UNITED NATIONS

E

Economic and Social Council

Distr.
RESTRICTED

ENG.AUT/AC.1/R.53
10 August 1995

ENGLISH
Original: RUSSIAN

ECONOMIC COMMISSION FOR EUROPE

WORKING PARTY ON ENGINEERING
INDUSTRIES AND AUTOMATION

Seventeenth Meeting on Questions of
Statistics concerning Engineering
Industries and Automation
20 October 1995

CALCULATING INDICES OF THE PHYSICAL VOLUME OF INDUSTRIAL OUTPUT

(Prepared by Mr. V. Dalin, First Deputy Chairman, State Committee on Statistics of the Russian Federation, Moscow)

Introduction

At the centre of the economic reform in Russia are far-reaching institutional changes intended to dismantle the central planning system in existence for decades and replace it with a market economy system.

The transition to market economy principles has made corresponding changes necessary in statistical practice and in the methodology for constructing general economic indicators. This has significantly affected a most important tool for describing the evolving economic situation - the index of the physical volume of industrial output.

The abandonment of centralized price-fixing and the associated increasing use of contract prices formed by the evolving relationship between demand and supply in the market for most manufactured goods has made it impossible to apply the method traditionally used for many years, namely measuring changes in industrial production on the basis of estimates of the volume of output in uniform, comparable prices as set out in price lists and fixed for a long period of time.

The basic method now being used to measure changes in production is one that is widely applied in international statistical practice and is based on data concerning the movement of physical indicators for a specified set of goods which are aggregated in several stages to construct branch indices and an overall industrial index.

The method is based on the assumption that the indices for the major aggregates are averages of the constituent elements of those aggregates. It therefore involves carrying out the following sequence of operations:

- structuring industry into fairly distinct and homogeneous branches with an indicator chosen as a weight for aggregating the individual indices into an overall industrial index;

- constituting a "basket" of basic commodities for each branch or sub-branch, calculating the physical indices for them and on that basis determining the physical volume index for the sub-branch;

- aggregating the sub-branch indices into indices for the major branches and the branch indices into the overall industrial index.

In contrast to international statistical practice, where monthly data are compared for a long time (e.g. 5 to 10 years) with a single period taken as the comparison base, the Russian practice is to make comparisons for two related years. This is largely dictated by the particular features of the development of the Russian economy today - major institutional changes, modifications in intra- and inter-branch proportions, the establishment of an economically justified parity between prices for different goods, and so on.

1. Methodological principles of accounting

1.1. Choosing a formula

An essential factor influencing the accuracy of the resulting index is the kind of mathematical formula used in the calculations. The Laspeyres index and the Paasche index are the most commonly used in statistical practice, having the advantage of being easy to interpret and relatively simple to calculate.

In the light of this, and given the scope for rapidly building an information basis for the calculations, preference was given to the Laspeyres formula:

$$I\ physical\ volume\ of\ output = \frac{\sum g_i^{/} . P_i^{o}}{\sum g_i^{o} . P_i^{o}},\ where$$

$g_i^{/}, g_i^{o}$ - volume of output of good i in the periods being compared;

P_i^{o} - price per unit of output.

1.2. Choosing an indicator as weight base for individual indices

The weighting system used for aggregating individual (physical) indices into branch indices and the overall industrial index must correspond to the economic nature of the weighted indicator and has to be relatively "stable" over time.

A weighting system was chosen on the basis of recommended international statistical practice, where various indicators (gross output, net output, man-hours worked, etc.) are used for weighting purposes, but preference was given to the "value added" indicator. This has the advantage of not including "double counting", not being dependent on the organizational structure of enterprises and reflecting the branch's real contribution to production.

The State programme for the transition of the Russian Federation to the internationally accepted system of accounting and statistics calls for the introduction of "value added" into Russian practice. For the time being, however, value-added calculations are at an experimental stage and are performed chiefly at the macro level. Regional statistical offices are only beginning to undertake them. This effectively limits the practical application of the indicator for constructing the index of the physical volume of industrial output, in particular for calculations involving a quite differentiated structure of weights for the branches of industry.

