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Volume measurement of services

Current methodology for deflating retail and wholesale services within the Canadian System of National Accounts

Note by the Statistics Canada

Summary

This paper discusses the development of the Wholesale and Retail Price Index Program at Statistics Canada and the potential use of these indexes in measuring the volume of wholesale and retail service in the Canadian National Accounts.

I. Introduction

1. Services industries comprise approximately two-thirds of the Canadian economy and business services represent almost 40% of gross domestic product, compared to about 17% for government services and 11% for personal services. Despite their importance, there is a significant gap in the Canadian economic statistical system of price indexes for the business services sector. This gap affects the quality of real output and productivity change estimates for this sector.

2. In 2006-07, Statistics Canada began a significant expansion of its coverage of price information for the business services sector, targeting roughly 30 broad business services categories. The project has made significant progress and several indexes were published first in 2009-2010. The Wholesale Services Price index (WSPI) and the Retail Services Price Index (RSPI) are two prominent indexes, and the topic of this paper. The time series for both these surveys begins in 2008.

3. This paper is organized in three parts. The first part is a description of Statistics Canada's current methodology for compiling volume estimates of wholesale and retail services. A considerable amount of time is spent describing the Wholesale and Retail Price Index program. An important part of the international dialogue around volume measures must be spent discussing service price measurement issues and options. The paper concludes with some analysis and discussion of the impact and transitional issues of using the new indexes in calculating volume estimates of wholesale and retail services.

II. Wholesaling and retailing in Canada

A. Overview

4. The wholesale sector is comprised of establishments primarily engaged in the wholesale distribution of merchandise on their own account (taking title to goods), or the buying and selling on a commission or fee basis (the goods being owned by others).

5. The wholesaling process is an intermediate step in the distribution of merchandise; wholesalers act as marketing intermediaries that neither produce nor consume the finished product, but instead sell to retailers, other merchants, and/or to industrial, institutional, or commercial users. However, some wholesalers, in particular those that supply non-consumer capital goods, sell merchandise in single units to final users.

6. Retailing is a vital part of the Canadian economy and the services that retailers provide are crucial for an effective and efficient flow of goods through the distribution process. The retail trade sector comprises establishments primarily engaged in retailing merchandise, generally without transformation, and rendering services incidental to the sale of merchandise.

7. In 2008, value added of the retail sector totaled \$83.4B or 5.5% of Canada's total (all industries) gross domestic product. If we include wholesale

trade, the distributive trades sector accounted for approximately 10.7% of the national total.

8. Given the importance and size of these industries in the Canadian economy, it is important to develop high quality volume estimates of retail and wholesale services.

B. Current methodology for deflating retail and wholesale services within Canadian System of National Accounts

9. Several programs in the Canadian System of National Accounts (CSNA) cover the retail and wholesale trade sector. These programs are: the Input-Output program, the monthly GDP by industry program, and the provincial industry GDP program. Through each of these programs—monthly, annual, national, and provincial/territorial—estimates of the volume of wholesale and retail services are derived and released to the public. Statistics Canada also releases monthly estimates of the volume of retail and wholesale sales—an important current economic indicator used by many Canadian forecasters and modelers.

C. Annual Input-Output tables

10. The Input-Output (I-O) tables are the most detailed representation of the Canadian economy from which the benchmark values of GDP in the Canadian System of National Accounts are computed. They are produced on an annual basis, with 2008 being the latest available reference year.

11. The retail and wholesale sector are each presented as an industry in the Canadian I-O tables. The main output of the industry is the retail or wholesale margin which is defined as the sales of goods purchased for resale less the cost of goods purchased for resale.¹

12. The nominal estimates are derived using results from Statistics Canada's annual business surveys (the principal survey's being are the annual retail and wholesale industry surveys). Margin output from these surveys are combined with the secondary output of retailing and wholesaling margins from other industries. This forms a total margin supply is then allocated across the various dimensions of the input-output table.²

13. The constant price I-O tables are estimated by deflating the nominal I-O tables valued in producer prices using a variety of deflators such as the Industrial Product Price Index for manufactured goods. Value added by industry in constant prices is estimated using the double deflation method (the difference between deflated gross output and deflated intermediate inputs). When deflating the intermediate inputs the producer value of the good is

¹ It should be noted that the retail and wholesale industries also produce other products that are also part of their gross output.

