economy, how will the demand for energy grow? This is the first problem to be stated. After a preliminary projection of the demand has been made, it will be necessary to consider possibilities from the viewpoint of supply. Can the latter increase sufficiently to cover the projected demand? What pressure will the increased consumption exert on the balance of payments, in terms of imports for sources of energy? What alteration must be made in the composition of supply in order to reduce that pressure or to adapt it to the country's own potential energy resources?

The starting point for a development policy in the energy sector must therefore be a projection of demand based on a hypothesis of growth for the entire economy. The projection then leads to a formulation of supply policy, bearing in mind the need not only to obtain minimum costs, but also to make the best possible use of domestic resources and the prospects for the capacity to import.

In recent years, the general lines of a development policy for Brazilian energy sources have continued to be traced. Certain plans to develop the coal and petroleum sectors are being carried out. Electric energy has figured in regional development plans and a national electrification programme is being studied.

### 1. Domestic coal

The Coal Plan provides for an increase in output of between 2.0 and 3.7 million tons. After rising from 1 to 2 million tons between 1939 and 1943, coal production remained stationary over the next ten years. In 1949 the calorific value of domestically mined coal was 100 per cent more expensive than that of fuel oil and 78 per cent more than that of imported coal. Under such conditions little else could be expected than the stagnation of domestic production. Bearing in mind that the Companhia Siderúrgica Nacional has since 1946 been consuming increasing quantities of local coal, it may be deduced that consumption in the remaining sectors has been declining. Technicians who studied the situation of the Brazilian coal industry in order to prepare the Coal Plan were of the opinion that, with suitable rationalization measures and the improvement in techniques consequent upon the planned investment, the calorific value of domestic coal could well compete with that of the imported product. Taking account of the fundamental alteration of relative prices resulting from the 1953 exchange reform, domestic coal may still regain its position on the market.

The problem of domestic coal is basically one of price competition. The following example is illustrative. The plan for the Companhia Nacional do Alcalis includes the possibility of using Brazilian coal, provided that it does not raise costs. The alternative lies between using 150,000 tons of domestic coal or spending \$1.7 million on imported petroleum. This is a problem of comparative costs for the company, the key to which may reside in exchange policy, but for Brazil it is a question of the balance of payments. The same could be said of any heavy consumer of imported fuel, the cement industry, for example. The remarkable development of this industry, whose production was 1 million tons in 1947 and will probably reach 4 million by 1960, has taken place without any consideration of production costs in terms of foreign exchange.

The Coal Plan is essentially based on the policy of raising consumption by reducing fuel costs. It is possible, however, that some of its proposals cannot be carried out for technical reasons. Thus, however much the prices of domestic coal are reduced in relation to the imported product, diesel locomotives cannot be adapted to burn this fuel. But the use of coal in power plants may considerably exceed forecasts, since the National Electricity Plan provides for the installation at Santa Catarina of a 200,000 kW plant, which would absorb 1.5 million tons of low-grade coal. It may therefore be assumed that in 1962 consumption will reach at least 3.7 million tons, the minimum figure forecast by the Coal Plan for an earlier date.

### 2. Charcoal and bagasse

The projection of charcoal consumption took as a basis the probable growth of the iron and steel industry. Consumption should reach 1,823,000 tons in 1962. Known plans for expanding the basic steel industry—excluding Volta Redonda—show that there will be growing interest in electric furnaces. In addition, the sinterization process makes it possible to save increasing quantities of charcoal in blast furnaces. For lack of complete information on each plant it may be assumed that coal consumption will keep pace with the probable growth of the smelting process, excluding coke furnaces.

Projection of sugar-cane bagasse consumption as a fuel is based on the probable growth of sugar production. This is a typical example of a by-product. Production of bagasse is determined by that of sugar-cane, which in turn depends on that of sugar. When sugar production begins, bagasse accumulates and its use as a fuel for the boilers of thermic plants has hitherto been considered as the most economical method. Other applications may also be found, and at least one mill is already using bagasse for pulp manufacture in Brazil. Other small pulp-mills consuming bagasse as a raw material are now being studied or are already under construction. Their number will probably increase as technical improvements to boilers reduce the requirements of bagasse as a source of heat and as the output of industrial alcohol expands. But for the moment, it is unlikely that any substantial proportion of the available bagasse will be utilized for purposes other than the production of calorific energy, particularly in view of the recent rise in the cost of imported fuels.

### 3. Petrol

The demand for normal-octane petrol basically depends upon the number of vehicles with internal combustion engines in the country and the extent to which they are used. Between 1946 and 1952 the number of such vehicles in Brazil (excepting tractors and motor-cycles) increased by 156 per cent; the consumption of petrol rose by 204 per cent during the same period, giving an increase in consumption per vehicle of 18.6 per cent. It is highly probable that the greater consumption per vehicle arose from the relative increase in the number of lorries, which expanded by more than 230 per cent.<sup>5</sup>

If pre-war figures are compared with those for more recent years, a substantial increase in consumption per vehicle is evident: about 100 per cent between 1939 and 1952. A major reason for the greater consumption, *inter alia*, lies in the increase in the relative numbers of lorries, omnibuses and taxis. All of them are today working more hours daily and consume more

<sup>5</sup> Excluding lorries with diesel-type motors.

fuel per kilometre than private passenger cars, although it is also probable that a greater use is now being made of this latter class of vehicle. As cities grow in size, passenger cars cover a greater distance each day. Better highways and the creation of entertainment centres outside the cities lead to a more extensive week-end utilization of private cars, while modern highway systems allow a wider use of all vehicles over greater distances and also reduce the time when they are off the road for repairs.

Allowing for further road improvements during the coming years and for other favourable factors, it has been assumed that the annual rate of increase of petrol consumption per vehicle for the period 1946–1952 (2.9 per cent) will be maintained until 1962. Consumption in the latter year will be 7,000 litres of petrol per vehicle-year, as compared with 5,290 in 1952 and 4,460 in 1946. Assuming that all vehicles work an average of 300 days annually and consume 0.2 litre per kilometre, the aggregate consumption of 7,000 litres gives an average of 35 kilometres daily, or between one and two hours' work daily per vehicle.

As regards the number of vehicles, there should not be more than 545,000 passenger cars in 1962, according to the hypothesis on the increase of consumption<sup>6</sup> and allowing for the price increments already affecting this type of vehicle. It is possible that this is a maximum figure, since a hypothesis of a reduction in numbers is equally plausible.

The number of lorries, which stood at approximately 300,000 in 1954, is expected to increase between 1954 and 1962 at the same rate as during the period 1939–1949; it is a matter of fact that this rate showed a considerable rise between 1949 and 1952. But, as studies of this subject show,<sup>7</sup> this expansion cannot be expected to continue. Substantial improvements in the railway system and the relative price increases for lorries and petrol, will entirely alter the competitive conditions between the two chief means of transport in Brazil.

According to the rate of increase mentioned above, there should be approximately 573,000 lorries in 1962, or 273,000 more than in 1952. But the number of diesel motor lorries—not more than 10,000 in 1952—may be expected to grow. In view of the increasing preference for this type of vehicle, which is today more pronounced because of the relative increase in petrol prices, it would not be an exaggeration to assume that at least one out of every five new lorries will have a diesel motor. On this basis, diesel lorries will represent approximately 70,000 of the total 573,000 lorries estimated for 1962.

The rise in the number of omnibuses has closely followed the increase of lorries; 232 per cent for the former and 228 per cent for the latter between 1939 and 1952. In the absence of a definite study of the demand for omnibuses and of the determining factors, it must be assumed that the increase will continue to keep pace with the demand for lorries. In view of the high proportion of diesel-engined buses, it will be assumed that one-half will use that type of traction in 1962. Table 113 provides figures for the three principal types of road vehicle.

Assuming a consumption of 7,000 litres of petrol per vehicle, the annual consumption for 1,070,000 petrol-engined vehicles would amount to 7,490 million litres, an increase of 129 per cent in relation to 1954.

Table 113. Brazil : Projection of road vehicle numbers  
(Thousands of units)

	Petrol		Diesel		Total	
	1954	1962	1954	1962	1954	1962
Passenger cars ...	350	545	—	—	350	545
Lorries .....	285	503	15	70	300	573
Omnibuses .....	12	22	12.5	22	25	44
TOTAL ...	647	1,070	27.5	92	675	1,162

Source : Official publications and Economic Commission for Latin America.

#### 4. Fuel oil

There was a very pronounced rise in the consumption of fuel oil between the pre-war period and more recent years; 11.6 per cent annually between 1939 and 1954. This rapid increase is a reflection of the relative price advantage over domestic fuelwood and coal, resulting from the foreign exchange policy applied to fuel oil. It is not the only reason, however, since technological advances in recent years have generally favoured the use of petroleum derivatives as fuel.

The consumption of fuel oil in 1952 amounted to 2,309,500 tons; 68.8 per cent by industry, 11.8 by rail transport, 11.3 by ocean transport and 8.1 per cent in the production of electric energy for public use. A substantial proportion of the oil consumed by industry was used to generate energy, a factor demonstrating the inadequacy of the public utility companies. In the cement industry, for instance, 365,000 tons of fuel oil were used in 1952 to produce 1,619,000 tons of cement. Since one ton of clinker requires approximately 17 kilogrammes of fuel oil, nearly 90,000 tons of fuel were used for purposes other than cement manufacture, almost certainly to generate energy.

It is thus clear that the increase in the industrial consumption of fuel oil will to some extent depend upon the availability of power from public utility companies. To use the cement industry as an example once more, production could exceed 4 million tons in 1962. If cement factories were to use only purchased power, this production would require but 680,000 tons of oil. If, on the other hand, they must use fuel oil to generate the required energy, the consumption would rise to 1.72 million tons; the total in practice will undoubtedly lie between these two extremes. Since there are few projects for improving the supply from public utility companies, the relation between purchased power and energy generated by industry should remain similar to that of 1952. The consumption of the cement industry in 1962 would thus stand at 902,000 tons.

Using similar criteria, and allowing for projected increases in other branches, the consumption of fuel oil by the principal industries may be calculated in this way.

Based upon the analysis in chapter III, an annual rate of increase of 7 per cent has been assumed for rail transport. A hypothesis of 5 per cent was selected for sea transport, using a minimum probable rate of growth for coastal shipping. The marked trend towards the substitution of fuel oil for coal in this latter sector must be recalled, but, since it would also involve a reduction in the number of ships, it has been assumed that one effect would offset the other.

It remains to consider the fuel oil consumed by public utility companies in generating electric energy. Uncompleted projects

<sup>6</sup> See chapter VI, Part One.

<sup>7</sup> See the study of the transport situation in chapter III.

in 1952 included the 30,000 kW power station at Carioba, two units of 100,000 kW at Piratininga, which entered service in 1954, and probably other smaller projects. The possible construction of hydroelectric generating plants, especially Paulo Afonso, will reduce the consumption of fuel oil in some areas. The increase in installed capacity of approximately 230,000 kW will bring the fuel oil consumption of public utility power stations to almost 507,000 tons in 1962.

It should not be overlooked that the plans of the company operating the Piratininga plant include the addition of four further 100 kW units by 1961; in this case the consumption of fuel oil by the public utility sector would rise to 1,130,000 tons. However, since the expansion at Piratininga was not foreseen in the National Electrification Plan, it is excluded from the subsequent projections. (See table 114.)

Table 114. Brazil: Projection of fuel oil consumption  
(Thousands of tons)

	1952	1954	1962	Percentage increase over 1952
<i>Industry</i> .....	1,590.0	—	3,595	126.1
Cement .....	365.2	—	902	147.0
Textiles .....	219.9	—	387	76.0
Metallurgical .....	147.9	—	414	180.0
Foodstuffs .....	97.2	—	175	80.0
Miscellaneous .....	759.8	—	1,717	126.0
<i>Transport</i> .....	533.0	—	956	79.4
Rail .....	273.0	—	535	96.0
Sea .....	260.0	—	421	61.9
<i>Public utility services</i> ..	186.5	—	507	171.8
<b>TOTAL</b> ...	<b>2,309.5</b>	<b>3,032.8</b>	<b>5,028</b>	<b>119.0</b>

Source: Economic Commission for Latin America.

The projection in table 114 shows an annual rate of increase of 6.6 per cent, considerably lower than that of 1940-54 (11.6 per cent) and even below that of 1940-49 (9.3 per cent). Since competitive conditions for fuel oil in the near future will be less advantageous than during the past ten years—for instance, the considerable price increase due to foreign exchange policy reform—the projection in table 114 certainly shows the lowest level which may be expected.

### 5. Diesel oil

The consumption of diesel oil has risen even more rapidly than that of fuel oil, the annual rate of increase between 1939 and 1954 being 15.2 per cent, and 12.5 per cent between 1939 and 1949. From 1949 to 1954 the rate of growth rose to 20.9 per cent. This exceptional increase is not a true reflection of the development of the economy, but rather of the abnormal manner in which it developed during that period. The shortage of energy generated by public utility companies has obliged the different types of consumer to install small units for their private use.