For the transitional period, therefore, other indicators were considered for the purpose of aggregating branch indices into the overall industrial index.

Under the present circumstances (before system-wide introduction of the SNA), in order to provide for a uniform methodology at all levels it was decided that the weight base for calculating the physical volume index would be the "imputed net output" indicator as currently used in Russian practice, this being closest in meaning and content to "value added". The necessary statistical information for this indicator is available in the reporting on production inputs (work or services). It is calculated by the formula:

INO = V - I, where

INO - imputed net output;
V - volume of output (work or services);
I - input of materials (less depreciation).

Given that the branch structure of industrial output is somewhat "inert" over time, the calculation of the index is simplified by using a standard structure of industry in terms of imputed net output for the previous year.

1.3. Defining a "standard" set of representative goods

Accounting practice shows that the quality and reliability of the overall result obtained for change in industrial output are largely determined by the representativeness of the set of goods used in the calculations. This is especially important when constructing physical volume indices for particular branches.

A "standard" set of goods, or "basket", was constituted from the types of products characteristic of the given sub-branch. In the case of engineering and a number of other sub-branches, the basket was defined taking account of consumer goods produced by enterprises.

The "standard" set of goods was made up where possible from items differentiated in terms of quality and applications. In the case of the coal industry, for example, the representative commodity selected is not coal in general but specific types of coal (hard coal, steam coal, coking coal) which differ in terms of the product attributes and end-uses. Likewise, in the case of the steel industry, rolled products are not taken together but broken down into bars, sheets, etc. Where the Russian commodity classification used in statistical practice allows for data to be obtained not only in physical units but also with reference to a basic economic or technical parameter (useful content, power, load capacity, productivity, etc.), preference is given to the latter. In this way, qualitative changes in output can also be reflected to a certain extent in the calculations.

Following these principles, 430 representative goods (covering more than 70% of total industrial output in the country) disaggregated into 120 sub-branches and branches of industry have now been chosen for calculating the monthly physical volume indices. Details of coverage of the output of branches of industry in physical series are given in annex 1.

Annual results are prepared for smaller (disaggregated) sub-branches, with about 800 representative goods included in the calculation.

The "basket" method is by no means ideal for all sub-branches of industry. The great variety of products in instrument manufacturing, for example, makes combining them in consolidated groups difficult because of the wide range of product attributes.

Forming a "basket" is difficult for branches characterized by a long production cycle (for example, shipbuilding or the aircraft industry).

A significant share in the volume of output is represented by services and work of an industrial character that are wide-ranging and hard to measure in physical terms.

The deflation method is used in international practice when there are difficulties in constituting a "basket" of representative goods. Similar techniques are also employed in Russian practice when calculating physical volume indices. However, the scope for applying this method is considerably limited and governed by the nature of the information available. As a rule, measuring the development of production from the relationship of the change in output in current prices and the price index understates rates of growth. This happens for a number of reasons.

First of all, there are the particular methods of recording prices and of calculating the price index. In current practice, prices are recorded as at a certain date, usually the end of the reporting month, and this fixes the

highest price for the selected representative commodity. No account is therefore taken of the movement of prices within the month, in which the enterprise itself directly calculates output in current prices.

Certain limitations on the use of the deflation method are furthermore imposed by the fact that prices are recorded for products shipped, whereas output in physical units and in value terms has traditionally been calculated in most cases on the "gross output" principle. Thus, total output of a particular product included the amount that went for further processing. Also, under present circumstances, large quantities of products do not find a market and pile up in factory warehouses.

Another reason for exercising some caution in using this method is that, because of its selectiveness, the practice of recording prices does not reflect the movement of prices for all products. In particular, the price index does not take account of price changes for export and defence-related products, which are included in the volume of output in current prices.

For sub-branches where it is difficult to select a representative set of goods, the possibility of using various indirect measures in the calculation of production indices - for example, changes in the unit labour requirements for goods in a particular sphere of industrial production - is now being explored. This work, however, is still at the theoretical stage.