² It should be noted that in the Canadian context, the purchaser values of commodities are estimated first, and then the margins with the producer value defined as the difference between the purchaser value and the margin.

deflated separately from the retail and wholesale margins (i.e, the producer value is deflated using a net supply implicit price index whereas the constant price estimate of each margin is derived indirectly). Currently, within the CSNA, the new WSPI and RSPI are not used to produce volume estimates of wholesale and retail services. Instead, Statistics Canada derives volume estimates as follows:

- a) First, a producer value for each commodity within the Input-Output table is calculated. Let's assume that the producer value of good x is \$100.
- b) Second, a retail and wholesale margin are estimated for each commodity.³ Let's assume that the wholesale margin on good x is \$5 and the retail margin on good x is \$5.
- c) A margin rate is then calculated, which is the value of the margin divided by the producer value of the commodity. The wholesale margin for good x would be $\$5/\100 or 5%. The retail margin for good x would be $\$5/\105 or 4.8%⁴.
- d) Next, the margin rates for the current year and previous year are averaged⁵ and applied to the constant price basic value of the commodity to compute a margin estimate in constant prices. For example, let's assume that the deflated value of good x is \$90 and that the average wholesale margin rate (between year t and $t-1$) is 5% and the average retail margin rate (between year t and $t-1$) is 4%. The constant price wholesale margin value would be $\$90 \times 5\% = \4.5 and the constant price retail margin value would be $\$94.5 \times 4\% = \3.7 . The constant price wholesale and retail margins across all commodities would then be aggregated to derive the constant dollar value for the wholesale and retail industries, respectively.
- e) An implicit price index is calculated by dividing the sum of current price margin values by the sum of their constant price margin values. This implicit index is used to validate the results of the deflation exercise. If the implicit index is not consistent with what is understood to be the movement in retail and wholesale services relative prices, further investigation of the data is undertaken.

D. Monthly GDP by industry

14. The monthly measures of the wholesale and retail industry GDP are projections of the annual estimates of constant price GDP at basic prices originating from the constant price I-O tables noted above. The new WSPI and RSPI are currently not used to derive the volume estimates.

³ Within the Canadian I-O tables the sum of the retail and wholesale margins across all commodities equals the margin output of the retail and wholesale industry.

⁴ This example is a simplified version of the actual Canadian calculation. In practice, the retail margin rate is calculated as a percentage of the sum of the nominal value estimates for producer, wholesale margin, transportation margin, storage margins, and pipeline transportation of oil and gas margins (excluding gas distribution margin and tax margin).

⁵ The two years were averaged to reduce the variability in the index

15. To derive the monthly volume measures for the retail and wholesale services changes in constant price output are used as indicators of the growth rates in constant price value added by industry. The movement in constant price output is assumed to be represented by the month-to-month growth rates in constant price sales by retailers and wholesalers.

16. Statistics Canada compiles monthly estimates of retail sales and wholesale sales. These estimates form the basis for the monthly volume estimates of wholesale and retail GDP. The methodology for deriving the monthly volume estimate of retail GDP is as follows:

- a) First, current price sales by retailers by commodity are taken from Statistics Canada's Quarterly Retail Commodity Survey.
- b) Second, consumer price indexes are concorded to each commodity. The commodity values are then deflated and aggregated up to an industry total.
- c) The industry volumes are then aggregated to a total retail sales volume.
- d) The monthly movement in the volume of retail sales by industry is then applied to the annual retail constant price value added series to estimate the monthly volume of retail GDP.

17. The methodology for estimating the monthly volume estimate of wholesale GDP is as follows:

- a) Current price sales by wholesalers (from the monthly wholesale trade survey) are allocated to wholesale commodities using the annual wholesale commodity origin and destination survey.
- b) The commodities are deflated using weighted aggregates of industrial product price indexes and import price indexes. The weights applied to the import index and the industrial product price index are taken from the Input-Output Table and represent the share of the value of the commodity that is imported vs. the share of the value of the commodity that is domestically produced.
- c) The deflated commodity values are then aggregated to the industry and the industries are aggregated to derive an estimate of the volume of total wholesale sales.
- d) The monthly movement in the volume of wholesale sales is then applied to the annual constant price value added series to estimate the monthly volume of wholesale GDP.

E. Issues with the current methodology

18. There are several issues with the current methodology for estimating the volume estimates of value added for the retail and wholesale industries.

