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IMPLEMENTING QUANTITY AND UNIT VALUE INDICES IN THE OECD INTERNATIONAL TRADE IN COMMODITY STATISTICS DATABASE (ITCS)

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IMPLEMENTING QUANTITY AND UNIT VALUE INDICES IN THE OECD INTERNATIONAL TRADE IN COMMODITY STATISTICS DATABASE (ITCS)

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Introduction

1. At the OECD Working Party on Trade in Goods and Services (WPTGS) meeting in October 2006, some preliminary ideas[1] were developed for calculating price and quantity indices on annual trade data as contained in the OECD International Trade in Commodity Statistics database (ITCS). The calculation of such indices is useful in the analysis of inflation transmission, terms of trade effects, and to deflate import and export value series to derive volume series or conversely, to derive the price index from the calculated quantity index. Laspeyres, Paasche and Fisher quantity[2] indices were calculated for a selection of annual merchandise import series (customs based) from Switzerland as quantity information of good quality is available for that country. Following this first test, the treatment of outliers as well as the change in the composition and quality of the products were seen as the most challenging issues. The experiment was not extended to other products, countries and partners at that time, also because the overall quality, especially of the quantity information was unsatisfactory.

2. In its Programme of Work and Budget 2011-2012, the OECDs Statistics Directorate has included this issue again. The main reasons are given below.

3. The main drivers for taking up again the issue of import and exports quantity and unit value indices are the following:

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1 Sarah Miet, Andreas Lindner, *Developing quantity indices for imports and exports-progress report on a new OECD project*, STD/NAES/TASS/ITS(2006)22.

2 A volume index is an average of the proportionate changes in the quantities of a specified set of goods or services between two periods of time. The quantities compared over time must be those of homogeneous items and the resulting quantity changes for different goods and services must be weighted by their economic importance, as measured by their relative values in one or other, or both periods. For this reason volume is a more correct and appropriate term than quantity in order to emphasize that quantities must be adjusted to reflect change in quality. SNA 2008 (par 15.13) However, in the field of foreign trade statistics indices based on customs documentation are not volume indices when the number, or weights, cover different items selling at different prices. They are sometimes called 'quantity indices for this reason" (SNA 2008, par 15,14)

- First, there is from 2005 onwards an increased availability of quantities which are derived from Standard Unit values calculated by UNSD.
- Second, the recent IMF publication *Export and Import price Index Manual* (*XMPIM*) details current best practices in the field and serves as the core source for the present note together with the Centre d'Études Prospectives et d'Informations Internationales (CEPII) work on calculation of Unit Values indices on UNSD Comtrade data[3].
- Third, the recent crises has made clear the need to better discriminate between variations in value series due to changes in quantities and the variation caused by change in unit values (prices).

4. The type of price index that will be referred to here is the unit value index[4]. The calculation of such indices is technically possible in international trade databases like the OECD ITCS and the UNSD Comtrade because both quantities and values are available. Indeed, the changes in the values of flows of goods can be directly split into two components; one reflecting changes in the unit values of the goods and the other one the changes in their quantities.

5. A main advantage of using unit value indices is their large coverage (countries, partners, products…) and relatively low compilation cost. Another reason for calculating unit value indices is the use of a comparable methodology as, across countries, unit value indices can be generated following quite a number of different aggregation methods.

6. It should be noted however that the IMF's *XMPIM* is clearly critical when it comes to the compilation of unit value indices based on customs data. Its recommendation would rather be for individual countries to make use of price data from establishment surveys. This is what the "most advanced" countries usually do. However a large number of OECD, including European countries[5], as well as international organisations like Eurostat[6], UNSD[7], IMF[8], but also CEPII[9], still calculate unit value indices in order to generate indices following a comparable methodology.

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3 Gaulier Guillaume, Martin Julien, Méjean Isabelle, Zignago Soledad, (2008) *International Trade Price Indices*, CEPII, Working paper. No 2008-10.

