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Constant Price Measurement for External Transactions in National Accounts

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Price indices for external transactions originate from the necessity to measure the price fluctuation of export and import commodities. For the countries which have a large proportion of external trade volumes in the economy, it is important to measure the overall price changes of external trade for gauging its impacts on their domestic economies.

On the side of national accounting, price indices for external transactions are important in line with deflating the current price value of export and import to derive the constant price value. Thus these indices have been developed with the national accounting history.

Generally, in order to measure the price indices for external transactions, trade statistics from customs service offices have been the main source data. Values, quantities and unit values are recorded for all commodities traded with other countries. Thus the overall average unit values can be derived from trade statistics data.(it is called *unit value indices*) Another method to measure the price indices for external transactions is to survey prices directly from exporters and importers. (it is called the *export and import price indices*, or XMPI)[1]

In this paper, the purposes of price indices on external transactions have been described, and the kinds of those price indices have been compared with merits and demerits. Finally, price indices as a practical deflator for external transactions are suggested with some issues attached.

Reference is also made to the ongoing work at international level to construct a manual on export and import price indices. This work is led by the International Monetary Fund and can be accessed at the IMF website[2].

Purpose of price indices for external transactions

One of the main purposes of price indices for external transactions in the context of compiling national accounts is to make deflators for external transactions. To make current price data on export and import values transform into constant price data, deflators for external transactions are necessary, and export and import price indices or unit value indices are used for that purpose.

For instance, weights of price indices used for *exports and imports* in national accounts range 5-26% of *total supply and use* amount (supply side: output + imports, use side: intermediate consumption + gross capital formation + final consumption + exports), and they increase in most of countries in 2002 than in

[1] Some countries compile the XMPI as a part of the PPI. In this paper, I would like to confine the coverage of PPI to *domestic* PPI, and exclude the export and import price indices from the PPI.
[2] http://www.imf.org/external/np/sta/tegeipi/index.htm

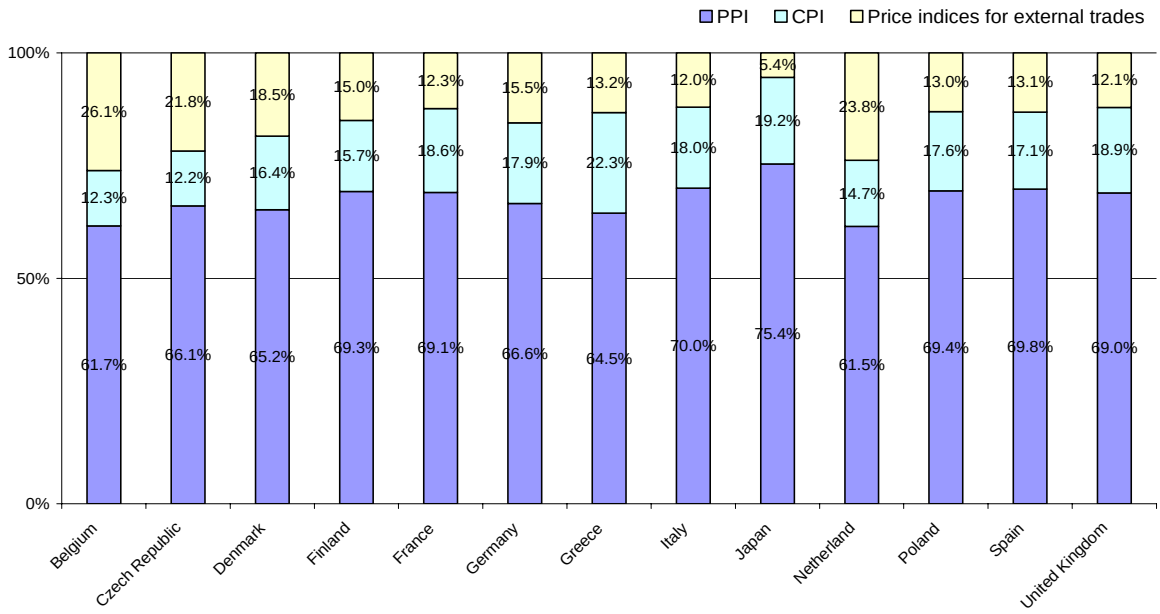
1995, comparing to weights of CPI usage. Therefore, the importance of price indices for external transactions is not negligible in deflating in national accounts.