Consumption of diesel oil in 1952 amounted to 871,900 tons. Of this total, 221,800 were used by industry, 68,800 by rail and sea transport and 58,200 by public utility services, leaving a balance of 523,100 tons. There were not more than 10,000 diesel motored lorries in 1952. The number of diesel omnibuses and tractors of all types may be estimated at 20,000,

or half the total of all such vehicles in the country. Assuming that each of these vehicles consumed 10,000 litres of diesel oil per annum—which is a high consumption—the total for all types of vehicles would be 255,000 tons. A balance of 268,000 tons, or 30 per cent, would remain. This large tonnage gives an indication of the extent to which small units are being used to supplement the inadequate public energy supply, a costly procedure both for the consumer and for the public in general. One of the reports of the Joint Brazil-United States Economic Development Commission states, for example, "energy supplied by the Light, Power & Traction Company to COBRASMA (a factory manufacturing railway materials) costs approximately 0.14 cruzeiros per kWh, whilst the total cost from their own diesel-electric plant, including amortization of the equipment, is approximately 1.30 cruzeiros per kWh, or almost ten times more".<sup>8</sup>

In principle, it may be accepted that if—as may be anticipated from 1955—the public energy supply improves, especially in Rio Grande do Sul and Minas Gerais where the higher consumption of diesel oil was most marked,<sup>9</sup> there will be a decline in the rate of increase in the consumption of this type of fuel. This statement applies only to residual consumers; the remaining groups will be examined separately.

The consumption of diesel oil is more widely distributed amongst industries than that of fuel oil; the textile industry, which is apparently the heaviest consumer, used less than 10 per cent of the total in 1952. Because of the dispersed utilization and the lack of complete data on all industries, it must be assumed that the consumption of diesel oil will increase at the same rate as that of industrial production.

The projected consumption of diesel oil by the railways is based on the probable number of diesel locomotives. According to existing plans, and bearing in mind certain other factors, approximately 750 diesel locomotives will be running in 1962. The projection was made on the basis of their probable average consumption.

For road transport, the projection uses the estimate of diesel engined vehicles presented earlier or 92,000 in 1962, with an average annual unit consumption of some 10,000 litres. For diesel-powered tractors, a first estimate is that the number will increase threefold between 1952 and 1962.

The projection for sea transport uses the same criterion as in the case of fuel oil.

The consumption of diesel oil by fixed plants generating electric energy for public use depends upon a number of factors, especially upon the outcome of development plans for hydro-electric power. In the north-east, for instance, the energy from Paulo Afonso will partly replace a widely dispersed number of diesel plants; the same applies to Minas Gerais and Rio Grande do Sul. It is unlikely, however, that these plants will remain unused, since they will perhaps be moved to other areas which are not served by the general network. On the other hand, plans at present being implemented will not cover many important areas in Brazil, where it is probable

<sup>8</sup> Joint Commission Project No. 24. It should be noted that this calculation was made by using the lower price of fuel before the exchange rate was modified.

<sup>9</sup> Between 1945 and 1952 the consumption of diesel oil increased eightfold in Rio Grande do Sul and nine-fold in Minas Gerais, whilst the total for the country was five times greater.

that the number of small and medium diesel plants will increase. For these reasons, a conservative assumption shows that the installed potential for diesel units in public service will be doubled between 1952 and 1962. Finally, a projection has been made of the residual group, taking into account the probable average rate of increase of the other groups. (See table 115.)

Table 115. Brazil: Projection of diesel oil consumption  
(Thousands of tons)

	1952	1954	1962	Percentage increase over	
				1952	1964
Industry .....	221.8	—	555	150	—
Transport .....	323.8	—	1,257	388	—
Road* .....	255.0	—	1,037	407	—
Rail .....	38.8	—	170	287	—
Sea .....	30.0	—	50	67	—
Public services .....	58.2	—	116	100	—
Miscellaneous .....	268.1	—	856	319	—
TOTAL ...	871.9	1,229	2,784	219	127

Source: Economic Commission for Latin America.

\* Including tractors.

The annual rate of increase between 1955 and 1962, as shown by this projection represents 10.8 per cent, slightly lower than the period 1940-49, when it varied around 12.5 per cent.

#### 6. Kerosene

Little information is available on the pattern of kerosene consumption, although this fuel is known to represent the principal means of lighting in rural areas. A pronounced increase has taken place in the number of tractors using kerosene,<sup>10</sup> while in country districts the number of domestic appliances, especially refrigerators, using this fuel has risen. Kerosene consumption is thus linked closely to the income of the farmer and has, in fact, increased more rapidly during the recent years of high agricultural incomes. The rate of increase in 1939-52 stood at 8.9 per cent. In 1940-49, when agricultural incomes rose more slowly, this rate was only 6.3 per cent. During the peak period for the growth of this type of income, 1948-52, the annual rate of increase in kerosene consumption moved up to 12.7 per cent.

Because it is unlikely that farmers' income during the next ten years will be higher than in 1940-52, the working hypothesis may be accepted that the consumption of kerosene will continue to show the same trend as during that period. Thus the consumption of 539,000 tons in 1954 may be expected to rise to 1,014,000 in 1962.

This projection does not allow for the possible development of jet-aircraft, which require much kerosene fuel. In the absence of adequate information on the possible expansion of military and civil aircraft of this type, no hypothesis will be presented on this subject.

#### 7. Imported coal

Almost since the First World War, Brazilian coal imports have been decreasing. Peak imports—2,262,347 tons—were

<sup>10</sup> Nevertheless, since the higher fuel prices of 1955, kerosene tractors have become uneconomical as compared with diesel oil and their number will probably decline.

registered in 1913. Since that time, competition from domestic coal, petroleum and also fuelwood has prevented an increase in the consumption of imported coal, although in 1929 it was still over 2 million tons. During the 'thirties, legislation providing for tariff protection enabled a substantial increase to be achieved in domestic production, which had remained almost constant during the previous ten years. Finally, the Second World War interrupted supplies from abroad and gave a definite stimulus to domestic output.

As noted in chapter III, the chief reason for the reduction in coal imports—at least during the past fifteen years—has been the replacement of this fuel on the railways. It suffices to quote the reduction from 750,000 tons in 1939 to 165,000 in 1952. It is highly probable that complete replacement of imported coal will be achieved by the railways.

Sea transport is another sector in which the use of imported coal is tending to decline, since it is gradually and entirely being replaced by fuel oil and, to a lesser degree, by diesel oil.

In addition to rail and sea transport, imported coal is also used in gas production and by iron and steel plants. The Plano Nacional do Carvão predicts the possibility of a 30 to 40 per cent substitution of imported coal in the gas industry, which consumed 231,000 tons in 1950. It may be assumed that this total will expand by at least 60 per cent by 1962, in view of the increasing population in the cities where gas is used. In other words, consumption would then amount to 370,000 tons and, allowing 30 per cent for the share of domestic production, 260,000 tons of imported coal would be required. The metallurgical sector is at present the heaviest consumer of imported coal, especially the Volta Redonda iron and steel plant. It is thus very likely that the next ten years will witness a change in the declining trend of coal imports, because of the planned expansion of coke utilization in the iron and steel industry. Competent authorities believe that between 30 and 40 per cent of all domestic coal mined will be used with metallurgical coal in the coke furnaces of the steel plants. Assuming that 35 per cent is used, approximately 900,000 tons of imported coal will be required for a minimum consumption to produce one million tons of coke.

In 1962, therefore, the volume of imports will have risen to approximately 1.2 million tons, an increase of 36 per cent above 1952.

#### 8. Aviation petrol

There has been a very considerable increase in the consumption of high-octane aviation petrol between the pre-war period and recent years; it expanded ten-fold between 1939 and 1949. This period, therefore, does not constitute a satisfactory basis for a projection.<sup>11</sup> The rate of increase had in fact already begun to decline in 1949, and between 1949 and 1954 the average rate of growth stood at 11.4 per cent, lower than that for the whole group of liquid fuels. In the absence of any sounder basis, 11.4 per cent will be used for projection purposes, which gives a consumption of 218,000 tons in 1954 and 517,000 in 1962.

#### 9. Lubricants

The increase in the consumption of lubricating oils has kept pace with that of liquid fuels; for the projection it has

<sup>11</sup> The progressive substitution of more modern types of aircraft will result in a considerable saving of fuel.



been assumed that the same relationship will continue in coming years. The consumption should therefore reach 418,000 tons in 1962, or exactly double the volume in 1954.

#### 10. Aggregate consumption of fuels and lubricants

Table 116 groups together all the projected consumption of the various types of fuels and lubricants.

Table 116. Brazil: Projection of consumption of fuels and lubricants  
(Thousands of tons)

	1954	1962	Percentage increase
Petrol (other than aviation) . . . .	2,408	5,514	129
Fuel oil . . . . .	3,033	5,058	67
Diesel oil . . . . .	1,229	2,784	127
Kerosene . . . . .	539	1,014	89
Aviation petrol . . . . .	218	517	137
Imported coal . . . . .	808	1,200	49
Domestic coal . . . . .	2,019	3,700	83
Lubricants . . . . .	209	418	100
Charcoal . . . . .	1,315	1,823	39
Bagasse . . . . .	5,703	9,524	67

Source: Economic Commission for Latin America.

The aggregate consumption of petroleum derivatives is thus seen to increase from 7.3 million tons in 1954 to 15.3 millions in 1962, which represents an average rate of increase of 7.2 per cent, compared with 10.7 per cent in 1940-49 and 12.6 per cent between 1939 and 1954.

#### 11. Electric energy

Projection of the demand for electric energy entails a series of difficulties caused mainly by the inadequacy of statistical data and an additional problem exists which is not encountered in the case of petroleum derivatives. The consumption of electric energy in recent years has been heavily restricted through a shortage in the supply. To project the present position would therefore be to assume that this abnormal situation will continue. The solution to the problem may lie in preparing an inventory of present shortages, sector by sector. Some such attempts have already been made but the results, apart from being incomplete, are of doubtful value. It is known that, when enterprises detail their unsatisfied requirements the tendency, for various reasons, is to exaggerate them. In addition, current unsatisfied needs are usually confused with expansion plans for the more or less distant future. The most satisfactory solution will probably be to base the projection upon the year 1949, when the supply shortage was only just beginning to appear. Furthermore, projections based on that year enable the data from the census to be used.

In 1949 consumption of electric energy stood at 6,237.2 million kWh. Of that total 47.2 per cent was consumed by industry, as compared with 31.2 per cent in 1939. The major changes in the composition of consumption between the two years cited are shown in table 117.

The composition of energy consumption in 1949, broken down into the various industry groups, was calculated on the basis of data for the forty largest manufacturing enterprises. These data consist of the aggregate energy sold to industry.

Table 117. Brazil: Distribution of electric energy consumption

	1939	1949
Total consumption (millions of kWh) . . . . .	2,488.7	6,237.2
(Percentages)		
Industry . . . . .	31.2	47.2
Transport . . . . .	10.2	7.2
Railways . . . . .	3.2	5.0
Urban . . . . .	7.0	2.2
Public lighting . . . . .	6.7	6.0
Commerce . . . . .	13.9	8.6
Household lighting in capital cities . . . . .	10.9	15.6
Unspecified <sup>a</sup> . . . . .	27.1	15.4

Sources: Industrial Census 1939 and 1949.

<sup>a</sup> Including household lighting outside capital cities.

In order to divide this total among the various industry groups, the census data on energy purchased were used. Information on the energy produced by individual companies for their own consumption, compiled for the 1949 census, has not yet been published; the projection was therefore computed by assuming a proportionate increase over the figures in the previous census. The results are shown in table 118.

Table 118. Brazil: Breakdown of electric energy consumption by manufacturing industries  
(Millions of kWh)

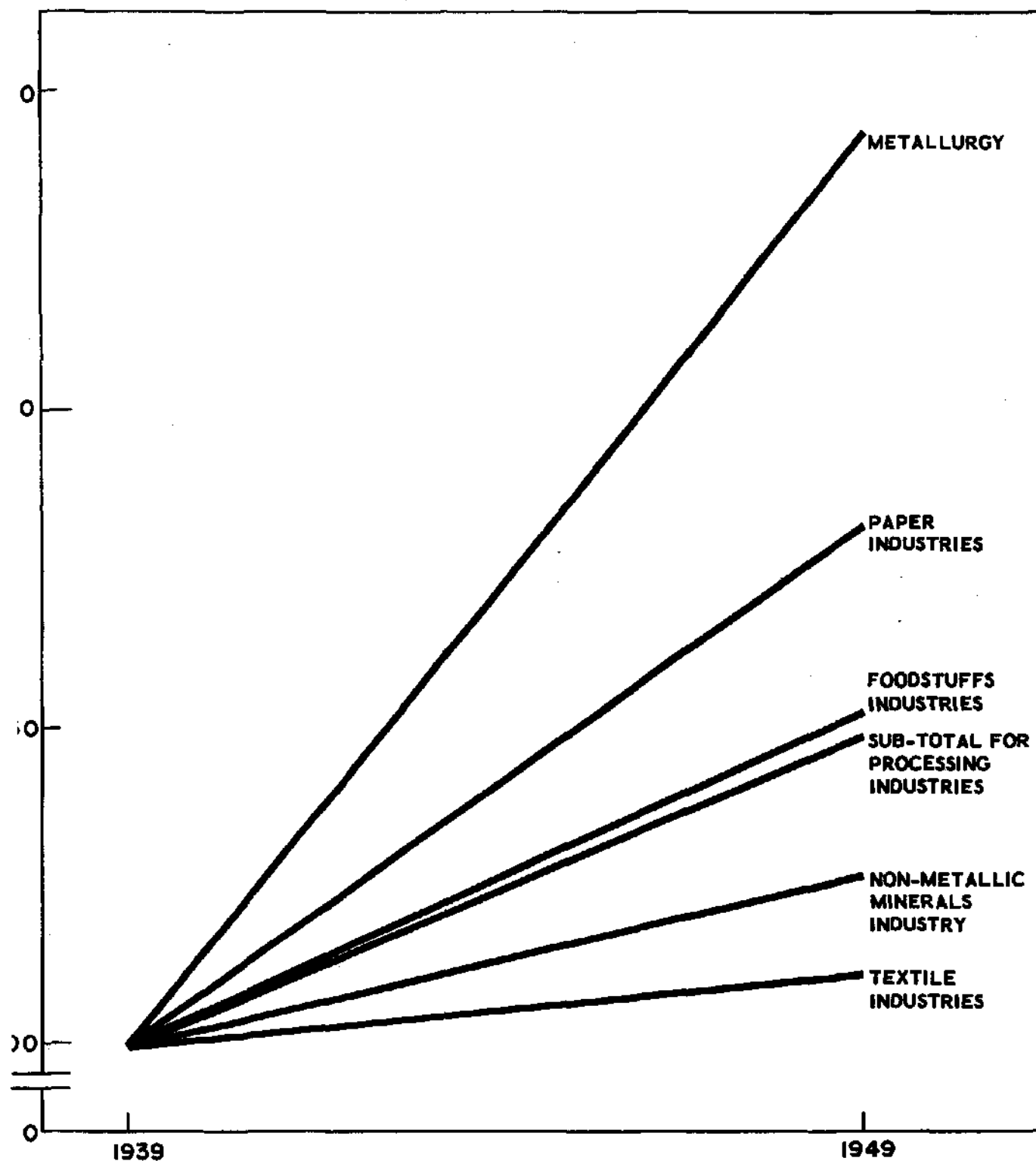
	1939	1949	Percentage increase
Non-metallic minerals . . . . .	48.8	255.6	423.8
Metallurgy . . . . .	69.0	381.3	452.6
Foodstuffs . . . . .	148.1	600.8	305.6
Textiles . . . . .	261.1	629.7	141.2
Chemicals . . . . .	74.1	284.5	283.9
Paper . . . . .	33.4	134.0	301.2
Others . . . . .	141.3	656.0	364.3
TOTAL . . . . .	775.8	2,941.9	379.2

Source: Census statistics and data supplied by the forty largest producing firms.