4 Unit value indices measure the change in the average value of units that are not necessarily homogeneous and may be affected by changes in the mix of items as well by changes in their prices (SNA 2008, par 15.14)

5 Including Belgium, Czech Republic, Germany, Denmark, Spain, Finland, UK, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Poland, Sweden.

6 Eurostat calculates elementary Unit value indexes at the most detailed (8digit) level of data (flow: imports and exports, reporter: each EU27 Member State, Partner: all detailed intra-and Extra-EU partner countries, Product: all CN8-codes).

7 UNSD compiles index numbers (unit value and volume indexes) for Manufactured goods exports and fuel imports

8 IMF, *International Financial Statistics (IFS)*. Data are the index numbers reported in the country tables expressed

7. At this first stage, quantity indices will be calculated directly for deflation of the value indices in order to obtain price indices. We could have privileged the computation of unit value indices for deflation of the value indices in order to obtain the quantity indices. In theory, when a complete set of data is used, both methodologies will yield identical results. However at the six digit level of the Harmonised System Classification (HS), as shown in figures 1 to 6 below, computing unit values indices (UVI) gives more unstable results than quantity indices. UVIs tend to make apparent large variations that could result from changes in commodity composition and changes in quality mix which might be less the case when direct quantity indices are computed. Quantity indices are however also affected by large variations due, for instance, to the irregular importation of some commodities, especially among groups composed of one or few commodities like, precious metals.[10]

8. In order to check to robustness of the methodology applied at this first stage, the unit value and quantity indices calculated at the total level will be compared with the export and import volume index and deflator compiled for national accounts and presented in the OECD annual national accounts database. [11]

9. The structure of the note is the following. First, in order to explain the need for compiling XMPIs in ITCS, their different possible uses, including their link to the GDP deflator are presented. Secondly, the methodology chosen by OECD and some main advantages of and concerns for using unit value indices, are presented. Third drawing on work done by the CEPII and the UNSD, some possible ways for dealing with missing values, outliers and other issues are presented. Fourth, examples with actual data are calculated. Finally, some preliminary conclusions and next steps are drawn and questions to WPTGS delegates are laid out.

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in U.S. dollars. The country indices are typically unit value data. However, for some countries, they are components of wholesale price indices or are derived from specific price quotations.

9 CEPII stands for Centre d'Études Prospectives et d'Informations Internationales, Gaulier Guillaume, Martin Julien, Méjean Isabelle, Zignago Soledad, (2008) *International Trade Price Indices*, CEPII, Working paper. No 2008-10.

10 Sarah Miet, Andreas Lindner, *Developing quantity indices for imports and exports-progress report on a new OECD project*, STD/NAES/TASS/ITS(2006)22, p.8.

11 In the OECD annual national accounts database the series code for the volume index (imports) is P71.VIXOB and the series code for the price index is P71.DOB.

1. Calculating unit values indices on OECD ITCS for what purpose?

10. Like other price indices in the system of price statistics, exports and imports price indices serve multiple purposes. As noted in the introduction of the present note and in the *XMPIM,* the calculation of such indices is useful in the analysis of inflation transmission from a resident's perspective, terms of trade effects, and to deflate import and export value series to derive volume series. (*XMPIM*, Paragraph 1.30).

A. Analysing inflation transmission from the resident's perspective

11. A monthly or quarterly XMPI with detailed commodity and industry data allows monitoring of price inflation for different types of commodities. MPIs facilitate the understanding of the transmission of inflation though different stages of the resident producer's production process and directly to final products purchased by resident households. At the annual level, compiling XMPIs allows to better monitor the evolution of trade flows (factoring down the value of goods into their quantity and unit value component), a statistical task which is particularly important in periods, like the current one, of major swing of these flows. Compiling unit value indices at the annual level is potentially less problematic than at infra-annual level as the annual series might be more stable.