Weights of exports and imports from the total supply and use amounts in national accounts[1] (%)

	1995	2002
Belgium	24.0	26.1
Czech Republic	17.3	21.8
Denmark	15.9	18.5
Finland	14.6	15.0
France	10.8	12.3
Germany	11.7	15.5
Greece	11.1	13.2
Italy	11.5	12.0
Japan	4.3	5.4
Netherlands	22.3	23.8
Poland	10.0	13.0
Spain	10.7	13.1
United Kingdom	12.4	12.1

Note: 1) weight = (exports + imports)/ (total supply + total use). Source: OECD, SNA database

Potential weights of price indices usage in national accounts(2002)



Note: For deflating indicators in national accounts, it is assumed that, on the supply side, the PPI are used for output, and the XMPI for imports while, on the use side, the PPI are used for intermediate consumption and gross capital formation, the CPI for final consumption, and the XMPI for exports. Weights of price indices usage are calculated by the value amounts of each component of GDP.

Secondly, in order to derive the *real gross domestic income*(GDI) from real GDP in national accounts statistics, trading gains and losses resulting from changes in terms of trade should be calculated. The difference between the change in GDP at constant prices and real GDI is described as the trading gain and loss in SNA.

real gross domestic income = gross domestic product at constant price + trading gain and loss resulting from changes in terms of trade

Terms of trade are ratios of export prices over import prices, which show the degree of improvement or deterioration in the overall price aspect of the external trade. Export and import prices are needed for calculating the terms of trade and real exports and imports, thereby deriving the trading gain and loss.[3]

Thirdly, import price indices could be used for analysts to predict the impact of import prices on the domestic economy. In most cases, the import prices precede the domestic prices like PPI and CPI with a time lag of at least several months or half a year. Therefore, in order to forecast the degree of domestic impact on prices and growth in advance from foreign trade, import price indices have a role of a good leading indicator.

There are two kinds of price indices for external transactions used for these purposes.

Unit value indices for external transactions

[3] The relation between *terms of trade* and *trading gain (and loss)* comes from the following derivation.
Trading gain and loss resulting from changes in term of trade, T, are expressed as following in SNA 93.
$T = \frac{X - M}{P} - (\frac{X}{P_X} - \frac{M}{P_M})$, where X: export at current prices, M: import at current prices, P: price indices based on some selected numeraire, P_X : the price index for exports, P_M : the price index for imports.
Then, there are several suggestions for the choice of P in SNA 93. One of them is to use an average of P_X and P_M.
If we select this choice, the following will be derived by transformation. $T = \frac{(\frac{P_X}{P_M} - 1)(\frac{X}{P_X} + \frac{M}{P_M})}{(\frac{P_X}{P_M} + 1)}$
From this expression, we can conclude that *if the terms of trade,* $\frac{P_X}{P_M}$ *, is above 1, trading gain will occur*. On the contrary, *if the terms of trade is below 1, trading loss will occur*.

In most countries, unit value indices have been used more widely and compiled with the history of recording trade statistics at the customs office. Unit value indices can cover relatively a larger proportion of commodities than price indices, and it is easy to access to the price data without surveying them regularly.

Unit value indices are derived from administrative data of the customs office. The value, unit value and quantity data of all imports and exports reported to the customs office are available to the statistics office. Unit value indices can be calculated from value indices divided by quantity indices, or quantity indices can be acquired from value indices divided by unit values indices.

Unit value indices are compiled based on the historical data recorded when commodities have been cleared at the customs frontier. Therefore, the data source of the indices is coming from price data on the delivering process.

One of the defects of unit value indices is that they lack the quality change adjustment in commodities. For unit value and quantity data reported to the customs office, there is no distinction in quality difference among commodities within the same category of HS classification. There is no model matching in comparing the price of commodities within the category. Therefore, when the mix of commodities changes within the category, unit value indices will change even though prices of individual commodities within the category do not change.