The future demand for energy by industries was based on the projections of production for each branch of industry appearing in Part One. But, to obtain an idea of probable energy demand, a hypothesis of production growth in a branch of industry is insufficient, because, when industries expand, they tend to replace manpower by machinery or to use equipment of more advanced technical design. All such modifications cause changes in the relationship between the volume of production and the consumption of energy. An illustration appears in chart II where the growth of connected power—that is, installed horse-power—is compared with the size of the labour force in the principal industry groups. As regards manufacturing industries as a whole, the growth in installed horse-power was 50 per cent greater than the number of workers. But while this difference was only 12 per cent in the textile industries, in metallurgy it reached 144 per cent. It is quite possible that utilization of equipment during 1949, in relation to 1939, was more intense in one branch of industry than in another. In any event, since equip-



Chart II. Brazil : connected power per worker employed in industry



Source: Industrial census, 1940 and 1950.

ment utilization was generally more intense in 1949 than in 1939, the indices presented here reflect the minimum mechanization which must have taken place. In the textile industry, for example, it is known that in 1939 part of the capacity remained idle, whereas in 1949 many mills were working more than one shift. The difference of 12 per cent thus under-estimates mechanization—especially the increase in the relative number of automatic looms—which occurred in the period under review.

The present projection assumes that the mechanization process, i.e., the dynamic substitution of machines for manpower, will continue in the near future, or rather until 1962, at a rate approximately equal to that shown in the period 1940-49. This hypothesis is acceptable when it is recalled that the growth of heavy industry—metallurgy, mechanical and chemical industries—will continue at a more rapid rate than in industry as a whole.

So far as the main industry groups are concerned, chart III gives an idea of the increase in labour productivity and of the more intensive use of equipment. If the indices of real production are compared with those of employment, it may be seen that an appreciable increase in productivity took place. The only exception is the paper industry. However, bearing in mind the substantial increase in connected power, it may be inferred that this is not properly a question of a reduction in labour productivity, but of basic alterations in manpower structure. In point of fact, the establishment in Brazil of a

large-scale newsprint and pulp industry altered the structure of this branch between 1939 and 1949. The number of unskilled workers must have risen sharply in relative terms, thus reducing the comparability of the data.

A more interesting feature than the increment in labour productivity is the more than proportionate increase in energy consumption as related to connected power. (See again chart III.) Electricity consumption grew more heavily than connected power in all industry groups. This means that the utilization of equipment was more intensive in 1949 than in 1939. In the foodstuffs industry, intensification in the use of machinery appears to be 195, as compared with an index of 100 in 1939. In the paper industry it reaches 109. The remaining industry groups are situated between these two extremes.

The aspects discussed above show that the factors which determine the increase in electric energy consumption by industries are three in number—(a) growth of industrial production, (b) increased mechanization (i.e., increased horsepower—secondary motors—per worker), and (c) greater efficiency in energy utilization. The point of departure for each branch of industry in this projection is the hypothesis of production growth shown in Part One. It is then assumed that the mechanization process will continue at the rate observed between 1939 and 1949 and that factor (c) will remain constant. The results are given in table 119.

Table 119. Brazil : Projection of electric energy consumption by industries

Industries	1949 consumption (millions of kWh)	Increased consumption forecast for 1949 and 1962, derived from		Total	Probable consumption in 1962 (millions of kWh)
		Increased production (percentages)	Greater use of machinery (percentages)		
Non-metallic minerals .....	255.6	206	32	238	864
Metallurgy .....	381.3	289	206	495	2,269
Foodstuffs .....	600.8	82	68	150	1,502
Textiles .....	629.7	84	12	96	1,234
Chemicals .....	284.5	194	160	354	1,292
Paper .....	134.0	167	110	277	506
Others .....	656.0	158	9	167	1,751
TOTAL ...	2,941.9	—	—	220	9,417

Sources : Table 118 and Economic Commission for Latin America.

The total increase in energy consumption by industries will thus represent 220 per cent, implying that the annual growth rate stands at 9.4 per cent, which may be regarded as relatively modest, since it was 14.2 per cent in 1940-49. The latter period, as noted earlier, was characterized by great intensification in the use of equipment, which largely explains the exceptional increase in energy consumption.

The rise in electric energy consumption in the transport sector represents 145.4 per cent, that is to say the annual growth rate would be 7.1 per cent, which compares favourably with that of 5.8 per cent for the period 1940-49. It is assumed that there will be a recovery in urban electric transport with a substantial expansion in the number of trolleybuses.

Projection of energy consumption in the public lighting branch is based on a series of data referring to State capitals

and the Federal District, which has been available since 1944 and reflects an annual growth rate of 5.2 per cent. This rate was utilized, despite the fact that it is acceptable only in a hypothesis of reduced growth, since no allowance is made for an increase in the public lighting services through their extension to urban centres without these facilities at present. In 1950 about 11 per cent of the municipal districts were in this situation.

The growth of electric energy consumption in commerce was projected on the basis of the tendency apparent in several cities served by one of the larger power companies. This tendency is reflected in an annual growth rate of 9.4 per cent.

As regards household lighting, similar data exist for capital cities in the period starting in 1944, when the annual growth rate stood at 13.6 per cent. They were accepted here as a preliminary approximation. Household consumption in

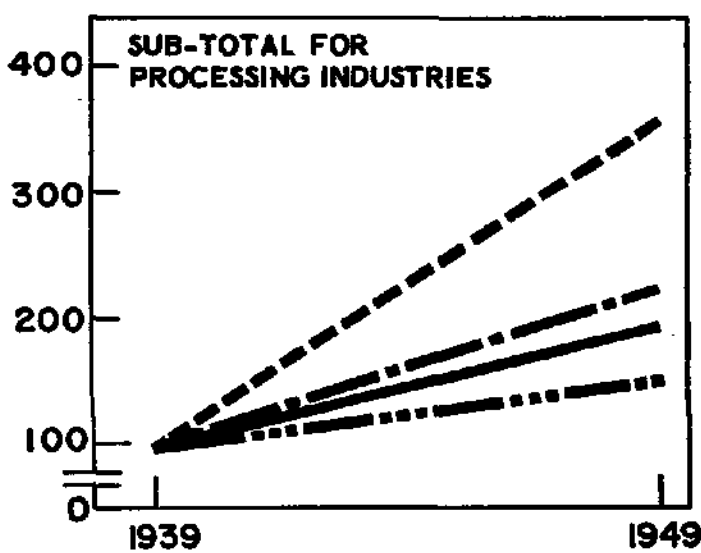
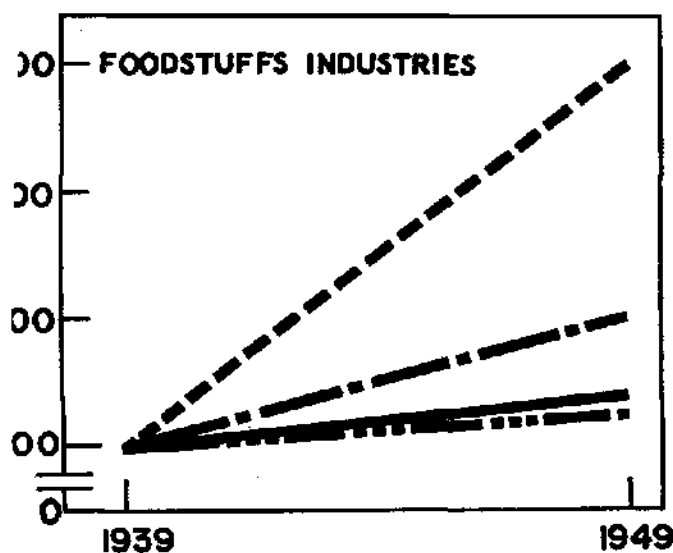
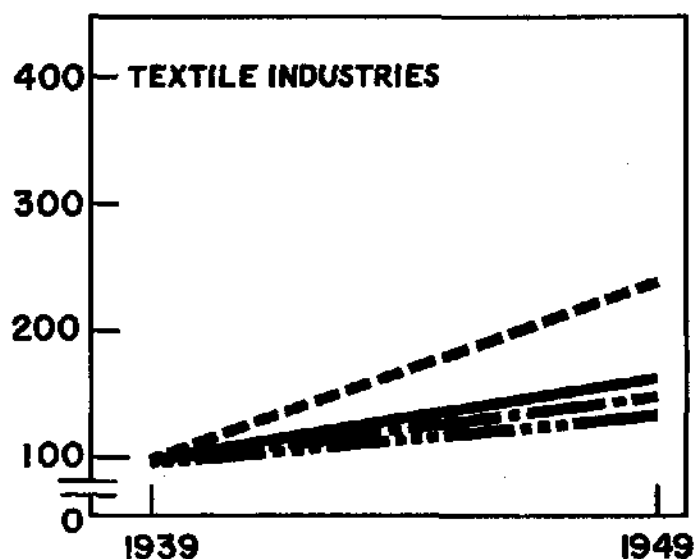
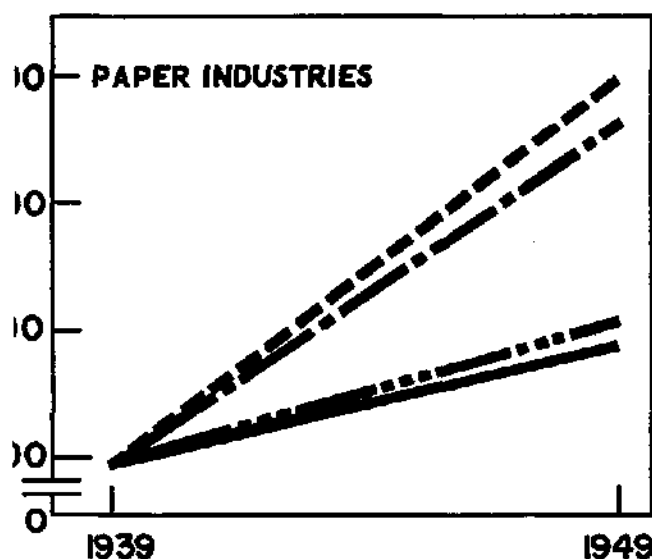
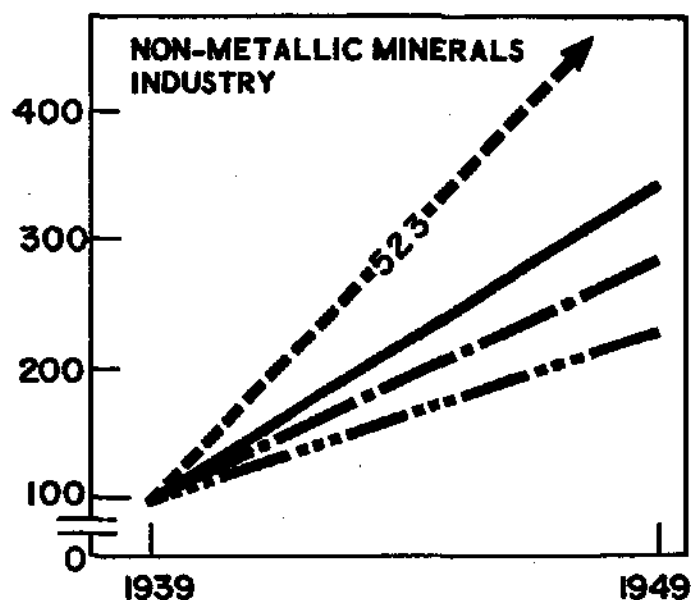
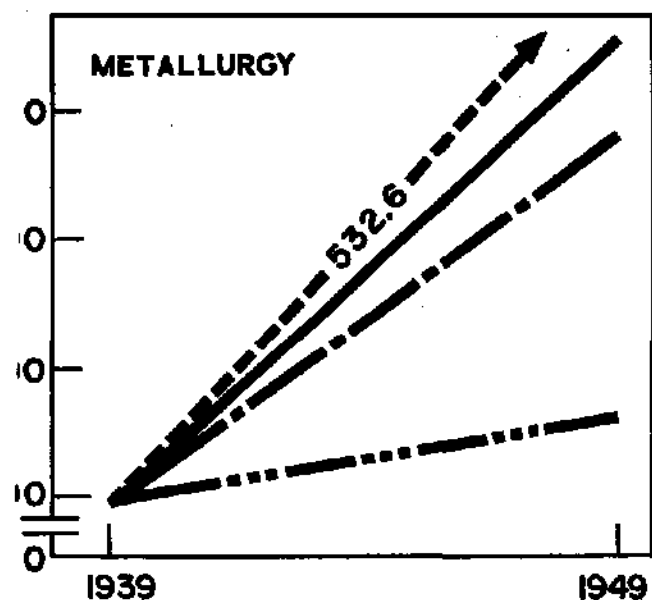
Chart III. Brazil : utilization of capacity and labour productivity  
(1939 = 100)

----- ELECTRICITY CONSUMPTION

----- CONNECTED POWER

..... NUMBER OF WORKERS

----- PRODUCTION



Sources: Industrial census and Fundação Getúlio Vargas.

the remaining cities was projected on the same basis. Calculations for 1949 pre-suppose that per capita consumption in the remaining cities is one-third of that in the capitals. The group entitled "unspecified" was projected on the basis of the average for the others.