B. Analysing Terms of Trade

12. Measures of changes in the term of trade of a country, determined by the ratio of the XPI to the MPI are used in the determination of changes in the real income of residents[12] "A country's terms of trade is a critical variable in many open macroeconomic models. Terms-of trade are an important determinant of aggregate trade and their measure helps explaining global imbalances at the world level."(Gaulier et al, p.31)

C. Deflating nominal trade series for deriving volume estimates of GDP by the expenditure (and production) approaches

13. Exports and imports are defined by the 2008 SNA, from a non-resident or rest of the world perspective[13]: The trade data that are presented in SNA, are compiled on a FOB/FOB basis in line with Balance of payments data and thus slightly depart, on the import side from customs based data[14] that are provided CIF. As explained in the *XMPIM* (par 1.31), beyond their use as deflators, the national accounts framework for XMPIs provides insight into the interlinkages between different price measures. Through net exports, XMPIs directly affect the price index (deflator) of GDP by expenditure.

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12 Also the import subindex of the Producer Price Index (PPI) for intermediate consumption is an important component of the price index for imports from the resident's view.(MXMPI, p.345))

13 "Because the rest of the world is shown in this way, flows to the rest of the world (exports) are shown as a use by the rest of the world and flows from the rest of the world (imports) as resources" (SNA 2008, par. 26.3 p.483).

14 See paragraphs 14.88 and 14.90 of SNA 93. http://unstats.un.org/unsd/sna1993/tocLev8.asp?L1=14&L2=4

14. The MPI also contributes to the price changes of intermediate consumption by establishment; the household consumption deflator; the government consumption deflator; the capital formation deflator; and through reexports and goods for processing, the XPI.

15. The XPI contributes to changes in the output PPI. As such, the detailed information in XMPIs allows compilers to show the contributions of XMPIs to changes in each index of the system of price statistics. Because the price index (deflator) for GDP by the production approach (value added=output-intermediate consumption) is a function of the output and intermediate consumption PPIs, XMPIs viewed in this way, contribute to changes in the price index (deflator), for not only GDP by expenditure but also GDP by production. (*XMPIM*, par 1.31)

16. The 2008 SNA equates, as outlined in chapter 15 of the *XMPIM*, the sum of the value of transaction for goods and services supplied by the economy by domestic production (output) and imports (including taxes less subsidies on products) with the sum used for intermediate consumption, final consumption, capital formation (including inventories), and exports, that is,

Supply:	=	***Uses:***
Output +		Intermediate consumption +
Import +		Final consumption +
Taxes less subsidies on products		Capital formation +
		Exports

17. For the identity to balance at the product group level, it is necessary to add **trade** (distribution) and **transport margins**[15] and taxes less subsidies as separate items to the basic supply prices on the left side supply to equate with uses at the price purchasers pay on the right. Such commodity balances are used by national accountants to validate data and, where necessary, to estimate missing values as residual.

15 As explained in par 4.45 of the XMPI Manual, Information on imports from customs declarations are valued c.i.f. (they include the cost of carriage, insurance and freight) at the point of entry into the importing economy. A c.i.f valuation based on customs declaration excludes the cost of transport from the border of the importing economy to the premises of the importer. Transport for this may be provided by either a resident or non-resident carrier. If a resident enterprise undertakes this element of the transport it will be excluded from the import value of the good, and the basic price plus taxes less subsidies should equal the purchasers' price.

Supply and use tables (SUTs) consist of set of such product balances covering all products in an economy organised in matrix form with product groups in rows[16].

2. Methodology, and main concerns when calculating unit value indices.

18. The *XMPIM* notes that although most statistical agencies have traditionally used the Laspeyres index[17] (*XMPIM*, p. xvii) as their target index when compiling export and import price indices, according to both economic and index number theory, a more appropriate target would be the Fisher, Walsh or Tornqvist-Theil indices, in their chained form. These "superlative" or "ideal" indices have a number of advantages in their chained form, principally, they take into account that when price changes are observed, substitution to cheaper products may occur (Gerschenkron effect)[18] and they can deal with margin effects (disappearance and appearance of new products). In short, a superlative index is expected to approximate the underlying economic index[19] . For the present paper, we do not aim at calculating an economic index but rather the classic basket indices. The following section makes a brief review of the classic Laspeyres and Paasche indices and presents how the Fischer index is derived from the combination of the two.