Export and Import Price Indices

The XMPI was developed to measure overall price changes of external trade in an economy. The indices cover representative commodities above certain proportion of total trade amount traded with foreign countries. The indices are apt to keep the consistency of specifications of surveyed commodities by model matching. Surveys of prices are conducted regularly to exporters and importers by statistical agencies.

Some countries such as UK, Japan and France etc. compile the XMPI as a part of the PPI because exports and imports constitute the total supply and use of the economic resources. They deal with the XMPI as a component of input-output price indices in the context of compiling national accounts.

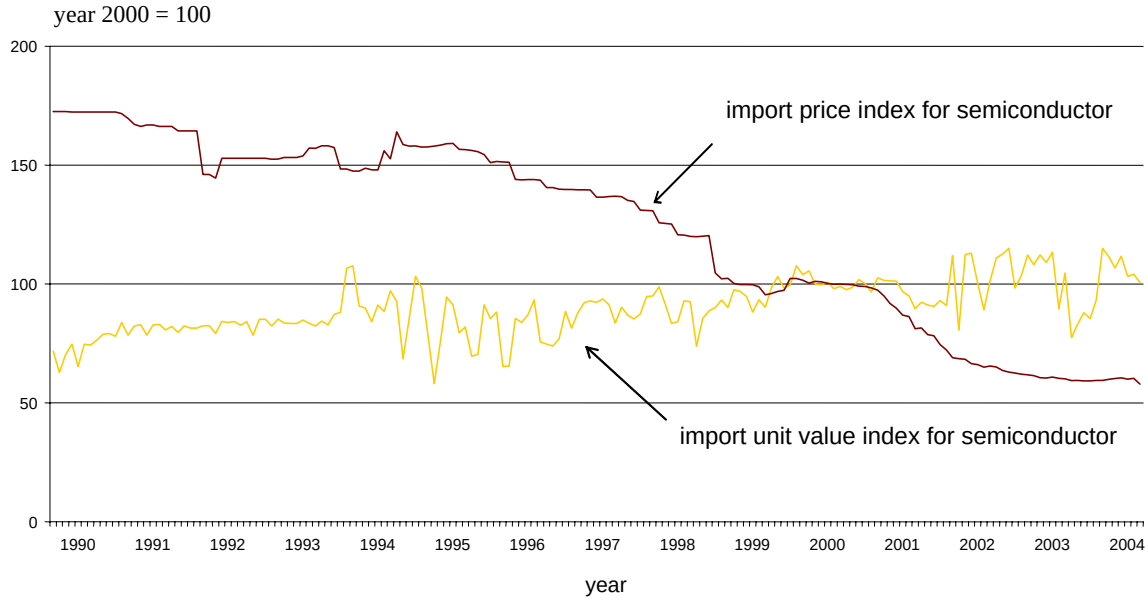
The XMPI are surveyed normally at the time when transactions take place. However, some countries are collecting data on contract price in order to predict impacts on domestic economy in advance. So there

is a time lag ranging from one to three months between the XMPI and unit value indices which are recorded when the delivery is made at the customs frontier.

The quality change of commodities can be adjusted in the XMPI because the basic premise of these indices is to eliminate the quality change from the price change while the quality adjustment in unit value indices is not done automatically. We can easily observe the phenomena of discrepancies between price indices and unit value indices in commodities like electronics and semi-conductors whose qualities change very rapidly.

Some countries compile both indices, so we can compare these two indices from one of those countries. The following graph shows *the import price index* and *the import unit value index* for semiconductor in Korea. In this example, the coverage of the category between two indices might be slightly different. However, their trends are completely different from each other. The import price index on semiconductor shows a downward trend while the import unit value index on that shows a horizontal trend. The import price index for semiconductor is compiled by surveyed data from importers and other import-related institutions. On the other hand, the import unit value index for semiconductor is derived by dividing import value by import quantity, *kilogram*. Therefore, there is no way to adjust the quality change for the import price.