- a) The retail and wholesale margin ratios used in the calculation of the deflated I-O tables are based on current dollar estimates. In all likelihood these are not the same as the constant price estimates. In practice we are saying the producer price and the margin price move in the same direction and with the same magnitude. This may not necessarily be the case.

- b) The monthly GDP estimates are based on the hypothesis that the volume of service is proportional to the volume of sales, the proportions being derived annually from the I-O tables.
- c) There is no adjustment made for changes in the quality of the service (although quality adjustments are made to the goods priced as part of the IPPI, CPI, and Import Price indexes – the main deflators currently used to derive the volume of retail and wholesale sales in the CSNA) .

19. In 2006-2007 Statistics Canada launched a Services Producer Price Index (SPPI) program to address these types of measurement issues. The Wholesale Services Price Index (WSPI) and Retail Services Price Index (RSPI) are important components of the SPPI program. The intention of the program is to eventually provide indexes that can be used to deflate retail and wholesale industries margin component of each goods commodity in the I-O tables. Before discussing the use of these new indexes within the CSNA, we will review how they are constructed.

F. Pricing wholesale and retail services

1. Industry versus commodity

20. The main classification of wholesale and retail activity is by industry. The Wholesale and Retail Price surveys are based on the definition of wholesale and retail trade under NAICS (North American Industrial Classification System). NAICS is the agreed upon common framework for the production of comparable statistics by the statistical agencies of Canada, Mexico and the United States. NAICS is based on a production-oriented, or supply based conceptual framework, in that establishments are grouped into industries according to similarities of production processes used to produce goods and services.

21. The level of comparability between the wholesale and retail price surveys and Statistics Canada's wholesale and retail trade sale surveys is high. First, both survey programs use the same industry (and soon product) classification system (NAICS, and then NAPCS, the North American Product Classification System). Second, the price survey sample is a sub-sample of the Annual Wholesale and Retail Trade Survey frame, so the same units are defined and covered. This frame ultimately is derived from the Business Register.

2. Margins

22. The pricing concept for the retail and wholesale service is the margin price per unit. The margin price per unit is derived by subtracting the average purchase price per unit from the average selling price per unit. These prices reflect real transactions measured monthly, but collected on a quarterly basis.

23. Retailers are asked to price two products for up to each of six commodity groups. The selected products should be representative of the retail activity and based on the sales revenue generated by these products. The items should be high volume products that are sold year round. Respondents are asked to continue reporting for these products each quarter. However, when a product ceases to be sold, the respondent is asked to provide a comparable product replacement. To produce a constant quality series,

retailers are asked to provide product specifications for each product reported. The detailed specifications facilitate the identification and tracking of a product and its replacements over time.

24. The wholesale price survey asks respondents to select three main products which are representative of their business activity based on the sales revenue generated by these products in the past fiscal year. The products, their descriptions (or specifications) and their prices are obtained, collected and verified through a combination of mail-out and telephone contact or follow-up. The respondents are also asked for the product's country of origin (domestic, or imported and from what country).

25. The survey is designed to collect both a selling price and a purchase price representative of current period transactions. The margin price is derived from the selling and purchase prices. All efforts are made to maintain constant quality through contact and follow-up with the respondent. The reported purchase and selling prices represent an average monthly price. Respondents are asked to continue reporting for the selected products each quarter. When a product ceases to be sold, the respondent is asked to provide a comparable product replacement.

26. The main variables used to price the retailing and wholesale services are:

- a) **Product Description** – Identifies a product, its color and/or other product attributes which can be used to uniquely identify and track the product or service reported.
- b) **Product Manufacturer or Label** – Identifies the manufacturer of the product, service or SKU (Stock Keeping Unit).
- c) **Product Code** - Can include the PLU (Price Look-Up code), UPC (Universal Product Code) or SKU.
- d) **Size/Weight** – Refers to the specific size or weight measurement for the product or service reported.
- e) **Unit of Measure** – Refers to a particular quantity or size, defined and adopted by convention, with which other quantities of the same kind are compared (dozen, foot, kg, litre, etc.).
- f) **Retailing/Wholesaling Activities** – A list of activities performed by retailers for the products or services chosen. Price margins may fluctuate due to (perceived or actual) value-added by the retailer in performing all or any of these activities.
- g) **Average Purchase Price** – The average purchase price is defined as the cost to the retailer/wholesaler to purchase a product/service from the supplier, excluding all taxes and rebates.
- h) **Average Selling Price** – The average selling price is defined as the cost charged by the retailer/wholesaler, excluding taxes and freight.
- i) **Main Reason for Purchase Price Change** – Identifies the reason for a change in the purchase price. Reasons can range from a change in supplier, change in product, inflation or exchange rate fluctuations.
- j) **Main Reason for Selling Price Change** - Identifies the reason for a change in the selling price. Reasons can range from a change in the retailing/wholesaling service offered, change in supplier, inflation or exchange rate fluctuations

3. Special considerations when collecting margin prices

27. Margin pricing introduces a new dimension to index construction as margin prices may behave very differently from sales prices and must be treated accordingly. The retail and wholesale industries in Canada, while seasonal in nature, are also influenced by price volatility and popularity trends.