1.4. Calculating the physical volume index by branch and for industry as a whole

As already noted, sub-branch indices are determined on the basis of a measurement of output in physical units for the periods being compared and in the same prices.

Since the result of the calculations is influenced not by the actual level of prices but by their relationship, use is made of data on average prices established for a relatively long period. This makes it possible to eliminate random price movements. The Russian practice here is to use data on prices for the year preceding the reporting year.

The sub-branch indices obtained are aggregated for consolidated branches and for industry as a whole using data concerning branch structure in terms of imputed net output as the weight base.

The calculation is shown schematically in annex 2.

The results of the calculations based on representative goods do not take account of change in the output of special goods for military uses in the defence sector, which is in the process of conversion. Statistical offices currently prepare information on the output of military goods in value terms in current and uniform prices for measuring changes in this output and its share in total production.

Given the difficulty of and the special arrangements for gathering output data for military goods in physical terms, and also the fact that pricing policy in this area of the economy is chiefly determined by the State, it was

decided to retain the current procedure and construct the index of the physical volume of output for military equipment on the basis of the valuation in uniform prices made directly by the manufacturing plants.

An adjustment is made to the physical volume index using the formula:

Ipv = Ipn x sn + Im x sm, where

Ipv - index of physical volume with an adjustment for military goods;

Ipn - index of physical volume derived from representative (non-military) goods;

Im - index of physical volume for military goods based on the evaluation by enterprises of output in uniform prices;

s - share of each component in total base year output.

The launching of the economic reform began with active institutional changes concentrated primarily on ownership. This above all involved the "destatization" of the economy - a reduction in the share of the State sector and an increase in the proportion of activities transferred from the State to the private sector and to other market structures (joint-stock companies, joint ventures, etc.). The reform or restructuring of State enterprises is accompanied by an expansion of the rapidly-growing small business sector. This, in turn, has made it necessary to redesign information flows.

With up-to-date information impossible to obtain from all enterprises, it became a problem to determine what effect they had on overall changes in industrial output during the year, especially in so far as small businesses and joint ventures with foreign participation were concerned.

The influence of changes in output from each of the above groups of enterprises on the physical volume index for industry as a whole and by branch is determined according to their share in overall industrial output in the base year and the physical volume indices for these groups covering the latest reporting period:

Ipvi = Ipv x sv + Ij x sj + Ib x sb + Io x so, where

Ipvi - aggregate physical volume index;

Ipv - index of physical volume derived from representative goods and adjusted for changes in the output of military goods;

Ij, Ib, Io - indices for enterprises (joint ventures, small businesses and others) not reporting monthly, as derived from rates of growth in current prices and the price index;

s - share of each component in total base year output.

2. Measuring changes in industrial output compared with the preceding period (month or quarter) of the year

2.1. Eliminating seasonal variations

In characterizing the economic situation as it evolves during the structural adaptation of production to market conditions, increasing importance attaches to comparisons of the current period with the preceding one during the year or consecutively with any one period taken as a comparison base.

When making comparisons in the course of the year with the preceding period, it is important to eliminate the influence of traditional seasonal variations in industrial output that are fairly sustained and in some periods have a significant effect on monthly or quarterly movements. This occurs in branches processing agricultural commodities (sugar, fruit and vegetables, meat, fibre crops, etc.). In some branches the variations are connected with the temperature regimen (large variations in electricity or thermal power generation at different times of the year) or with the particularities of the production cycle (hydropower, mining of ores and noble metals, logging, salt mining, etc.). In many branches output is traditionally lower in the main holiday season.

Specific projects have been undertaken by the State Committee on Statistics (Goskomstat) of the Russian Federation to identify the seasonal wave and eliminate its influence on monthly or quarterly changes in industrial output.

For years characterized on the whole by a relatively stable volume of output, it is possible to calculate directly both average daily output for these years and average monthly rates compared to the previous month. These data can be used as preliminary monthly or quarterly seasonality indicators.

Account must, however, be taken of the fact that in a period of overall significant increase or, conversely, decrease in output, the monthly indices of average daily output determined by the above method reflect not only seasonal variations but also a general trend.