Comparison of import price indices on semiconductors (Korea)



Source: the Bank of Korea, database for economic statistics

This is one of the reasons why the XMPI is recommended for external trade deflator rather than unit value indices. In the index number theory, the quality change is eliminated from the price change, and is transferred to volume change. Therefore, the XMPI is suited better than the unit value indices from the viewpoint of the index number theory. The relations between indices on price and unit value, indices on volume and quantity, and quality change indices are expressed as follows.

Relations among the indices

Price index × Volume index = Unit value index × Quantity index = Value index

Price index × Quality change index × Quantity index = Value index

Unit value index Volume index

By the way, in the practical sense, there are some advantages even in unit value indices. First of all, the coverage of unit value indices is commonly wider than that of the XMPI from the viewpoint of availability of data. Unit value indices are collected from the administrative data of the customs office in which all the traded commodities are recorded while the XMPI is based on the surveyed data from a selection of enterprises. Therefore, the number of commodities collected in the unit value indices is relatively larger than in the XMPI.

Number of commodities surveyed for export and import price indices

	Unit value indices		Price indices	
	Export	Import	Export	Import
Japan	2,116	2,684	209	247
Korea	976	1,226	227	222

On the other hand, it is not easy to survey price data in compiling the XMPI. In the trade statistics, there are so many commodities not frequently and continuously traded. Commodities with small quantities and different qualities are commonly traded in international transactions. As a result, it is quite difficult to match the same models of the surveyed commodities in practice when collecting price data.

Box: Hedonic price indices

Generally, price indices are constructed by comparing prices of sampled products between two periods in time. Two conditions have to be fulfilled for this to yield reliable estimates: the products in the sample have to be representative of a whole product group and they should be comparable between the two periods. Rapid technical change implies that neither condition is easily satisfied in the case of information and communication technology goods such as computers: models change very rapidly and there is a risk of comparing two non-identical products. And if only prices of those models that are available in both periods are compared, there is a risk of using a non-representative sample if the price movements of these goods do not reflect the broader market conditions. In a situation where the price statistician has to compare two different models, the fundamental question is: how much of the observed price change is due to quality change and how much to a true change in prices?

Consider the following example: in year 1, an old model costs 100; in year 2, a new model costs 90. How does one split the observed price change of 10 into a price and a quality component? What is missing here is the price that the old model would have collected in year 2, had it still been on the market. Suppose we know that price, and suppose it is 80. Then it would be easy to state that the price change between the two periods is 80-100= -20 and that the quality change equals +10.

But the price of the old model in year 2 is not known, and the price statistician, implicitly or explicitly, has to make some estimate. Simply ignoring the model change and calling -10 the true price decline is tantamount to saying that there has been no improvement in quality, or that the price of the old model in year 2 would have been 90 as well. As a consequence, the fall in prices would have been understated by half. Thus, to get price changes right, a more informed estimate of the year 2 price of the old model is required. Such an estimate may come from expert advice, from "option pricing", or from some observation of the price at which the old model is traded by in second-hand markets.

The hedonic method[4] is a systematic way to obtain an informed estimate for the price of the old model in year 2. Under this method, a hedonic function is estimated, that links the price of computer models to their characteristics such as speed, memory, equipment etc. Suppose, for ease of exposition that there is only one such characteristic. By observing a sufficiently large number of computer models in year 2, it is possible to establish a systematic relationship between price and this characteristic. One can then infer a hypothetical price for the old computer model in year 2 by using the information about its technical characteristics (which are known from period 1) and so obtain an approximation to the true price change.

A number of countries use such hedonic methods, among them the United States where hedonic functions are constructed for different types of computers and peripheral equipment, semiconductors and software. Australia, Canada, Japan, France, Germany and some other countries have also developed hedonic functions or adopted those of the United States. For ICT products, the hedonic method tends to yield price changes that drop more rapidly than price indices based on other estimates.

The choice between hedonic and other methods is relevant for import and export prices and may have sizeable impact on the measured composition of final expenditure and on the measured output and productivity growth by industry[5]. Several countries, for example Australia, have opted to adopt the US price index for ICT investment goods as the relevant import and investment deflator for their national accounts. It was judged that the possible error introduced by using the US index was probably smaller than the possible error associated with using a unit value or other price index without adequate quality adjustment. Such a choice is also motivated by the fact that computers constitute a standardised commodity that is traded internationally under competitive conditions.