Table 120 is a projection for the electric energy sector as a whole.

Aggregate electric energy consumption should grow by 257.9 per cent, or at an annual rate of 10.3 per cent, which is slightly higher than the 9.6 per-cent rate between 1939 and 1949. Table 121 contains a comparison between the projection of energy demand given in this volume, that of the National Electrification Plan, and a third extrapolating the 1939-49 trend. The projection presented here exceeds that of the National Plan by 13 per cent.

Table 120. Brazil : Projection of electric energy demand  
(Millions of kWh)

	1949	1962	Percentage increase
Industries .....	2,941.9	9,417.0	220.1
Transport .....	448.2	1,100.0	145.4
Railways .....	313.9	723.0	154.9
Urban .....	134.3	377	123.4
Public lighting .....	373.0	718.8	92.7
Commerce .....	563.3	1,719.4	220.6
Household lighting (capitals) .....	973.2	5,107.4	424.8
Household lighting (other towns) ..	482.3	2,531.1	424.8
Unspecified .....	482.3	1,726.2	257.9
<b>TOTAL ...</b>	<b>6,237.2</b>	<b>22,320.3</b>	<b>257.9</b>

Source : Economic Commission for Latin America.

Table 121. Brazil : Comparison between three projections of electric energy demand  
(Millions of kWh)

	1949	1962	Percentage increase	Annual rate of growth
Extrapolation of 1939-1949 tendency .....	6,237.2	20,589.0	230.1	9.6
National Electrification Plan .....	6,237.2	19,740.0	216.5	9.3
Hypothesis used in this study .....	6,237.2	22,320.0	257.9	10.3

Source : Economic Commission for Latin America.

To arrive at a projection of total energy consumption, certain suppositions will now be made as to the probable supply of thermoelectric energy. In addition to the two plants which recently entered production—Piratinunga and Carioba—it is assumed that those proposed in the National Electrification Plan will enter operation before 1962. The increase in installed capacity of thermal origin would represent 535,000 kW. (See table 122.)

Table 122. Brazil : New thermal power stations  
(Kilowatts)

Piratinunga .....	200,000
Carioba .....	30,000
Provided for in the Electrification Plan :	
Santa Catarina .....	200,000
Figueira .....	50,000
Sao Jerônimo .....	10,000
Charqueada .....	45,000
<b>TOTAL ...</b>	<b>535,000</b>

Sources : Official publications.

Since the majority of the power stations mentioned in table 122 are of a complementary character—they are part of systems mainly consisting of hydroelectric stations—a moderate utilization factor was assigned to the whole. Assuming that the energy delivered to the consumer would represent 40 per cent of production capacity, a total of 1,879.8 million kWh is obtained.

Apart from energy generated by the wind, consideration must be given to that produced by industrial concerns for their own use. According to calculations made here, in 1949 this source reached 14 per cent of the total energy

consumed by industry. Allowing for the probable improvement in supply by 1962, it is assumed that the proportion will fall to 10 per cent. The increase in this share of energy consumption will thus be 494.8 million kWh, as compared with 1952. If these two figures are added to total 1952 consumption, an aggregate of 3,323.2 million kWh is reached, which is the probable consumption of thermoelectric energy in 1962. Table 123 gives comparative data on the projected consumption of electric energy, thermal and hydroelectric plants being shown separately.

Table 123. Brazil : Projection of electric energy consumption  
(Millions of kWh)

	1939	1949	1952	1962
<b>TOTAL ....</b>	<b>2,488.7</b>	<b>6,237.3</b>	<b>7,607.5</b>	<b>22,320.3</b>
Hydro-electric .....	2,264.1	5,544.2	6,658.9	18,997.1
Thermal .....	224.6	693.1	948.6	3,323.2
Percentage of thermal energy to total .....	9.0	11.1	12.5	14.9

Source : Economic Commission for Latin America.

## 12. Aggregate energy demand

Table 124 shows that the projection of demand for energy from all sources will amount to 77,073 million kWh, always assuming that consumption of fuelwood remains more or less stationary. The ratio between total energy consumption and the gross product should rise from 0.103 to 0.130, which clearly indicates that the structural changes imposed by the present stage of development on the Brazilian economy cause heavy pressure on the energy sector. The funds absorbed by this sector must thus necessarily record a relative increase in any general development programme.

Table 124. Brazil : Projections of the demand for energy  
(Millions of kWh)

<i>Sources</i>	<i>1964</i>	<i>1962</i>
<i>Liquid fuels</i> .....	<i>18,817</i>	<i>37,538</i>
Aviation petrol .....	553	1,311
Petrol .....	6,033	13,816
Kerosene .....	1,443	2,727
Diesel oil .....	3,048	6,919
Fuel oil .....	7,644	12,765
Others .....	96	—
<i>Solid fuels</i> .....	<i>15,171</i>	<i>20,538</i>
Coal .....	4,097	5,554
Domestic .....	2,595	4,749
Imported .....	1,502	2,238
Fuelwood .....	6,166	6,000
Sugar-cane bagasse .....	2,623	4,380
Lignite .....	2,288	3,171
<i>Electric energy</i> .....	<i>8,307</i>	<i>22,320</i>
Thermal-electric .....	—	3,323
Hydroelectric .....	—	18,997
<i>Grand total (less thermal electric energy)</i> .....		
Including fuelwood .....	42,295	77,073
Excluding fuelwood .....	36,129	71,073

*Source* : Economic Commission for Latin America.

Table 125. Brazil : Consumption of energy, 1939-52  
(Energy : 1939-52)

Sources of energy	Unit	1939	1940	1941	1942	1943	1944	1945	1946
<b>A. Liquid fuels</b>									
Aviation petrol .....	1,000,000 l.	15.6	17.4	23.8	61.2	109.0	52.6	69.3	94.2
Petrol .....	1,000,000 l.	543.5	585.1	614.9	388.5	298.1	361.8	539.9	982.0
Kerosene .....	1,000,000 l.	152.2	142.5	165.8	99.3	85.5	93.8	113.0	167.7
Diesel oil .....	1,000 t.	146.6	156.7	162.0	126.9	133.3	187.3	177.4	218.5
Fuel oil .....	1,000 t.	586.2	695.0	696.6	634.3	1,054.9	631.9	766.6	962.3
Others :									
Alcohol-gasoline mixture .....	1,000,000 l.	—	—	72.7	60.6	19.4	25.9	11.5	12.2
Signal-oil .....	t.	—	—	—	—	—	—	349.0	206.0
Oil for gas production .....	1,000 t.	19.6	16.2	12.1	11.7	23.4	25.7	13.3	15.0
<b>B. Solid fuels</b>									
Coal :									
Domestic .....	1,000 t.	820.1	1,014.8	1,031.9	1,298.7	1,461.4	1,318.1	1,451.0	1,355.5
Imported .....	1,000 t.	1,382.5	1,210.2	1,058.3	616.6	587.4	492.1	715.8	1,071.0
Fuelwood <sup>a</sup> .....	1,000 m <sup>3</sup>	88,351.0	87,759.0	90,496.0	93,446.0	97,903.0	106,137.0	102,688.0	83,475.0
Sugar-cane bagasse .....	1,000 t.	2,182.3	2,534.1	2,482.5	2,434.5	2,396.9	2,531.3	2,500.5	2,920.5
Lignite .....	1,000 t.	720.0	722.9	740.4	681.9	902.4	896.6	978.3	528.8
C. Hydroelectric energy .....	1,000,000 kWh	2,264.1	2,555.8	2,780.1	3,022.9	3,223.0	3,546.6	3,714.7	4,102.3
Sources of energy	Unit	1947	1948	1949	1950	1951	1952	1953	1954
<b>A. Liquid fuels</b>									
Aviation petrol .....	1,000,000 l.	141.9	163.2	180.6	207.0	234.0	234.4	234.1	317.8
Petrol .....	1,000,000 l.	1,174.4	1,413.5	1,694.8	2,073.6	2,491.1	2,983.5	3,198.8	3,314.9
Kerosene .....	1,000,000 l.	187.1	215.4	262.5	320.8	359.8	432.2	552.4	725.1
Diesel oil .....	1,000 t.	321.6	410.9	475.2	676.3	687.7	871.9	1,071.2	1,234.2
Fuel oil .....	1,000 t.	1,191.6	1,217.6	1,432.1	1,824.8	2,045.5	2,309.5	2,486.2	3,094.8
Others :									
Alcohol-gasoline mixture .....	1,000,000 l.	46.1	59.5	61.2	11.4	19.1	61.3	—	—
Signal-oil .....	t.	181.0	207.0	119.0	193.0	294.0	287.0	181.2	390.0
Oil for gas production .....	1,000 t.	7.8	10.9	10.1	—	5.2	—	—	—
<b>B. Solid fuels</b>									
Coal :									
Domestic .....	1,000 t.	1,356.2	1,454.1	1,514.8	1,340.7	1,370.0	1,500.4	2,024.9	2,019.3
Imported .....	1,000 t.	1,572.7	1,082.9	814.5	1,155.6	1,070.7	954.9	745.9	807.7
Fuelwood <sup>a</sup> .....	1,000 m <sup>3</sup>	79,713.0	83,414.0	81,289.0	82,939.0	83,511.0	78,383.0	76,034.7	76,034.7
Sugar-cane bagasse .....	1,000 t.	3,728.8	3,920.4	3,783.0	3,640.8	4,213.3	4,806.2	5,390.5	5,702.8
Charcoal .....	1,000 t.	593.1	630.2	604.1	712.5	865.5	1,021.9	1,140.5	1,315.1
C. Hydroelectric energy .....	1,000,000 kWh	4,498.1	5,009.8	5,554.2	5,850.2	6,303.5	6,658.9	6,858.3	8,307.2

Source : Instituto Brasileiro de Geografia e Estatística, National Petroleum Board and Banco Nacional do Desenvolvimento Econômico, Joint ECLA-BNDE Working Group.

<sup>a</sup> Excluding fuelwood intended for charcoal production.

Table 126. Brazil : Energy consumption, 1939-1952

(Millions of kWh)

Sources of energy	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
A. All sources .....	18,405	19,097	19,490	18,625	20,668	20,496	21,769	22,093	24,739	25,958	27,125	30,398	32,717	35,331	37,637	42,295
B. Liquid fuels .....	3,157	3,522	3,714	2,982	3,914	3,050	3,704	5,251	6,560	7,395	8,720	10,961	12,439	14,617	16,160	18,817
Aviation petrol .....	27	30	41	106	189	91	120	164	246	283	314	359	406	407	407	553
Petrol .....	989	1,065	1,119	707	542	658	983	1,787	2,138	2,573	3,085	3,774	4,534	5,430	5,822	6,033
Kerosene .....	283	283	330	197	170	187	225	333	372	428	522	638	715	859	1,099	1,443
Diesel oil .....	362	387	400	314	329	463	438	540	794	1,015	1,174	1,671	1,699	2,154	2,646	3,048
Fuel oil .....	1,448	1,717	1,721	1,567	2,606	1,561	1,893	2,377	2,943	3,008	3,537	4,507	5,052	5,704	6,141	7,644
Others <sup>a</sup> .....	48	40	103	91	78	90	45	50	67	88	88	12	33	63	45	96
C. Solid fuels .....	12,984	13,019	12,996	12,620	13,526	13,899	14,350	12,740	13,681	13,553	12,861	13,587	13,974	14,055	14,619	15,171
Coal .....	3,556	3,472	3,221	2,728	2,906	2,560	3,165	3,702	4,671	3,883	3,472	3,940	3,752	3,704	3,989	4,097
Domestic .....	985	1,221	1,252	1,581	1,813	1,645	1,833	1,710	1,746	1,869	1,957	1,791	1,761	1,928	2,602	2,595
Imported .....	2,571	2,251	1,969	1,147	1,093	915	1,332	1,992	2,925	2,014	1,515	2,149	1,991	1,776	1,387	1,502
Fuelwood <sup>b</sup> .....	7,171	7,123	7,345	7,585	7,947	8,615	8,333	6,775	6,470	6,770	6,598	6,732	6,778	6,362	6,166	6,166
Sugar-cane bagasse .....	1,004	1,166	1,142	1,120	1,103	1,164	1,150	1,343	1,508	1,803	1,740	1,675	1,938	2,211	2,480	2,623
Charcoal .....	1,253	1,258	1,288	1,187	1,570	1,560	1,702	920	1,032	1,097	1,051	1,240	1,506	1,778	1,984	2,288
D. Hydroelectric energy .....	2,264	2,556	2,780	3,023	3,228	3,547	3,715	4,102	4,498	5,010	5,544	5,850	6,304	6,659	6,858	8,307

Source : Joint ECLA-BNDE Working Group.