Consequently, there is a need for further processing of the information. The main purpose here is to ensure representativeness in the detection of change in the basic trend.

Moving averages are a most convenient practical technique. Smoothed moving averages are obtained for particular levels of a series from the moving sums by successively carrying the totals forward by one date and dividing by the number of dates corresponding to the length of the seasonal component (i.e. 4 quarters, 12 months, 7 days, etc.).

The calculations show that quite reliable results can be obtained for quarterly changes with a four-part centred moving average. Smoothed quarterly seasonality indices, taking maximum account of changes in the seasonal wave for recent years, are used by Goskomstat to determine trends in industry for each quarter.

Eliminating the seasonal wave from monthly data has created a number of complications, which are largely due to the specific features of the development of the Russian economy. Long-term monthly series (the basis for the calculations) show a clear pattern up to 1991 - a significant increase in production in the last month of one quarter and a fairly substantial decrease in the first month of the next. This is obviously connected with the long-standing practice of planning, the quarterly assignment of basic mandatory targets and the peculiarities of contractual relations.

Under present conditions, with the abandonment of the planning methods used in the past, the basis for the above trend is practically disappearing. However, because of a certain "inertness" in economic development, the influence of these "intraquarterly variations", although not so sharp, is still apparent. Moreover, in a number of cases the situation today is characterized by changes in the parameters of the seasonal wave (affecting both its amplitude and duration).

Experience with using a 12-month moving average for seasonality indices shows that while this method gives the changing trends in the seasonal wave it does not, because of the above-mentioned factors, make it possible to measure the amplitude of the wave accurately enough, especially at the points closest to the reporting period.

Goskomstat is now working on improving methods to eliminate the seasonal wave from monthly data which take account of the specific nature of the development of the Russian economy.

2.2. Eliminating differences in available working time

Differences in available working time need to be eliminated because output in the periods of the month or quarter being compared depends to a significant extent on the regulation of working time during those periods, as defined by the number of calendar or working days.

The influence of differences in available working time is practically eliminated when total output is converted to average daily output. Particular regimes of work are determined for all goods by the requirements of the process involved. In the case of plants with a continuous production cycle, daily output is determined by dividing total output by the number of calendar days in the period under review, whereas in the case of plants with a non-continuous cycle it is divided by the number of working days (calendar days less public holidays and rest days).

When calculating output for industry as a whole or by branch, it is necessary to start with the number of adjusted days obtained by the following formula:

Number of adjusted days	=	Number of calendar days	x	Share of continuous production in total output	+	Number of working days	x	Share of non-continuous production in total output

For example, if the share of enterprises with continuous production processes in total output for industry as a whole is 40% and the share of enterprises with non-continuous production processes is 60%, the number of adjusted days will be:

January - 31 x 0.4 + 20 x 0.6 = 24.4
February - 28 x 0.4 + 19 x 0.6 = 22.6

Calculations for particular branches take account of the ratio of continuous to non-continuous production in those branches, as well as any special working time arrangements.

* * *

The changing economic situation has necessitated substantial refinements in the calculations of indicators of industrial production.

In introducing the conceptual framework for calculating production indices that is applied in international practice, Russian statisticians have encountered a number of methodological problems. These include determining indices for groups of products for which it is difficult or inappropriate to constitute a "basket" of representative goods, and taking account of change in the quality of goods. Improvement is needed in the mechanism for determining the influence on overall changes in industry month by month of work by enterprises for which information is gathered at yearly or half-yearly intervals.

Work has started on measuring changes in industrial output compared with the preceding period of the year. However, much still has to be done, on the basis of international experience with similar calculations, to take account of the specific functioning of the Russian economy.