[4] For a much more complete description and discussion see Triplett, Jack(2004); "Handbook on Hedonic Indexes and Quality Adjustment in Price Indexes: Special Application to Information Technology Products"; *STI Working Papers 2004/9*.

[5] See Schreyer, Paul (2002); "Computer Price Indices and International Growth and Productivity Comparisons"; *Review of Income and Wealth* series 48, March.

The second advantage is that index formula could be diversely selected from the unit value indices rather than price indices due to the easy access to the weights of commodities in the population data. For example, chain indices can be easily adopted more easily in unit value indices. On the contrary, in the XMPI, to change the weight regularly requires burdens of work force and time to the statistical agency.

Most countries are compiling the unit value indices rather than price indices for external transactions. As of September 2004, 43 countries publish explicitly export unit value indices and 36 countries do import unit value indices while only 14 countries make the XMPI.[6] Among them, five countries [7] are counted twice because these countries are compiling both indices.

Number of countries compiling price indices for external transactions

	Unit value indices		Price indices	
	Export	Import	Export	Import
Number of countries	43	36	14	14

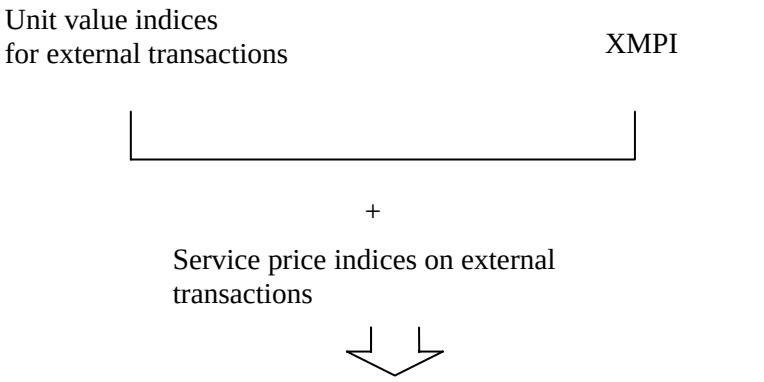
Source: IMF, International Financial Statistics

Deflators for external trades

As deflators for external trades in SNA, which indices are most desirable? Several criteria should be met in the context of compiling national accounts statistics such as the availability of quality-adjustment and the wider coverage of commodities. In this point of view, an alternative method is required which adopts advantages of both the indices. This method is to use unit value indices basically and insert the price indices of products which have rapid quality changes and need further price surveys into the unit value indices. For example, price indices on electronics and semiconductors can be made separately and be applied to unit value indices. Ships and aircrafts are rarely traded and the amounts of one shot trade are so big that it might be needed to search for the price data separately. It may be made as tailor-made indices by national accountants adopting the advantage of both indices.

[6] This figure does not include the countries who compile the XMPI as a component of PPI.
[7] Finland, Greece, Japan, Korea and Philippine.

At the same time, price indices on the service trade with foreign countries have to be added such as shipping and insurance costs of international trades to make an overall deflator for external transactions in national income statistics.



Some further study for external transactions deflator

It is still difficult to survey price data of commodities which are changing rapidly in quality such as semiconductor and electronics etc. In some case, the price data are confidential information in the competitive market situation. Therefore, to acquire the price information from the companies is almost impossible. Another problem is that the coverage of one representative commodity to be surveyed is sometimes quite broad, and within one commodity, there are so many kinds of items which have different qualities with small quantities. The practical solution for this problem is to adopt the chain indices to reduce the impact of quality change on commodity prices. In this context, unit value indices are more advantageous than XMPI in the availability of easy access to the population data.

There is one more area for price indices which has to be explored and studied further. It is the price index applied as a deflator for the service trade with other countries. In case of service import such as travel and transport, it is not easy to obtain the price data because the price change depends on those from abroad where the services are consumed. It means that the coverage of the price collection is extended to foreign countries. In case of travel service import, appropriate price indices of the countries where the travellers go should be collected in proportion to frequencies of their visit. It needs more expenditure survey on travellers and statistical data on tourism.