<sup>a</sup> Including petroleum for natural gas production, "Signal oil" and alcohol-gasoline mixture.<sup>b</sup> Excluding fuelwood for charcoal production.

Table 127. Brazil : Index of energy consumption, 1939-52

(1939 = 100)

Sources of energy	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
A. All sources .....	100	104	106	101	112	111	118	120	134	141	147	165	178	192	204	230
B. Liquid fuels .....	100	112	118	94	124	97	117	166	208	234	276	347	394	463	512	596
Aviation petrol .....	100	111	153	393	700	338	445	605	911	1,048	1,159	1,329	1,502	1,505	1,507	2,048
Petrol .....	100	108	113	72	55	67	99	181	216	260	312	382	458	549	589	610
Kerosene .....	100	100	117	70	60	66	79	118	132	151	185	226	253	304	388	510
Diesel oil .....	100	107	111	87	91	128	121	149	219	280	324	462	469	595	731	842
Fuel oil .....	100	119	119	108	180	108	131	164	203	208	244	311	349	394	424	528
Others <sup>a</sup> .....	100	86	214	187	160	186	94	103	138	182	181	25	68	131	94	200
C. Solid fuels .....	100	100	100	97	104	107	111	98	105	104	99	105	108	108	113	117
Coal .....	100	98	91	77	82	72	89	104	131	109	98	111	106	104	112	115
Domestic .....	100	124	127	161	184	167	186	174	177	190	199	182	179	196	264	263
Imported .....	100	88	77	45	42	36	52	77	114	78	59	84	77	69	54	58
Fuelwood <sup>b</sup> .....	100	99	102	106	111	120	116	94	90	94	92	94	95	89	86	86
Sugar-cane bagasse .....	100	116	114	112	110	116	115	134	150	180	173	167	193	220	247	261
Charcoal .....	100	100	103	95	125	123	136	73	82	88	84	99	120	142	158	183
D. Hydroelectric energy .....	100	113	123	134	143	157	164	181	199	221	245	258	278	294	303	367

Source : Joint ECLA-BNDE Working Group.

<sup>a</sup> Including petroleum for gas production, "Signal oil" and alcohol-gasoline mixture.<sup>b</sup> Excluding fuelwood for charcoal production.

## Chapter V

# FISCAL OPERATIONS OF THE PUBLIC SECTOR

### I. INTRODUCTION

The primary object of this chapter is to present a comprehensive description of receipts, expenditure, savings and investment of the public sector in Brazil, to be used in the calculation and projection of national income. In addition, an attempt is made to analyse the role of the public sector as reflected in its fiscal operations, from the viewpoint of the economy as a whole. Attention is concentrated largely on year-to-year changes of major significance, since the period covered is too short to shed any light on long-term trends. Finally, a brief analysis is devoted to federal budget transactions for the purpose of evaluating their importance in relation to the whole public sector. The period studied covers the years 1947 to 1953, because more recent data on a comparable basis could not be obtained at the time the analysis was prepared. However, the classification scheme of government transactions adopted herein provides a basic framework which can be utilized for the presentation of comparable data on future years as they become available.

This chapter is divided into three sections. The introduction contains a brief description of the various legal forms under which governmental activities are carried out and of the concept of the public sector employed here. The second section analyses public sector transactions, with special emphasis on the changes in the relation of income aggregates. This is followed by a review of over-all changes in federal budget transactions within the framework of the public sector.

#### 1. Structure of the public sector

Governmental functions in Brazil are performed at the federal, state and municipal levels.<sup>1</sup> Operating at the federal level, in addition to the central Government, are numerous autonomous bodies with social security, industrial, financial and regulatory activities. Although these agencies have their own separate budgets, they are also dependent in varying degrees on the Federal Government for subsidies and grants.

There are twenty states and a Federal District, which is usually classified as a state. Autonomous agencies also exist at the state level, but they are relatively few in number and their operations are comparatively small. As in the case of federal agencies, they are dependent on their respective state governments for financial aid to meet any operating losses and to undertake investment projects.

Finally, there are 1,932 municipalities, each having a separate budget and functioning as a separate entity.

<sup>1</sup> The term "government" is henceforth used as a synonym for the public sector; that is to say it includes the authorities at the federal, state and municipal levels. When reference is made to a given administrative unit, the term is specified.

#### 2. Definition of the public sector

While a nucleus of fiscal operations typified by the transactions recorded in the budget of central governments is easily identifiable, there are many autonomous agencies whose governmental characteristics are not clearly defined. Thus, a problem of identity usually arises. The decision to exclude or include a particular agency is, in most cases, somewhat arbitrary. It is based either on practical grounds or on a concept most relevant to the research task at hand.

The definition of the public sector employed herein is somewhat broad. It embraces the fiscal operations of the central Government at all levels and of all agencies at the federal level, except for those in which the Government is only a shareholder. The choice of this definition was dictated primarily by the need to present as comprehensive a picture as possible of the public sector which could be utilized for national income calculations and projections. The decision to exclude autonomous agencies at the state level and the transactions of partly owned enterprises, which are of importance at the federal level only, was based largely on practical grounds. The lack of readily available data was the ruling consideration in the case of state autonomous agencies. Partly owned enterprises were excluded, mainly because they are established as private corporations under Brazilian law. Moreover, although the Federal Government is a majority shareholder in all such existing enterprises, it was not possible to ascertain whether, in practice, their decisions on current and investment operations were guided principally by considerations of government policy. It should be noted, however, that the capital flow to these various enterprises, included by governments in the budget accounts, have been shown herein as capital transfers. Moreover, dividends transferred to governments by these agencies have also been taken into account.

### II. SIZE AND SIGNIFICANCE OF THE PUBLIC SECTOR

#### 1. Changes in size of the public sector

An attempt has been made in table 128 to present an over-all picture of public sector transactions. The data have been broken down into major components of particular relevance to national income accounting and so presented as to throw light on the public sector in its dual role of consumer and producer. It may be seen that government fiscal operations showed a substantial expansion in absolute terms during 1947-52. Total receipts and expenditure rose by about 144 per cent and 168 per cent, respectively. It is interesting to note, however, that the major components of public sector operations did not expand at the same pace over this period. Tax revenue advanced by 147 per cent between 1947 and 1952, as compared with a rise of 122 per cent in non-tax receipts. On the expenditure side, capital outlays showed



the greatest rise with an increase of 236 per cent from 1947 to 1952, as compared with increases of 170 per cent and 147 per cent for transfer payments and current outlays on goods and services respectively.

Table 128. Brazil: Income savings and investment in the public sector  
(Millions of cruzeiros)

	1947	1948	1949	1950	1951	1952
A. Transfer receipts:						
Tax receipts .....	25,248.1	29,400.6	35,113.4	40,886.4	55,010.7	62,370.5
Non-tax receipts .....	3,527.5	4,378.0	5,320.0	5,540.0	7,114.5	7,844.5
Sub-total ...	28,775.6	33,778.6	40,433.4	46,426.4	62,125.2	70,215.0
B. Transfer payments .....	6,073.7	7,036.8	9,527.9	11,302.6	13,510.0	16,544.0
C. Disposable income (A-B) .....	22,701.9	26,741.8	30,905.5	35,123.8	48,615.2	53,671.0
D. Current expenditure on goods and services ..	15,800.9	18,804.9	22,766.3	27,409.4	31,816.3	39,154.2
E. Savings (C-D) .....	6,901.0	7,936.9	8,139.2	7,714.4	16,798.9	14,516.8
F. Capital formation* .....	5,853.0	8,062.6	11,597.5	14,271.9	15,606.6	19,702.3
G. Net increase (+) or decrease (—) in cash and claims .....	+1,048.0	—125.7	—3,458.3	—6,557.5	+1,192.3	—5,185.5

Source: Economic Commission for Latin America.

Note.—Savings and capital formation have been expressed on a gross basis, since there were insufficient data to allow for depreciation charges. It should be noted, however, that the net results, or item G, net increase (+) or decrease (—) in cash and claims would not be affected if such a calculation could be carried out. For purposes of analysis of current economic trends, the difference between "capital" receipts

such as inheritance taxes (included under item A), and net purchases of existing assets (included under item F) could be deducted from the net increase in cash and claims. Since these items are of a relatively small order of magnitude, such a calculation would not result in any significant changes in "surplus" or "deficits".

\* Including net purchases of existing real assets.

This considerable increment in the volume of governmental transactions may be attributed to several factors. Of major importance has been the assumption of greater responsibilities by all governmental authorities from 1947 onwards, which in some measure arose from the relatively broad role assigned to government in the new Constitution of 1946, particularly in the fields of development and welfare. Thus governments at all levels were required to set aside a fixed percentage of tax receipts for the maintenance and expansion of educational facilities, for development of the Amazon Valley, of the São Francisco River and of the north-eastern area.

The growing consciousness of development, accompanied by an increased emphasis on the role to be played by government in this field as reflected in the Constitution, also exerted a powerful influence on the expansion of activities and on orienting over-all government policy. Thus, the Federal Government in 1949 set up an investment programme (Salte Plan) aimed at improving and expanding health, transport and electric energy facilities and at increasing agricultural production. This was followed in 1951 by another development plan which concentrated largely on implementing projects prepared by the Joint Brazil United States Economic Development Commission in the field of transport and electric energy. State and local authorities pursued, to some extent, similar policies of increasing investment outlays, with major emphasis on road construction.

More recently, the Federal Government established two new banks, the Bank for National Economic Development and the Bank for the North-East. The basic purpose of these banks is to help finance both private and public projects which would contribute to the further development of the national economy. Various other measures taken by the

Federal Government, and also by governments at all levels, would indicate that policy is still basically oriented towards encouraging a higher rate of economic development.

Another factor of major significance during this period was the accelerated growth of productivity and income of individuals and enterprises, which raised taxation receipts of the government. On the other hand, as a consequence of the demographic growth and the shift of the population caused by rapid industrialization, governments were faced with the need to create new public services and an expansion of existing facilities.

The relatively substantial price, cost and income inflation which accompanied this accelerated growth also contributed to the rise in monetary terms of the fiscal operations of the public sector, as may be seen in table 128. Government wages, salaries, pensions and benefit payments had thus to be increased because of the rise in the cost of living. Unfortunately, the data available did not enable a quantitative assessment to be made of the impact of the prevailing inflation upon government fiscal operations.

The incorporation of privately owned railways and other enterprises, the creation of a new federal agency for the construction of low-cost housing and the broadening of the price-support programme for agricultural products also contributed to the growth of the public sector.

The expansion in receipts was evidently a consequence of the growth in national income and the inflationary rise in prices and income. But an additional factor of some importance was the introduction of rate increases in almost all the major taxes. It is interesting to note, however, that no new taxes of major importance were introduced during this period and that the main increases were introduced largely

at the state and federal level. While state governments raised the incidence of taxation on sales, the Federal Government appears to have introduced only somewhat moderate increases in the rates of both direct and indirect taxes.

This review of factors which accounted for the growth of the public sector should not be considered as exhaustive, but rather as an attempt to emphasize those which appear to have had the greatest influence. Although it is impossible to measure, with any degree of accuracy, the impact of each of these factors, it would appear that the accelerated rate of growth of the economy and the accompanying inflation were the two most important contributory elements.

## 2. *Changes in the major components of the operations*

An analysis of the changes in the major components of Federal Government taxation, as shown in table 128, should throw further light on the effects of the various factors discussed above upon fiscal operations in the public sector. Disposable government income advanced at almost the same pace as transfer receipts, although transfer payments rose steadily during the period, reaching in 1952 a level 172 per cent higher than in 1947. As a consequence, the ratio of disposable income to transfer receipts remained at about the same level throughout this period. This is all the more significant in the light of steadily rising losses in federal public undertakings and of the implementation by governments of a broader social policy. But the relatively small increase in interest payments helped to reduce somewhat the level of transfer payments.<sup>2</sup>

Another feature emphasized by the data in table 128 is that although current expenditure on goods and services rose by about 150 per cent during this period, the central Government was able to achieve steadily rising surpluses on current account. These surpluses, however, were not sufficient to cover capital outlays, and as a result deficits were incurred in four of the six years. The large capital expenditure reflected to a great extent the new direction of government policy towards accelerating the rate of development of the country. Nevertheless, it should be noted that 10 to 15 per cent of these capital outlays were made by social security institutes for the construction of luxury apartments.

It is interesting to observe that 1949 was the first year in which a heavy over-all deficit appeared, which mainly reflects the considerable rise in capital expenditure in relation to previous years, partly as a result of the application of the Salte Plan. The appearance of a surplus in 1951 was the result of an unprecedented rise in taxation revenue, as compared with the increase in current expenditure and transfer payments. Furthermore, capital outlay in 1951 rose only moderately above the 1950 level owing to the retrenchment policy adopted by the Federal Government in its efforts to balance the budget. The recurrence of a heavy deficit in 1952 can be ascribed largely to the drop in government savings and to the extra-budgetary expenditure of 4,400 million cruzeiros made by the Federal Government for the purchase of the domestic cotton crop which was held in reserve at the end of the year.