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16 The 2008 SNA (chapter 14) also advises that SUTs be developed in volume terms. It is good practice that deflators be applied at a detailed product group level. The deflation of the aggregates at the level of the product groups to provide SUTs in volume terms provides a framework for deflators to be applied in a manner that reconciles the volume estimates and, thus deflators for all transactions of goods and services supplied and used. This requires that for each product group, each output, intermediate consumption, final consumption, capital formation and import and exports be deflated, and because the left hand side should equal the right, in volume terms as well as current prices, the deflators, including the XMPIs, benefit from this reconciliation of the volume estimates. (XMPI Manual, par. 1.36)

17 It is worthwhile noting that in general, most national accounts systems use Laspeyres indices to calculate volumes and **Paasche indices to calculate prices,** (Understanding national accounts p.50). According to UNSD, also the majority of Statistical agencies are compiling price and unit value indices using a Paasche price. This seems to be in contradiction with the observation made in the XMPIM that most countries use the Laspeyres index for prices.

18 The Gerschenkron effect can arise with aggregation methods that use either a reference price structure or a reference volume structure to compare countries. For methods employing a reference price structure, a country's share of total GDP (that is the total for the group of countries being compared) will rise as the reference price structure becomes less characteristic of its own price structure. For methods employing a reference volume structure, a country's share of total GDP will fall as the reference volume structure becomes less characteristic of its own volume structure. The Gerschenkron effect arises because of the negative correlation between prices and volumes. In other words, expenditure patterns change in response to changes in relative prices because consumers switch their expenditure towards relatively cheap products. Eurostat, OECD, 2007, Eurostat-OECD Methodological Manual on Purchasing Power Parities, OECD, Paris – Annex VII, Glossary of terms and abbreviations.

19 MXMPI, Section 10.93.

2.1 The classic Laspeyres and Paasche indices.

19. The OECD sets out to calculate unit value and quantity indices of the chained Fischer type. This is also the method used by Eurostat for the "indice trend" domain of Comext[20] and by the CEPII for the *tradeprice* dataset associated to the BACI (the CEPII's database for international trade) database. However in the case of CEPII other "superlative" indices are also generated[21].

20. As stated above, the target indices are of a chained type, the **reference year** would then be revised each year. The 2008 indices have 2007 as reference year, the 2007 indices have 2006 as reference year etc. As the Harmonised System classification (HS) 1996 has been chosen for this first test, each index would then be expressed in term of 1996 as a **base year** (i.e 1996=100) by chaining all the links back and up to 1996[22].

21. The Laspeyres quantity index is an arithmetic mean of quantity changes for which the weighting system describes the structure of the reference period values. Laspeyres quantity indices compare the quantities of a basket of goods in year t valued at prices of the reference year (here t-1). The chained Laspeyres quantity index between year t and t-1, rewritten to make apparent the value share (or weighing system) and quantity ratio form, is then defined as

$$L_{t/t-1}(Q) = \frac{\sum P_{t-1} * Q_t}{\sum P_{t-1} * Q_{t-1}} = \sum \frac{P_{t-1} * Q_{t-1}}{\sum P_{t-1} * Q_{t-1}} * \frac{Q_t}{Q_{t-1}}$$

22. The Paasche quantity index is a harmonic mean of quantity changes with a weighting system that describes the structure of the values in the present period t.

$$P_{t/t-1}(Q) = \frac{\sum P_t * Q_t}{\sum P_t * Q_{t-1}} = 1/\sum \frac{P_t * Q_t}{\sum P_t * Q_t} * \frac{Q_{t-1}}{Q_t}$$

23. Laspeyres quantity index numbers are common in national accounts as "most national accounts systems use Laspeyres indices to calculate volumes and Paasche indices to calculate prices" [23]. It will therefore be useful to check the Laspeyres quantity indices generated by OECD against those presented in national accounts to test if lack of reported (quantity) data does not affect too much the robustness of the calculated indices. If Paasche price indices, have been calculated, Laspeyres quantity indices can also be generated as residuals using the fundamental relation between indices (or product test[24]) presented below (in their chained form):

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20 Eurostat, (2000), p.2.