28. There are a few issues associated with seasonality and seasonal goods that must be considered when pricing retail and wholesale services. The first is the importance of including seasonal goods at the appropriate time, as the truncation of seasonal items could distort price measurement. One way to avoid this is to stress to survey respondents that product selection should reflect an annual period. Take for example, a respondent reporting prices for men's fall/winter dress pants. Reporting for this product starts at the beginning of the fall/winter season with high margins. The margins fall to mid-level by the spring and are sold at a loss in the summer. The respondent has followed this same pattern for the past two years. The price index reflects this seasonal volatility, but one must be careful to avoid substituting a non-comparable product at the end of the previous item's season as this would break the series and cause a downward bias on the index. To minimize the downward bias and deal with cases like this, it is preferable to find comparable substitutions to link in and bring the index back up.

29. The second issue relates to setting the base price for a good. When establishing a new series, re-pricing an item or taking a non-comparable substitution, liquidation prices or near-zero prices should be avoided. Liquidation prices and prices approaching zero can cause fluctuations in the price relative in the month that the price is first encountered and again in the month that the price reverts to normal. Consider the example where a retailer reports a margin price of \$0.02 at the end of the year for cucumbers. The following month the margin price returns to \$0.32, resulting in a price relative of 16. Under normal circumstances when the margin price approaches so close to zero we would generally exclude this price from estimation. If the margin price had reached \$0.00, it would have been automatically excluded as zero or negative margins are excluded from the index calculations.

30. Clearance sales can also distort the price index. As a case in point, a brand of computer laptop entered the retail sample with a margin price of \$186 per unit. By the third quarter that margin fell to \$110, being marked down as an end-of-life clearance item. The following month, the margin price fell again to \$34. By the end of the year, the margin price was negative and in the first quarter of 2010 a replacement product was received. For the year that this product was in the sample, its margin price declined 80% from \$186 to \$34 (the negative margin being excluded from estimation). While high-tech goods are always coming down in price (and implicitly, margins are becoming narrower), it is doubtful that such a large annual decline is representative of meaningful economic activity. Clearance prices in general are not sustainable over the long run for any business, and as such are viewed as one-time or special events—they do not reflect trends in pricing over any significant period of time. Ideally, we would substitute products out of our sample before they become clearance items. When it is not possible to do this, we try to find a comparable substitution to link into the index.

31. Estimating wholesale and retail service prices is a complex undertaking given that the prices are not directly observable and must be calculated. In addition, margin prices are expected to be volatile. An item with a gross retail selling price of \$10.00 and a margin price of \$1.00 that has a \$0.50 (5%) increase in the gross retail selling price results in a 50% increase in its margin price. The volatility is caused by the very small value that a margin price has relative to either the selling or purchasing price. While margin prices can indeed be volatile, margin volatility is sometimes indicative of other problems, such as product mix issues.

32. While there are many challenges in developing wholesale and retail price indexes Statistics Canada is now publishing the indexes on a quarterly basis approximately 90 days following the reference period.

III. Incorporating the WSPI and the RSPI into CSNA

33. Given that the WSPI and RSPI are relatively new products, the CSNA has not yet had time to incorporate them into the CSNA deflation program. Research has started and it is expected that these new indexes will be fully incorporated into the CSNA when results from the current CSNA comprehensive revision are released beginning in October 2012. The following highlights some of the results of our experience with the indexes, as well as some of the challenges of incorporating these new data series. The examples focus on the wholesale price index but equally apply to the retail price index.