With final reference to table 128, it should be pointed out that the deficits incurred by the public sector had a far greater impact on private savings and on the whole economy than a mere glance at the figures might indicate. The deficits were largely financed by currency issues of the Federal Government owing in part to the lack of a money market and in part to the limited interest in government securities as compared with private bonds. This method of deficit financing was undoubtedly more inflationary in effect than that of government borrowing aimed at absorbing credit funds on the market. Currency issues led to increased liquidity of the banking system and thus laid the basis for the additional expansion of commercial credit which occurred. In the case of the largest State, São Paulo, however, a certain amount of financing was done through issues of short-term bonds, which were sold at a high discount rate owing to the ever-increasing volume floated and to the nature of the market.

In practice, the deficits of the federal budget, of federal autonomous agencies and of state and local authorities were, and still are, financed by advances from the Banco do Brasil. In turn, this bank obtained advances from the Federal Rediscount Department to meet such credit demands. Finally, the Rediscount Department requested the Federal Treasury for an issue of currency to replenish its reserves. Although the Federal Government had the legal power to curtail advances to autonomous agencies and to state and local authorities by exercising its control over the credit policy of the Banco do Brasil, in actual fact, the restriction was exercised only to a very limited extent.

The net result of this type of deficit financing was to generate substantial inflationary pressures and thus aggravate the existing inflation created by commercial credit expansion and by external influences, such as the considerable rise in world market coffee prices which occurred from 1949 onwards. Further discussion of fiscal policy will be found in a later section.<sup>3</sup>

## 3. *Importance of the public sector in relation to the national product*

So far, the discussion has been confined to the over-all growth of the major components of the public sector transactions and changes in them. It might be appropriate, therefore, to ascertain whether these changes have been of a purely nominal character, or whether they reflect changes in real terms. The available data, unfortunately, do not lend themselves to such precise measurements. It is possible, however, to obtain a quantitative picture of the changes in relative terms, both in the size and significance of the public sector from variations in its share of the national product. An attempt has been made in table 129 to present public sector transactions in terms of ratios of relevant components of the national product. Undoubtedly, these ratios do not reflect too accurately the changes in real terms which have occurred, but they do give a relatively good indication of the demands made by the public sector on the flow of goods and services within the economy.

The almost regular rise in aggregate public sector expenditure and receipts in relation to national product shown in table 129 is a fairly clear indication of the growth experienced by the public sector throughout this period. Moreover,

<sup>2</sup> This may be explained by the decline in foreign indebtedness and the absence of any substantial rise in the federal domestic debt.

<sup>3</sup> See section III of this chapter dealing with the role of the federal budget.

Table 129. Brazil : Public sector transactions in relation to national income

(Percentages)

	1947	1948	1949	1950	1951	1952
A. Public sector expenditure to net national income at market prices .....	18.0	19.6	21.9	22.7	21.5	23.2
B. Public sector receipts to net national income at market prices .....	18.3	19.3	20.1	19.8	21.8	21.5
C. Current purchases of goods and services to net national product at market prices .....	10.0	10.7	11.3	11.7	11.1	12.0
D. Transfer payments <sup>a</sup> to personal income	3.6	3.7	4.3	4.4	4.5	4.6
E. Government capital formation to aggregate capital formation .....	22.1	31.7	34.8	39.0	29.6	30.3
F. Direct tax receipts to national income	4.6	4.7	4.8	4.9	5.4	5.7
G. Personal income tax receipts to personal income .....	2.7	2.4	2.6	2.7	3.1	3.1
H. Indirect tax receipts to net national income at market prices .....	12.0	12.6	13.2	13.1	14.6	14.1

Source : Economic Commission for Latin America.

<sup>a</sup> Excluding subsidies to private enterprises, deficits of public enterprises and grants to public undertakings.

it clearly illustrates the increased participation and growing significance of the public sector in the Brazilian economy.

The apparent reversal of this trend in public sector expenditure relative to national income in 1951 and 1952 may be explained in part by the curtailment of federal capital outlays mentioned earlier and in part by the fact that the expenditure of municipalities is under-estimated owing to the use of budget figures. The decline in the ratio of receipts from 1951 to 1952 may be largely attributed to the smaller rise in the volume of receipts. This, in turn, was mainly the result of a fall in absolute terms in the yield of import duties, of the taxes on exchange remittances and on dividends. Moreover, as in the case of expenditure, receipts of municipalities are also under-estimated.

It is significant that consumption expenditure of the public sector showed a moderate but steady rise relative to national income. This may be ascribed to a large extent to the expansion of public services required by the growing population and increased industrialization. It should be borne in mind, however, that wages and salaries amounted to about two-thirds of total current expenditure on goods and services throughout this period. Because almost all government wages and salaries appear to have lagged somewhat behind the inflationary rise in the price level, the expansion of this type of expenditure relative to national income was probably greater than would be indicated by the figures. This lag and the under-estimate of the expenditure of municipalities referred to earlier, tend to explain in part the levelling off in 1951 and 1952 of the ratios of the current outlay on goods and services as compared with aggregate expenditure.

The steady advance of transfer payments relative to personal income reflects in some measure the application of an official policy of providing greater social and educational benefits for the community. This rise is all the more striking when it is seen that personal income more than doubled between 1947 and 1952. The growing importance of transfer payments as an element of personal income clearly illustrates the changing and important role played by government in the redistribution of income.

The effect upon the economy of the relative growth in the public sector is perhaps more clearly borne out by the changes which occurred in governmental capital formation in relation to aggregate capital formation. Government capital formation rose in absolute terms by 239 per cent between 1947 and 1952, while capital formation for the economy as a whole increased by only 148 per cent over this same period. The large relative increase in government investment from 1947 to 1948 largely arose from a decline in private capital formation. In 1949 and 1950, the annual increases were obtained despite substantial increments in private capital formation. The sharp decline in relative terms during both 1951 and 1952 was caused by the slower rate of increase in the volume of capital outlays, largely a result of a reduction in federal expenditure for investment and also by a drastic curtailment during 1952 of investments by social security institutions. In fact, public investment would have shown an even greater drop in 1952 had it not been for the heavy federal expenditure on the purchase of the domestic cotton crop which was largely held in bond at the end of the year.

It is doubtful whether correction for the under-estimate of municipal expenditure from 1951 and 1952, referred to earlier, would result in any significant change in the ratios, since the amounts involved in such investment would tend to be relatively small.

The salient feature is the shift from private to public capital formation, particularly during the period 1947 to 1950. Thus, the steady increase of public investment in absolute terms acted as a stabilizing influence which offset the sharp fluctuations in private investment.

A striking feature on the receipt side is that the relation of direct tax receipts to national income remained at more or less the same level for most of the period. The relatively limited expansion shown by direct tax receipts may have been caused by two factors : the slow progress of the comprehensive income and profits tax structure, notwithstanding the changes introduced in 1947 and 1951; and, very widespread taxation evasion—as repeatedly stressed by the Federal

Table 130. Brazil: Expenditure of public sector  
(Millions of cruzeiros and percentages)

	Closed Accounts											
	1947	1948	1949	1950	1951*	1952*	1953	1954	1955	1956	1957	1958
Current expenditure on goods and services:												
Compensation to employees:												
Civil agencies .....	7,303.8	25.8	9,299.7	27.0	10,879.2	24.6	13,015.8	24.4	15,452.5	25.1	20,067.6	26.0
Defence agencies .....	2,820.5	10.0	3,002.6	8.7	3,798.8	8.6	3,945.0	7.4	4,945.6	8.0	5,518.0	7.3
Sub-total ...	10,124.3	35.8	12,302.3	35.7	14,678.0	33.2	16,960.8	31.8	20,398.1	33.2	25,585.6	33.3
Other purchases of goods and services:												
Civil agencies .....	4,155.9	14.7	5,092.9	14.8	6,536.2	14.8	8,643.3	16.2	9,825.2	16.0	11,103.8	14.6
Defence agencies:												
Current .....	1,052.3	3.7	955.2	2.8	995.2	2.2	1,179.1	2.2	1,158.9	1.9	1,320.1	1.7
Capital .....	468.4	1.6	454.5	1.3	556.9	1.3	626.2	1.2	434.1	0.7	1,144.7	1.5
Sub-total ...	5,676.6	20.0	6,502.6	18.9	8,088.3	18.3	10,448.6	19.6	11,418.2	18.6	13,568.6	17.9
Sub-total current expenditure on goods and services .....	15,800.9	55.8	18,804.9	54.6	22,766.3	51.4	27,409.4	51.5	31,816.3	51.7	39,154.2	51.6
Losses on public undertakings .....	873.6	3.1	1,137.0	3.3	1,793.1	4.1	2,309.6	4.3	2,377.4	3.9	2,910.7	3.8
Gratuities to individuals .....	2,870.3	10.1	3,345.0	9.7	4,566.9	10.3	5,502.0	10.3	7,335.0	11.9	9,207.9	12.1
Interest .....	1,495.1	5.3	1,601.7	4.7	1,709.7	4.1	1,939.4	3.6	2,146.9	3.5	2,398.6	3.2
Other transfers to private sector <sup>b</sup> .....	834.7	2.9	953.1	2.8	1,369.2	3.1	1,551.6	2.9	1,650.7	2.6	2,036.8	2.7
Sub-total current expenditure .....	21,874.6	77.2	25,841.7	75.0	32,294.2	73.0	38,712.0	72.7	45,326.3	73.7	55,708.2	73.4
Capital expenditure:												
Expenditure on new physical assets .....	5,777.6	20.4	8,118.6	23.6	11,536.3	26.1	14,101.8	26.5	15,482.6	25.2	15,239.0	20.1
Increase (+) or decrease (—) in inventories ..	—13.7	—	+10.8	—	—16.3	—	+6.3	—	+5.7	—	+4,453.5	5.9
Purchase of existing physical assets .....	93.8	0.3	92.0	0.3	165.6	0.4	213.1	0.4	139.5	0.2	183.0	0.2
Sub-total capital expenditure .....	5,857.7	20.7	8,221.4	23.9	11,685.6	26.4	14,321.2	26.9	15,627.8	25.4	19,875.5	26.2
Purchases of ownership rights <sup>c</sup> .....	584.9	2.1	373.3	1.1	285.4	0.6	206.7	0.4	565.5	0.9	272.1	0.4
GRAND TOTAL EXPENDITURE <sup>d</sup> ...	28,317.2	100.0	34,436.4	100.0	44,265.2	100.0	53,239.9	100.0	61,519.6	100.0	75,855.8	100.0

Source: Economic Commission for Latin America.

\* Includes budget estimates for municipalities.

<sup>b</sup> Covers largely subsidies to private educational and health institutions.

<sup>c</sup> Corresponds to capital grants to semi-public undertakings.

<sup>d</sup> Excludes amortization of public debt and federal government contribution to the International Bank for Reconstruction and Development.

Income Tax Office— by both individuals and enterprises. Another factor of secondary importance was the time-lag in revising property assessments in face of rapidly rising property values. A more detailed discussion of this problem follows.<sup>4</sup>

The increase in the ratio of direct tax receipts to national income in 1951 and 1952 largely arose from a higher yield from those taxes. This, in turn, was the result of a combination of factors: substantial increments in personal monetary incomes and profits over previous years; unprecedented dividend distribution during 1951, in anticipation of the introduction of higher taxes; increased income and profits tax rates effective early in 1952; and an improvement in tax collection methods.

The influence exerted by some of the above-mentioned factors on direct tax yields is perhaps more clearly demonstrated by the behaviour of the relation of personal income taxes to personal income. The relative stability of these ratios, particularly during the years 1947–50, can be better understood when viewed in the light of changes in the patterns of receipts from individual taxes. Thus, the yields from the dividend tax and social security contributions from employees, which were both levied at flat rates, rose continuously and had increased in 1950 by 73 per cent and 68 per cent respectively over 1947. In contrast, however, the revenue from other individual income taxes, principally on wages and salaries, remained at about the same level throughout this same period, rising in 1950 only by 18 per cent over the level of the three previous years. The slight increase in the ratios for 1951 and 1952 was largely the reflection of an unprecedented rise in dividend tax receipts in 1951, of the maintenance of the same level in 1952, and of the considerable annual increments in other individual income tax receipts as compared with previous years.

Table 129 demonstrated that indirect tax revenues in relation to national income followed a significantly different course, rising throughout almost the whole period. Heavy rate increases, particularly in state consumption taxes and a greater susceptibility than direct taxes to react to greater business activity and to the rising price level, accounted in large measure for this behaviour.<sup>5</sup>

The absence of any change between the 1949 and 1950 ratios of indirect tax receipts to national income chiefly reflects the fact that the 1950 yield from import duties and from the tax on exchange remittances declined slightly from the 1949 level. It should be noted that the volume of imports in 1950 rose only slightly above 1949. The major causes for the pronounced rise in the 1951 index and the decline during 1952, mainly lie in the fluctuations in the yield of import duties and exchange remittances, which accompanied the considerable expansion in the volume and value of 1951 imports, and the subsequent drop in 1952.

#### 4. Pattern of public expenditure

A detailed statement of public sector expenditure classified by major economic categories is presented in Table 130 in order to ascertain what changes, if any, have occurred in the over-all expenditure pattern.

<sup>4</sup> See sub-section 5 which deals with the pattern of receipts.

<sup>5</sup> See pp. 161–162 for a fuller discussion of the indirect taxation structure and its basic characteristics.