21 CEPII also generates Tornqvist both in chained and fixed based form. Gaulier Guillaume, Martin Julien, Méjean Isabelle, Zignago Soledad, (2008), p. 14.

22 For the present very preliminary test, the base year used is 2001 (figures 11 to 15).

23 Lequilier, Blades, 2006, p. 50.

24 Frisch (1930, p.399) called this fundamental equation the "product test".

$$L_{t/t-1}(Q) * P_{t/t-1}(P) = \frac{\sum P_{t-1} * Q_t}{\sum P_{t-1} * Q_{t-1}} * \frac{\sum P_t * Q_t}{\sum P_{t-1} * Q_t} = \frac{\sum vt}{\sum vt-1}$$

24. The Laspeyres price index measures the price variation of the basket of goods consumed in the reference period while the Paasche index weights prices by current quantities. The Paasche index, which is an harmonic average of elementary indices weighted by the share of each product in the current traded value thus better captures changes in the structure of trade. (Gaulier et al, (2008) p.12)

$$L_{t/t-1}(P) = \frac{\sum P_t * Q_{t-1}}{\sum P_{t-1} * Q_{t-1}} = \sum \frac{P_{t-1} * Q_{t-1}}{\sum P_{t-1} * Q_{t-1}} * \frac{P_t}{P_{t-1}}$$

$$P_{t/t-1}(P) = \frac{\sum P_t * Q_t}{\sum P_{t-1} * Q_t} = 1/\sum \frac{P_t * Q_t}{\sum P_t * Q_t} * \frac{P_{t-1}}{P_t}$$

2.2 Deriving the superlative Fischer index from the combination of the Laspeyres and the Paasche.

25. As noted in the literature[25], over the longer term, constant base Laspeyres and Paasche indices drift apart. "The Laspeyres index, because it uses the weight matrix in the reference year, tends to overestimate real price evolution: when prices rise, consumers tend to substitute their consumption towards relatively cheaper goods (reducing thus the quantities consumed at the end of the period). Said otherwise, the Laspeyres index reflects a world without substitution effects and consequently overrates the true price growth. Conversely, the Paasche index tends to underestimate price evolutions by attributing a larger weight to products that have been increasingly consumed following a relative price drop. One can thus expect the Laspeyres price to exceed the Paasche." (Gaulier et al, (2008), p. 12). The existence of this also called "Gerschenkron" effect was observed empirically in the CEPII note (section 4.1.1).

26. This substitution bias is the strongest argument in favor in chained indices as, economically speaking, they bring closer the observed changes in behaviour, e.g. a rise in volume demand of a certain product and the relative price signals that influence this behavior. With constant reference year Laspeyres indices, the weight reference year and the quantity reference year can be far apart and so combine price weights with unrelated observations on quantities. (Paul Schreyer,(2004),p.7)

27. Computing a chained Fischer index, which is the geometric mean of the Laspeyres and Paasche indices, is a good way to approach the unobserved real unit value index (and the quantity index). It also to a certain extent deals with the Gerschenkron effect as the Fisher index allows substitution across goods

[25] Eurostat, (2000), p. 3 & CEPII, (2008) p. 12, Schreyer, (2004), p.7.

with a non-unitary elasticity[26]. (Gaulier et al, (2008), p.25). Fisher quantity and price indices are written as follows.