Annex 1

Coverage of the output of branches of industry in growth series for representative goods in physical units

Branch of industry as listed in the Russian classification of branches of the national economy	Number of representative goods	Share of items included in calculation in total branch output, %
Total, industry	432	75
Electric power generation	2	97
Fuel industry	19	91
Ferrous metallurgy	18	93
Non-ferrous metallurgy	27	70
Chemicals and petrochemicals	46	71
Engineering	146	46
Forestry, woodworking, pulp and paper	36	91
Building materials	20	88
Glass, china and earthenware	2	
Light industry	49	70
Food processing	61	96
Milling, hulling and feed concentrates	4	89
Microbiological processing	2	94

Annex 2

Calculating the index of the physical volume of industrial output
(schematic example)

Table 1

Calculating the physical indices and an aggregate index
for each sub-branch

Representative commodity	Output in physical units		Average wholesale price per unit of output in base year	Output in base year prices, billions of roubles		Physical volume index, % *
	Reporting period	Base period		Reporting period	Base period	
1	2	3	4	5=2x4	6=3x4	7
Oil production	X	X	X	1 444	1 475	97.9
Oil, million tonnes	74.3	75.9	19.3	1 434	1 465	97.9
Petroleum gas, billion m^3	6.4	6.8	1.5	9.6	10.2	94.1
Oil refining	X	X	X	1 335	1 435	93.1
Motor fuel, million tonnes	6.5	6.7	49.0	318	328	97.0
Jet fuel, million tonnes	2.1	2.2	48.9	103	108	95.4
Diesel fuel, million tonnes	10.9	11.5	49.7	542	572	94.8
Heating oil, million tonnes	15.7	18.9	20.0	314	378	83.1
Lubricating oils, million tonnes	0.6	0.5	97.1	58.3	48.6	120.0
etc.						

* The physical volume index for the particular representative commodities is calculated by dividing the data in column 5 by those in column 6 and multiplying the quotient by 100. The physical volume index for each sub-branch is calculated by dividing the total for the representative goods in column 5 by the total in column 6 and multiplying the quotient by 100.

Table 2

Calculating physical volume indices for major branches of industry

Sub-branches and branches	Imputed net output for base year, billions of roubles	Physical volume index, % *	Imputed net output for reporting period in base year prices, billions of roubles
1	2	3	4 = 2 x 3/100
Fuel industry	9 062	96.8	8 772
Oil production	4 918	97.9	4 815
Oil refining	2 056	93.1	1 914
Gas	869	98.4	855
Coal	1 188	98.0	1 164
Shale	9	66.7	6
Peat	22	81.8	18
Ferrous metallurgy	4 890	109.9	5 372
Ore mining and concentration	718	106.4	764
Production of ferrous metals	3 276	111.9	3 666
Production of tubes and pipes	310	90.4	280
Production of ferro-alloys	149	105.7	157
Coking by-products	86	108.3	93
Production of refractories	120	129.1	155
Production of metalware	231	111.2	257
etc.			

* The physical volume index for each sub-branch is taken from table 1. The physical volume index for the major branch is calculated by dividing the imputed net output total for sub-branches in column 4 by the total in column 2 and multiplying the quotient by 100.

Table 3

Calculating the physical volume index for industry as a whole

Sub-branches and branches	Imputed net output for base year, billions of roubles	Physical volume index, % *	Imputed net output for reporting period in base year prices, billions of roubles
1	2	3	4 = 2 x 3/100
Industry, total	52 767	94.9	50 100
Electric power generation	7 609	93.1	7 084
Fuel industry	9 491	96.8	9 187
Ferrous metallurgy	4 969	109.9	5 461
Non-ferrous metallurgy	3 818	101.2	3 864
Chemicals and petrochemicals	3 317	108.4	3 596
Engineering	10 312	98.5	10 157
Forestry, woodworking, pulp and paper	2 294	89.1	2 044
Building materials	1 797	88.8	1 596
Glass, china and earthenware	247	89.5	221
Light industry	2 785	60.4	1 682
Food industry	5 426	84.9	4 607
Milling, hulling and feed concentrates	585	90.9	532
Microbiological processing	117	58.9	69

* The physical volume index for major branches is taken from table 2. The physical volume index for industry as a whole is calculated by dividing the imputed net output total in column 4 by the total in column 2 and multiplying the quotient by 100.