Table 130 shows that there were significant changes over this period. Particularly striking was the shift in the allocation of resources from current to capital expenditure, the former declining from 77.2 per cent of aggregate expenditure in 1947 to 73.4 per cent in 1952 and the latter rising from 20.7 per cent to 26.2 per cent over the same period. Current expenditure on goods and services fell from 55.8 per cent in 1947 to 51.6 per cent in 1952, whereas transfer payments, excluding interest on the public debt, rose from 16.1 to 18.7 per cent. The continuous drop in interest payments on aggregate expenditure mainly reflects the fact that federal interest outlays remained at the same level throughout the period, which in turn was chiefly due to the absence of any increase in the federal public debt. The Federal Government resorted to currency issues in preference to public borrowing for the financing of its deficits.

It is also interesting to note that the fall in current outlays on goods and services was concentrated largely on expenditure for defence. Both current and capital outlays for defence in relative terms declined substantially over this period. The sudden rise in such defence expenditure during 1952 occurred through heavy outlays for modernization of the Navy. The absence of any sizeable expansion in the military establishment and the time-lag in pay increases in relation to the rising cost of living—as evidenced in part by the stable level of current purchases of goods and services for defence agencies—accounted in large measure for the decline in total defence disbursements in relation to aggregate expenditure.

Purchases of ownership rights, consisting mostly of federal government subscription to shares in mixed companies, such as steel and hydroelectric plants and other industrial enterprises, declined in relative terms throughout the period. The bulk of these payments were made in the earlier years of the period, largely because the majority of these enterprises were either created just prior to 1947 or were only then in a position to obtain equipment and supplies from abroad. With operating capital needs covered largely by credit granted by the Banco do Brasil under federal government guarantee, the need for capital tended to diminish somewhat. The sharp rise in relative terms shown by this item in 1951 was due to increased expenditure resulting from the purchase of a privately-owned railway by the Federal Government.

The changes in the pattern of expenditure which characterized this period, on the whole, reflected the general orientation of public policy which aimed at promoting a more rapid rate of economic and social development in Brazil. The change in the trend towards steadily rising capital outlays apparent in 1951 and 1952 may be largely attributed to the decline of federal government investment expenditure in absolute terms.

#### 5. Pattern of receipts

There were no outstanding alterations in the composition of public sector revenue. (See table 131.) Tax receipts rose from 87.7 per cent of total receipts in 1947 to 88.6 per cent in 1952, while non-tax revenue declined from 12.3 to 11.4 per cent over the same period. A similar stable pattern prevailed within the category of tax receipts. Direct assessment yields in relation to total receipts rose slightly from 22.4 per cent in 1947 to 23.2 per cent in 1952, while indirect tax receipts remained more or less at the same level throughout.

Table 131. Brazil : Receipts of the public sector  
(Millions of cruzeiros and percentages)

	Closed Accounts *											
	1947		1948		1949		1950		1951		1952	
Direct taxes :												
Taxes on income of individuals <sup>b</sup> .....	4,811.6	16.7	5,026.6	14.8	6,139.4	15.1	7,403.7	15.9	9,738.4	15.7	11,563.1	16.4
Taxes on corporations .....	1,639.3	5.7	2,220.6	6.5	2,312.2	5.7	2,622.7	5.6	3,467.0	5.6	4,788.3	6.8
Sub-total ...	6,450.9	22.4	7,247.2	21.3	8,451.6	20.8	10,026.4	21.6	13,205.4	21.2	16,351.4	23.2
Indirect taxes :												
Taxes on imports, exports and exchange remittances .....	2,472.7	8.6	3,103.7	9.1	3,355.9	8.3	3,472.9	7.5	5,616.0	9.0	4,842.1	6.9
Consumption, sales and excise .....	16,324.5	56.7	19,049.7	56.1	23,305.9	57.5	27,387.1	58.9	36,189.3	58.2	41,177.0	58.5
Sub-total indirect taxes .....	18,797.2	65.3	22,153.4	65.3	26,661.8	65.8	30,860.0	66.4	41,805.3	67.3	46,019.1	65.4
Sub-total tax receipts .....	25,248.1	87.7	29,400.6	86.6	35,113.4	86.7	40,886.4	88.0	55,010.7	88.5	62,370.5	88.6
Non-tax receipts <sup>c</sup> .....	3,532.2	12.3	4,536.8	13.4	5,408.1	13.3	5,589.3	12.0	7,135.7	11.5	8,017.7	11.4
TOTAL RECEIPTS ...	28,780.3	100.0	33,937.4	100.0	40,521.5	100.0	46,475.7	100.0	62,146.4	100.0	70,388.2	100.0

Source : Economic Commission for Latin America.

\* 1951, 1952; budget estimates for municipalities.

<sup>b</sup> Including inheritance and property taxes.

<sup>c</sup> Including sales of physical assets which are quantitatively insignificant.

A somewhat clearer picture of movements in the over-all pattern of tax revenue may be obtained from table 132.

Table 132. Brazil: distribution of tax receipts  
(Percentages)

Taxation	1947	1948	1949	1950	1951	1952
Direct .....	25.6	24.7	24.1	24.5	24.0	26.2
Indirect .....	74.4	75.3	75.9	75.5	76.0	73.8

Source: Economic Commission for Latin America.

The failure of direct tax receipts to advance in relative terms as shown in table 132 is particularly striking in the light of underlying economic conditions and the rate increases on individual income and profits taxes introduced both in 1947 and in 1951. The apparently limited flexibility of direct tax yields may be attributed to the interaction of various factors. The relatively mild increase of taxation on both individual income and profits was one of the more important contributory factors. The individual income tax, as revised in 1947, would appear on the surface to have a fairly high progression rate. Thus the rate schedule of the complementary tax starts at 1 per cent for incomes in excess of 24,000 cruzeiros and rises slowly to a maximum of 50 per cent for incomes exceeding 3 million cruzeiros annually. Prior to the 1947 revision, the maximum rate was 20 per cent. Furthermore, in 1951 the Government imposed an additional rate of 15 per cent to be calculated on the tax applicable to individuals whose tax liability exceeded 10,000 cruzeiros.<sup>6</sup> It was estimated that this increase would mainly affect individuals in the middle and upper income brackets. The progression of the individual income tax was substantially reduced, however, by the exemption of income accruing from dividends on bearer bonds which was taxed separately at a flat rate of 15 per cent from 1947 to 1951 and at 20 per cent thereafter.<sup>7</sup> It is impossible to assess the effects of this exemption on income tax yields, but it is relevant to note that bearer bonds are held largely by upper income groups who would be subject to steadily rising progression rates. Moreover, this period witnessed a rapid growth of industry, and a steady rise in the profits of private enterprises.

Although agricultural income is subject to income tax, in practice it is not taxed, for administrative and political reasons, thus tending to lessen the over-all effect of income tax. In view of the predominant role of agriculture in the Brazilian economy, the effects of this blanket exemption on income tax yields must be of some quantitative significance. But it was offset to some extent by the fact that farmers and exporters of agricultural products were, in effect, taxed during this period by means of the exchange rate system. The maintenance by the Federal Government until mid-1953 of an over-valued rate for the cruzeiro *vis-à-vis* other currencies, resulted in a concealed taxation of exporters. They could have obtained higher proceeds for their exports had they been allowed, for example, to sell their foreign currency on

the free market. This exchange policy constituted, in effect, a form of subsidizing importers and, in particular, of the industrial sector of the economy. Importers were thus able to buy foreign exchange at a highly favourable rate.

This tax burden on exporters was lightened to some extent in 1953, when the Government awarded a subsidy to exporters which varied with the type of product exported. Concurrently, a multiple-exchange system was introduced for the auction of foreign exchange, thus largely eliminating indirect subsidies to importers and industry.

Thus it can be said that the exemption of agricultural income from income tax was to some extent counteracted by this levy on exporters.

The net result of these exemptions was to leave wages and salaries as the only important category of income subject to the progressive income tax. As a consequence, the incidence of the individual income tax was considerably reduced, since wages and salaries constitute the most important element of income for the lower and middle income groups, while dividends usually provide most of the revenue for higher-income brackets.

The yield of excess-profits taxation showed the largest absolute increase as compared with those of other direct taxes, almost trebling between 1947 and 1952. This rise is not so striking, however, when viewed in the light of the doubling of the rates in 1947 and of the more than doubling in declared profits over the same period. Such profits rose from 16,600 million cruzeiros in 1947 to 34,700 millions in 1952.<sup>8</sup> The apparently limited flexibility of excess-profits taxes may be ascribed to the relatively moderate rates.

From low levels of 3-4 per cent, the excess-profits tax was changed in 1947 to a schedule of three rates, ranging from a minimum of 10 per cent to a maximum of 15 per cent, applicable to all types of business organizations. In late 1951, the Federal Government imposed additional assessments of 10 per cent to be paid on tax liability and a 3 per cent tax on undistributed profits.<sup>9</sup>

Tax evasion which, according to federal authorities was very widespread, also substantially influenced the level of the yield of the profits tax. However, the Federal Government has attempted, with some success, to improve the tax collection machinery as shown by the substantial rise in the yields of this tax during 1951 and 1952.

The modest advance over this period in the revenue from property taxes, levied by states and municipalities in lieu of income taxes, was another factor contributing to the minor advance in direct tax receipts. Thus the revenue from these taxes rose by 136 per cent between 1947 and 1952 as compared with a rise of 156 per cent in the yield of all other direct taxes. This is particularly striking when viewed in terms of the real estate boom and the speculative upswing in property values which prevailed during this period, especially in the large urban centres. The time-lag in reassessing property in pace with rising values largely accounted for the comparatively minor increase in the yield of these taxes.

Indirect tax receipts maintained the same position in relation to the aggregate throughout this period. (See table 132.)

<sup>6</sup> See *Anuários do Brasil*, 1949-53.

<sup>8</sup> It was established, however, that this additional surcharge would be in effect only for the period 1952-56 and that the amount paid by the taxpayer would be reimbursed by the Government in the form of 6 per cent interest-bearing bonds. The receipts from this tax were earmarked for financing the newly created Banco Nacional do Desenvolvimento Econômico.

<sup>7</sup> This rate was raised to 25 per cent in 1954.

<sup>9</sup> As in the case of the individual income tax, this additional tax is in effect for the period 1952-56 and is to be reimbursed at the end of this period by the Government in the form of 6 per cent interest-bearing bonds.

In part this may be attributed to the failure of direct taxes to advance more rapidly, as discussed above. Another major influence was the considerable increase shown by the taxation on sales of states and municipalities. Thus the yield of the sales tax and of its counterpart in the municipal tax structure, the industries and the professions tax, more than trebled over this period as compared with a doubling in the yield of federal consumption taxes and an 80 per cent increase in import duty receipts. As a consequence, sales taxes alone rose from 22 per cent to 29 per cent of total indirect taxation revenue between 1947 and 1952. This substantial increment may be accounted for in some measure by the heavy increases in rates, ranging from 50 per cent to 100 per cent, imposed by states. Another contributing factor was the higher degree of sensitivity of the sales tax as compared with other indirect taxation, to the growing volume of business activity and the rising price level. These sales taxes, which vary from state to state and range between 1.5 per cent to 6 per cent, are in practice multiple taxes imposed at every stage of a transaction except for the rendering of services. In contrast, consumption taxes of the Federal Government, which fell from first to second place as a major source of tax revenue, are levied only once and on a selected number of goods. Moreover, very few rate increases were imposed during this period. The taxes on tobacco and beer were the only ones to be raised substantially.

The comparatively smaller rise in the yield of import duties between 1947 and 1952 can be accounted for by the fact that import duties are largely specific in nature. Thus their yield is principally influenced by the quantum of imports, which fell after 1947, recovered to a higher level in 1950, rose substantially in 1951 and declined again in 1952. Import duties were revised upwards in 1948 for the first time since 1934. In the opinion of the Brazilian authorities, however, the specific rates were still somewhat low, especially when viewed against the higher prices for imports which could be obtained after 1948. Further upward revision is therefore at present being considered by the Federal Government in order to bring the rates more into line with prevailing import prices. Preliminary action has already been taken through the introduction in late 1952 of heavy increases in the duties imposed on imports of petrol and fuel oil, which represent a sizeable proportion of total imports.

It should also be noted that in 1948 the Federal Government reimposed the tax on exchange remittances at a rate of 5 per cent, raising it to 8 per cent in 1951. The imposition of this tax provided some correction for the relatively low import duties, since it applied to all exchange remittances with the exception of those covering payment for imports of basic foodstuffs, fuels, newsprint and for dividends and interest.

Export duties, levied only by states as stipulated by the Constitution, played an insignificant role in the tax revenue pattern, since their yield amounted to less than 1 per cent of all tax receipts. This may be explained by the fact that coffee, which is the major export product, is produced largely in the State of São Paulo where an export duty is not levied. Moreover, no export duties are applied in the Federal District and together with the State of São Paulo, these two areas handle more than 70 per cent of aggregate exports from Brazil. The efficacy of the sales taxes in these two areas made it unnecessary to levy such a tax.

## 6. Distribution of the tax burden

The basic data required for a thorough analysis of the distribution of the tax burden are not available. It would appear from the figures shown in this Appendix, however, that the tax structure was highly regressive. Moreover, the taxing of dividends at a relatively low rate and the levying of social security contributions at rates ranging from 5 to 7 per cent on gross wages and salaries of all civil servants and non-agricultural workers, both tended to make the system even more regressive than the data would indicate. This situation was further accentuated by the fairly severe inflation prevailing during this period, owing in part to the inability of low-income groups to escape indirect taxation which had a greater incidence upon them. Furthermore, the effect of indirect taxes was becoming more highly regressive as state sales taxes continued to grow in importance within the indirect taxation structure. In the case of income taxes, however, the Federal Government in 1951 raised family exemptions substantially in order to mitigate somewhat the burden of such taxes. This measure provided some relief principally to the middle-income brackets, since it would appear that the bulk of the low-income groups, regardless of family size, fell below the exemption limits. On the other hand, the growth in the volume of transfer payments had the effect of alleviating somewhat the regressive impact of the tax system upon the lower income groups.