$$F_{t/t-1}(Q) = \sqrt{P_{t/t-1}(Q) * L_{t/t-1}(Q)}$$

$$F_{t/t-1}(P) = \sqrt{P_{t/t-1}(P) * L_{t/t-1}(P)}$$

28. Chapter 18 of the *XMPIM* revisits the Fisher index from a purely economic approach. An additional assumption is invoked, that outputs are homogeneously separable from other commodities in the production function: if the input quantities vary, the output quantities vary with them, so that the new output quantities are a uniform expansion of the old output quantities. It is shown that a homogeneous quadratic production or utility function is flexible and corresponds to the Fisher index. The Fisher output price index is therefore also superlative. This result does at least suggest that, in general, the Fisher index is likely to provide a close approximation to the underlying unknown theoretical XMPI and certainly a much closer approximation than either the Laspeyres or the Paasche indices can yield on their own. (*XMPIM*, par 1.231)

2.3 Some advantages and concerns with compiling unit values indices

29. As noted in the introduction, a main advantage of using unit value indices is their larger coverage (both in term of commodity detail and of declaring and partner countries) and relatively low resource cost. Another reason for calculating unit value indices is the use of a comparable methodology as, across national statistical agencies, unit value indices can be generated following quite a number of different aggregation methods. To highlight the diversity of methodologies used nationally, UNSD sent a questionnaire on national practice for compiling price indices in 1999. By December 2002, responses were received on compilation practices from a total of 76 countries and one customs union (European Union and Euro Area). Of these, 75 percent calculated unit value indices only, 17 percent calculated price indices only and 8 per cent both unit value and price indices. Also 30 countries generated unit value or price indices using a Paasche unit value or price index, 18 countries use a Laspeyres index, 21 used a Fischer index. (UNSD, 2005, p. 1&2.)

30. The *XMPIM* lists the errors and bias in the use of unit values that are used by many countries as surrogates for price changes at the elementary level of aggregation (*XMPIM* p. 4) and highlights advantages in compiling export and import price indices from establishment surveys. To use the terminology used by the CEPII, issues with calculating UVI arise principally when treating margin effects, dealing with substitution effects and in the elimination of outliers.

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[26] Gaulier et al calculate from 1995 to 2004, in the BACI data base not only simple Laspeyres and Paasche price indices but also geometric Laspeyres and Paasche indices. The geometric mean implying a unitary elasticity of substitution between goods which is probably a more sensible hypothesis than the absence of substitution implicitly assumed in simple Laspeyres and Paasche indices. (Gaulier et al, (2008), p.12)

31. The issue with margin effects[27] is that bias may arise from compositional changes in the quantities and quality mix of what is exported and imported[28]. The calculations of the price indices are especially affected by these margin effects. This is why, in this first stage, we will calculate quantity indices as a priority in order to check first results with the total imports of goods indices reported in the OECD annual national accounts data.

32. As stated above, the Gerschenkron effect, where expenditure patterns change in response to changes in relative prices because consumers switch their expenditure towards relatively cheap products, is dealt with by using the Fisher index in its chained form. The Fisher index implies simplified hypotheses of unitary substitution between goods. The chained form implies not using a price structure that become more and more remote from the current price structure as the reference year is the preceding year. It should be noted that compiling geometric forms of the classic Laspeyres and Paasche and ideal Fisher indices would better take into account of the interdependence between price and quantities by implying a non unitary substitution between products. These types of indices calculated by the CEPII are not calculated in the present paper but could be at a later stage.

33. A major problem that has to be dealt with is the issue with the detection of outliers. Unit value indices rely to a large extent on outlier detection and deletion which runs the risk of missing the large price catch ups when they take place and understating inflation.

34. Other issues raised by the *XMPIM* are that information on quantities in customs declarations, and the related matter of choice of units in which the quantities are measured, has been found in practice to be problematic. Another issue is that customs union countries can have limited or no intra-area trade data to use. Also, to a certain extent, as world trade in services represents a stable average of 20% of total trade over the last years, in a number of countries, an increasing proportion of trade is in services and by electronic commerce (e-commerce) and not subject to customs declaration. It should be noted that there is a sort of mismatch in the way customs information and national accounts information are registered. First, valuation requirements for the deflation of the aggregates of the 2008 SNA are determined for unit value indices by customs procedures at the time of crossing a frontier, which are not in line with the change in ownership principle of the 2008 SNA. Second, as noted above, on the import side, customs data are registered CIF and SNA data are FOB-based transactions.