A. Special considerations when collecting margin prices

34. The specific challenge Statistics Canada faces when using the WSPI and RSPI is that while they are appropriate when deflating industry output, issues arise when trying to deflate the wholesaling margins for each commodity within the I-O tables. The current methodology (noted above) first deflates the wholesaling margin at a commodity level and then aggregates the commodity estimates to derive an industry total output. If the CSNA continues to use this approach it will involve mapping the industry based WSPIs to the commodity classification in the I-O framework. There are about 60 WSPI industry-based indexes that would need to be mapped to around 400 I-O commodities. A preliminary mapping has been completed and in some cases the number of commodities mapped to a single industry is quite large (e.g., to over 40 commodities). If the commodities that underlie the WSPI industry index are the same as the commodities that are being mapped to within the IO framework, this would be entirely appropriate. If the type and weighting of the commodities in the WSPI are different than the I-O commodities they are being mapped to, this may lead to spurious results. Research is on-going to determine the extent to which this is a problem. This research may well lead to feedback into the WSPI and RSPI programs that permit the programs to target margin prices for specific commodities from wholesalers and retailers.

35. An alternative to this approach would be to first deflate the aggregate industry output and then allocate these volumes to the individual commodities

using each commodity's share of the total industry margin. The benefit of this approach is that we are deflating the industry output with an industry deflator. Its drawback is that it implies the same margin deflator for each commodity within the Input-Output tables—meaning that the movement in the wholesale margin relative prices is the same for every type of wholesaling service. This approach is illustrated in Table 1.

Table 1

Allocating the industry total by commodity

	<i>Current Price Value</i>	<i>Deflator</i>	<i>Share</i>	<i>Constant Price Value</i>
Wholesale industry	70	1.07		66
Commodity 1	15	1.07	21%	14
Commodity 2	25	1.07	36%	23
Commodity 3	30	1.07	43%	28

36. Another option is to use a combination of the current methodology and the new industry based WSPIs. The WSPIs would be used to estimate the constant price value of wholesale services at the industry level. The current methodology would be used to derive a constant price wholesale service for each commodity. The difference between the industry total and the sum of the commodities would be raked over the commodities⁶. This option is illustrated in Table 2.

Table 2

Integrating new and existing methodologies

	<i>Producer current price value</i>	<i>Margin current price value</i>	<i>Margin rate</i>	<i>Producer deflator</i>	<i>Producer constant price value</i>	<i>Margin constant price value</i>
Commodity 1	150	15	10.0%	1.01	149	15
Commodity 2	300	25	8.3%	1.02	294	25
Commodity 3	550	30	5.5%	1.02	539	29

⁶ If a more appropriate pattern can be determined, it would be used instead of raking the data across the existing pattern.

	<i>Margin constant price value</i>	<i>Commodity share</i>	<i>Adjustment factor</i>	<i>Adjusted constant price margin</i>	<i>Adjusted margin deflator</i>
Wholesale industry	66				
Commodity 1	15	22%	(0.65)	14	1.056
Commodity 2	25	36%	(1.07)	23	1.066
Commodity 3	29	43%	(1.28)	28	1.066
Commodity total	69			66	

37. A final option, yet to be explored, involves constructing commodity margin deflators from the WSPI program. As noted above, the WSPI collects product detail from respondents. It is therefore possible to aggregate the margin prices by commodity rather than industry. The one concern with using this approach is that the wholesale price survey was not originally designed to produce commodity level indexes.

38. The long term strategy for the SPPI program is to develop product based indexes, but there are significant obstacles to overcome before these are produced. Some of the challenges include:

- a) Production of a commodity index would require pricing of secondary production in other industries. For this a commodity frame is required and one does not currently exist at Statistics Canada.
- b) Producing commodity margin price indexes would require a large increase in the sample size for the program. Given fiscal pressures it may not be possible to do this in the near term. .

B. Use of the WSPI in the monthly GDP by industry program

39. The CSNA is also exploring the use of the WSPIs to derive the monthly volume estimates of wholesale sales.⁷ The wholesale price survey collects two prices from wholesalers, a purchase price and a selling price from which a margin price is computed. From these data three price indexes can in fact be constructed—the margin price index, the purchase price index and the selling price index. The wholesale selling price index is the one most appropriate for deflating wholesale sales.

40. Statistics Canada has run a number of simulations using the wholesale selling price index as a deflator⁸ for wholesale sales as an alternative to the

⁷ Which, in turn are used to estimate the monthly volume estimates of wholesale GDP.

⁸ The key assumption here is that the movement of margin prices is identical to the movement of selling prices for a given commodity.