Another factor in evaluating the nature of the fiscal structure was the taxation of export producers through the exchange system. Although it is impossible to determine to what extent this concealed tax affected the incomes of farmers and planters, there is no doubt that it tended in some degree to offset the *de facto* exemption of agricultural income from normal income tax. The introduction of bonuses to exporters in 1953 does not appear to have eliminated the burden of this type of taxation owing to the continued depreciation of the currency both at home and abroad.

## III. THE FEDERAL BUDGET AND THE PUBLIC SECTOR

Since the budget was the basic instrument used to establish fiscal policy by the Federal Government, an appraisal of its relative importance within the framework of the public sector is essential for an evaluation of this policy.

It is true that the Federal Government could have directly influenced the policy of a much larger section of the public sector through the exercise of its legal powers over the activities of the social security institutions of the many other autonomous agencies and of the Banco do Brasil, the latter representing an important source of credit for state and local authorities.<sup>10</sup> In practice, however, the autonomy possessed by the various agencies and the very complexity and size of their operations made it extremely difficult, if not impossible, for the Ministry of Finance to exercise any effective co-ordinating role.

Table 133 presents federal budget expenditure, classified by major economic categories and as a percentage of aggregate public expenditure. The most striking feature of this table is the steady decline of federal budget outlays in relation to total expenditure of the public sector. This may largely

<sup>10</sup> A semi-official bank which has some attributes of a central bank and acts as a fiscal agent for the Federal Government, which is the largest shareholder.



have arisen from the relatively more rapid rate of growth of the activities of states, municipalities, and social security institutions. Thus, current expenditure of these authorities trebled in volume between 1947 and 1952, as compared with a two-fold increase in similar outlays of the Federal Government. This gap in the rate of increase in operating

expenditure was offset until 1950 by the constantly rising proportion of investment outlay effected by the Federal Government. However, with the retrenchment policy adopted during 1951 in respect to investment expenditure, the decline in the relative position of the federal budget became even more pronounced.

Table 133. Brazil : Federal budget expenditure in relation to aggregate public expenditure  
(Percentages)

	1947	1948	1949	1950	1951	1952
Current expenditure on goods and services :						
Payments to employees :						
Civil .....	6.9	8.3	6.5	6.7	6.2	5.8
Military .....	10.0	8.7	8.6	7.4	8.0	7.3
Other purchases of goods and services :						
Civil .....	4.1	4.0	4.4	3.7	3.6	3.4
Military .....	5.4	4.1	3.5	3.4	2.6	3.2
Sub-total current expenditures on goods and services .....	26.4	25.1	23.0	21.2	20.4	19.7
Gratuities to individuals .....	3.1	2.8	3.8	3.0	3.5	3.5
Interest .....	3.5	2.9	2.4	1.9	1.6	1.2
Other transfers to private sector .....	1.9	2.1	2.3	2.4	2.4	2.2
Sub-total current expenditure .....	34.9	32.9	31.5	28.5	27.9	26.6
Capital expenditure :						
Expenditure on new physical assets ....	4.7	6.4	8.3	9.1	6.6	5.5
Purchase of existing physical assets ....	—	—	0.1	0.2	—	—
Purchase of ownership rights .....	2.0	1.0	0.6	0.4	0.9	0.3
TOTAL EXPENDITURE ...	41.6	40.3	40.5	38.2	35.4	32.4

Source : Economic Commission for Latin America.

This divergence in the rate of expansion between the federal budget and the other headings of the public sector may be ascribed to several factors. In part, the growth of industrialization and urbanization had a greater impact by generating and increasing demand for the services of states,

municipalities and social security institutions. The improvement in the revenue structure of the states and local authorities, following the reforms introduced in the Constitution of 1946, also provided a certain stimulus for an expansion of activities. Finally, unlike the Federal Government, the

Table 134. Brazil : Federal budget and public sector expenditure in relation to net national income  
(Percentages)

	1947	1948	1949	1950	1951	1952
A. Federal budget expenditure in relation to net national income at market prices .....	7.7	7.8	8.7	8.5	7.5	7.1
B. Public sector expenditure in relation to net national income at market prices .....	18.0	19.6	21.9	22.7	21.5	23.2
C. Federal budget current expenditure on goods and services in relation to net national income at market prices .....	2.6	2.6	2.5	2.4	2.2	2.3
D. Public sector current expenditure on goods and services in relation to net national income at market prices .....	10.0	10.7	11.3	11.7	11.0	12.0
E. Federal budget transfer payments * in relation to personal income .....	1.5	1.4	1.8	1.6	1.5	1.4
F. Public sector transfer payments * in relation to personal income .....	3.6	3.7	4.3	4.4	4.5	4.6
G. Federal budget capital formation in relation to gross capital formation .....	5.1	8.6	10.5	13.1	7.9	6.3
H. Public sector capital formation in relation to gross capital formation .....	22.1	31.7	34.8	39.0	29.6	30.3

Source : Economic Commission for Latin America.

\* Excluding subsidies to private enterprises, deficits of public undertakings and grants to public enterprises.

other authorities were not faced with the task of pursuing an anti-inflationary fiscal policy. Thus, ever-increasing deficits did not prove in practice to be too great a deterrent to a further expansion of expenditure, particularly at the state level. This may partly be explained by the fact that states and municipalities could and did have recourse to advances from the Banco do Brasil in periods of emergency.

It is interesting to note that the decline of federal budget expenditure in relation to total expenditure was brought about principally by a sharp drop in current expenditure. Both transfer payments and capital outlays grew, in relative terms, in accordance with the federal government policy of concentrating on activities which promoted a more rapid rate of economic growth and an improvement in the social welfare standards of Brazil.

Table 134 attempts to provide more data on the changing role of federal budget expenditure. The salient fact to be observed is that such expenditure rose at a much slower pace than public sector expenditure in relation to the national income. Another significant feature, to which reference was made earlier, is the steady decline in current total expenditure in relation to national income, as contrasted with the increase in corresponding outlays of the public sector as a

whole. It would thus appear that the shift from consumption expenditure to transfer payments and capital outlays was more marked in the federal budget than in the public sector as a whole.

It is also interesting to note that as regards aggregate capital formation, federal budget outlay grew at a faster rate than that of the public sector until 1950. This is in striking contrast to the other categories of expenditure and essentially reflects the pronounced change in the allocation of resources by the Federal Government from current to capital outlay.

Although the change would not appear to have been so pronounced as in the case of expenditure, federal budget receipts also declined in relative importance. (See table 135.) This situation arose from the peculiar structure of the federal system with its heavier reliance on direct taxes and, as indicated earlier, the relatively limited sensitivity to rising prices and monetary incomes. Thus direct federal taxes accounted for slightly over 30 per cent of all federal tax revenue over this period, as compared with about 8-9 per cent in the case of the states. Moreover, while federal budget tax receipts declined from 45.9 per cent to 41.8 per cent of aggregate public tax revenue, between 1947 and 1952, the tax receipts of the states rose from 26 per cent to 31 per cent over the same period.

Table 135. Brazil: Federal budget receipts in relation to public revenue  
(Percentages)

	1947	1948	1949	1950	1951	1952
Direct taxation:						
Taxes on income of individuals .....	7.8	6.0	6.1	6.4	7.4	7.4
Taxes on corporation profits .....	5.7	6.5	5.7	5.6	5.6	6.8
Sub-total direct taxes ...	13.5	12.5	11.8	12.0	13.0	14.2
Indirect taxation:						
Taxes on foreign trade transactions .....	7.5	7.8	7.3	6.5	8.3	6.3
Taxes on consumption .....	22.3	20.3	19.0	19.0	19.0	18.8
Sub-total indirect taxes ...	29.8	28.1	26.3	25.5	27.3	25.1
Non-tax receipts .....	2.6	3.8	3.7	1.9	1.9	2.5
TOTAL ...	45.9	44.4	41.8	39.4	42.2	41.8

Source: Economic Commission for Latin America.

A comparison of the taxes producing most revenue in both the federal and state systems illustrates even more clearly this growing disparity in the rates of increase of tax receipts. State sales tax receipts thus trebled over this period as compared with a doubling in the yield of federal consumption taxes.

Further evidence of the comparatively low degree of flexibility of the federal tax system is provided in table 136 which presents the relation of the major categories of tax receipts to the components of the national income. No further comment is required here, since the earlier discussion of the changes in similar ratios of the major categories of tax receipts for the whole public sector is fully applicable. But it should be emphasized that the steady decline (excluding 1951) on indirect tax receipts shown in table 138 mainly arose from the quasi-stationary level of the revenue from import and stamp duties. This, in turn, was largely a conse-

quence of the fact that the import volume and related transactions declined from 1947 until 1950, when it rose to above the 1947 level. The substantial increment in the ratio of indirect tax receipts in 1951 was due to the unprecedented upswing of imports during that year, reflecting the advance purchases which followed the outbreak of the Korean conflict. The fall in the ratio in 1952 followed the reduced imports of 1952 as a result of official restrictions.

Further evidence of the role played by the federal budget within the public sector may be obtained from table 137 which shows surpluses and deficits for the various components of the public sector.

It is clear that the Federal Government was committed throughout this period to an anti-inflationary fiscal policy, particularly through a budget surplus. Although these measures appear to have succeeded in obtaining a budget surplus

Table 136. Brazil : Federal budget and public sector receipts in relation to net national income  
(Percentages)

	1947	1948	1949	1950	1951	1952
1. Federal budget receipts in relation to net national income at market prices .....	8.3	8.4	8.2	7.7	9.1	8.6
2. Public sector receipts in relation to net national income at market prices .....	18.1	18.9	19.7	19.5	21.5	20.6
3. Federal budget direct tax receipts in relation to national income .....	2.7	2.7	2.7	2.7	3.2	3.3
4. Public sector direct tax receipts in relation to national income .....	4.6	4.6	4.7	4.8	5.3	5.5
5. Federal budget indirect tax receipts in relation to net national income at market prices ...	5.4	5.3	5.2	4.9	5.9	5.2
6. Public sector indirect tax receipts in relation to net national income at market prices .....	11.8	12.4	13.0	12.9	14.4	13.5

Source : Economic Commission for Latin America.

Table 137. Brazil : Surplus and deficit of public sector components  
(Millions of cruzeiros)

	1947	1948	1949	1950	1951	1952
Federal budget .....	1,931.3	1,525.3	-785.1	-1,781.3	4,844.0	5,075.3
Social security institutes ..	1,000.5	630.7	659.7	466.3	126.4	1,960.3
States .....	-1,170.0	-1,109.4	-692.6	-1,901.3	-1,222.3	-4,894.6
Municipalities .....	-127.5	-391.1	-834.0	-1,041.4	-821.4	-1,306.4
Other federal agencies ...	-586.3	-781.2	-1,806.3	-2,299.8	-1,734.4	-6,020.1
Total surplus or deficit (—) of the public sector ...	1,048.0	-125.7	-3,458.3	-6,557.5	1,192.3	-5,185.5

Source : Economic Commission for Latin America.

NOTE.—The totals of surplus or deficit shown herein correspond to those in table 128. Amortization and purchases of ownership rights have thus not been taken into account in calculating the net results.

during four of the six years, they failed from the aspect of the public sector as a whole. Particularly noteworthy is the heavy federal budget surplus of 1952, which was offset by a large deficit for the whole public sector as a result of deficits among the other entities and of the extra-budgetary expenditure by the Federal Government of 4.5 billion cruzeiros for the purchase of the cotton crop. In 1953, the federal budget showed a deficit of 3.2 billion cruzeiros. The most important fact appearing from these data is that the federal budget is severely limited as an effective instrument of fiscal policy.

An examination of the federal tax structure appears to indicate that, as in the case of budgetary policy, federal tax policy is relatively limited in both its scope and effectiveness. (See table 138.) The percentages for the distribution of federal tax receipts show that the federal structure was much less regressive than the tax pattern of the states and municipalities. But the attempts of the Federal Government to implement tax policies aimed at a reduction in the over-all regression of the tax system largely failed because of the policies adopted by the states. It was noted earlier in this document that the over-all tax structure of the public sector appeared to be growing more regressive rather than correcting this trend. (See again table 132.)

During this period, most of the increases in the tax rates introduced by the Federal Government were concentrated

Table 138. Brazil : Distribution of federal tax receipts  
(Percentages)

	1947	1948	1949	1950	1951	1952	1953
Direct .....	31.2	30.8	31.0	32.0	32.3	36.1	37.2
Indirect ...	68.8	69.2	69.0	68.0	67.7	63.9	62.8

Source : Economic Commission for Latin America.

on direct taxation. The changes in income and excess-profits taxes were clearly aimed at raising their progression. In contrast, the states mainly increased the rates of indirect taxation, in particular of the sales tax. The heavy reliance of states and of municipalities on indirect taxation was partly due to constitutional provisions which assign income and corporation profits taxes to the Federal Government and partly to the relative ease with which such taxes are collected. Thus the heavy increases in the rates of indirect taxation of the states and their growing importance to over-all tax revenues counteracted federal government measures to make the tax system more progressive.

In conclusion, there can be little doubt that the efficacy of federal fiscal policy in the future will depend to an increasing degree upon the control and co-ordination which the Ministry of Finance can exercise over the fiscal operations of the states and the federal agencies.