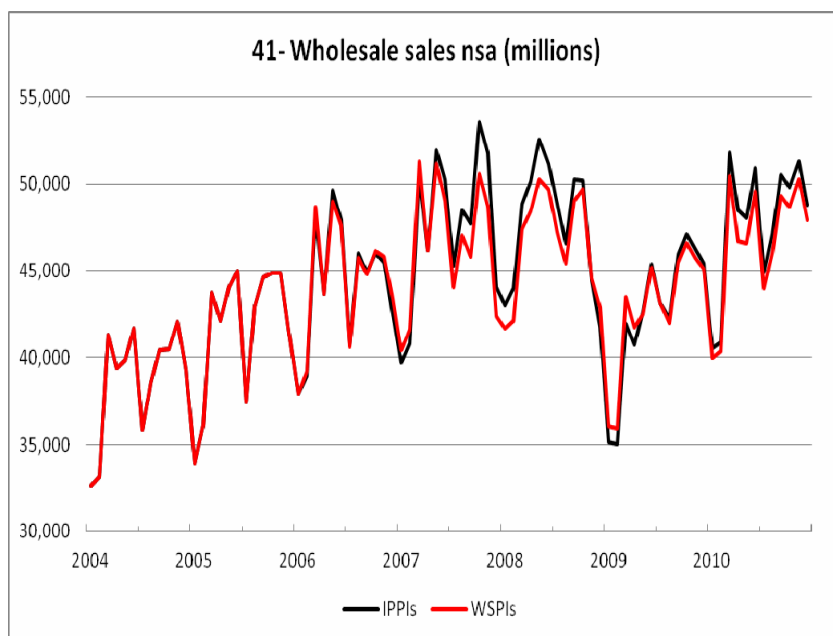
current methodology which uses a weighted average of import and domestic production prices. Early results point to the wholesale selling price index providing more robust results. Chart 1 shows the difference between the two methodologies based on a simulation. The significance of this difference is important. During 2007-2008 there was a large appreciation in the Canadian dollar vis-à-vis the US dollar. The current methodology for deflating wholesale sales relies on Canadian import price indexes which are heavily influenced by the Canadian/US exchange rate. During this period import prices were falling, due in part because, in converting commodity import prices from the USD to the CAD, Statistics Canada assumes an immediate and 100% exchange rate pass-through. Recent studies have demonstrated that the pass-through is less than 100%. Statistics Canada makes an aggregate adjustment to its import price deflator but does not allocate this adjustment back to the detailed commodities. Since the monthly GDP program uses the import commodity detail, the decline in the import prices during this period tended to be overstated (a 100% exchange rate pass-through was assumed).

41. As a result, the volume of wholesale sales tended to be overstated. The WSPI picked up the correct import price (prices that assumed less than 100% pass-through) directly from wholesalers resulting in lower volumes during times where the Canadian dollar was appreciating against the US dollar, and higher volumes when the Canadian dollar is depreciating against the US dollar.

Chart 1

New methodology vs. current methodology –

Volume of wholesale sales not seasonally adjusted



IV. Summary

42. Like most countries, the service sector in Canada is growing and high quality estimates of the volume of services are required to provide an accurate picture of total real output. Statistical agencies can no longer simply rely on proxy pricing to deflate service output. We must move towards direct measures of the price of these services. That said, the challenges associated with collecting, processing and implementing these new deflators are not trivial.

43. The wholesale and retail industries pose a particular challenge given the service price is not directly observable but must be calculated as the difference between the selling price and the purchase price. Even when the challenges of collection and processing can be overcome the integration of these new indexes into the various programs is not straightforward and requires a significant amount of research and testing.

44. Making sense of the results is an important part of the research. The preliminary research undertaken by the CSNA indicates that the current wholesale output volumes are too high. The two alternative approaches to deflating the IO estimates that have not yet been tested may yield different results. One test of the validity of the results is whether or not other parts of the SNA framework point to the quality and usefulness of the WSPIs. This is indeed the case when the WSPIs will be used in the monthly GDP program. The results lead to new estimates that addressed known quality issues.

45. One word of advice to any country considering the implementation of a new methodology to measure the volume of services: allot enough time to do the required research to integrate the new information. The changes, while an improvement on quality, are significant and care must be taken to ensure the correct approach is used as well as time taken to properly explain the changes to users.

V. References

The paper contains sections of previous papers on this subject that were presented at the 23rd and 25th Voorburg group of meetings on Services Statistics by Fred Barzyk, André Loranger and Catherine Draper.