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27 Margin effects neglect changes in the supply of traded varieties due to the appearance/disappearance of products between the reference and the current period, Gaulier Guillaume, Martin Julien, Méjean Isabelle, Zignago Soledad, (2008) *International Trade Price Indices*, CEPII, Working paper. No 2008-10, 13.

28 In the case of unique and complex goods, model pricing can be used in establishment-based surveys where the respondent is asked each period to price a commodity, for instance a machine with fixed specified characteristics. This possibility is not open to unit value indices. Also methods for appropriately dealing with quality change, temporarily missing values, and seasonal goods can be employed with establishment-based surveys to an extent that is not possible with unit value indices.

3. Calculating imports indices in practice: The data used and related issues (Handling missing values, outliers in unit value variations, different reporting thresholds etc)

3.1 The "raw" data used.

35. The data provided in the OECD International Trade by Commodity Statistics (ITCS) database are the raw data from which indices are calculated. As noted already (Miet, Lindner, (2006)), OECD and UNSD have been working together over the past years to agree on the best statistical treatment of all aspects relating to trade data and to align their respective data processing practice. As a result, both organisations have agreed and implemented a Joint Trade Data Collection and Processing System, which also means that in the database, country codes, commodity codes, conversion to older classifications and methods for estimating missing quantity units and net weights have been harmonised. The joint database provides (from 2005 onwards) all net weights in kilograms and quantities which are in line with standard unit values (see annex 1). For data covering earlier years, quantity units might change over time, which makes it very difficult (or even impossible) to compile quantity or price indices.

36. Harmonised System (HS) 96 data, at the most detailed level available for international comparisons (6-digit) are used. Indices are computed for 4-digit, 2-digit and total level. At this initial stage, indices are calculated on data presented in US dollars. However, at a later stage, data in national currency might be used to eliminate the exchange rate effect which might distort the calculation in particular of the price indices. It should be noted that Memorandum items (including confidential trade) are not included in the calculation of the indices as usually, there are no quantity information provided for these series.

3.2 Handling missing values, outliers in unit value variations, different reporting thresholds

37. As detailed in the previous OECD paper, cooperation with UNSD will be sought in order to deal with missing values and outliers.

38. For treating missing values and quantities an algorithm will need to be generated, most likely this will draw on standard unit values as defined by UNSD. The *XMPIM* also discusses treatment of missing price information and in particular the "carry-forward" method. (*XMPIM*, section 10.208.)

39. For outliers, the "deletion routine" retained by the CEPII[29] could be used as reference. As noted in the CEPII paper, a few outliers impact the accuracy, outliers being unusual price increase in the product specific distribution of unit value ratios. However, the XMPIM (par 2.70, 2.71), underlines that the problem with such deletion is twofold. First, is the implicit effect on the sample representativity and coverage. The second problem is the deletion removes "signal as opposed to noise". This problem seems to be aggravated with external trade statistics, compared to CPI compilation for instance, when price changes can become volatile as a result of exchange rate fluctuations. (Nakamura, 2008). Those deletion routines,

[29] The retained methodology is inspired from Hallak and Schott (2008). The idea is to keep product-specific empirical distribution across countries. Once medians have been computed, observations five time above or below the product specific median are deleted. (Gaulier et al, 2008, p.19)

should ideally (but this is unfortunately not realistic) be used to identify unusual price changes, and should then be followed up to ensure that they are not real changes.

40. Different reporting thresholds across national customs could be dealt with eliminating low value transactions (less than 10000 $?) and low quantity information (less than two tons?) as done in the BACI.

41. There is also the possibility to calculate means amongst similar countries and compare the results. For instance, one could assume that German exports to OECD countries represent high-quality products packages while those to Africa are a basic version of those products. This would entail analysis of bilateral flows and comparing the values obtained for the different market segments might allow developing a better proxy for quality. Miet, Lindner (2006), p.11.

42. The coverage of the cleaned database would have to be satisfactory (about 90% of original value).

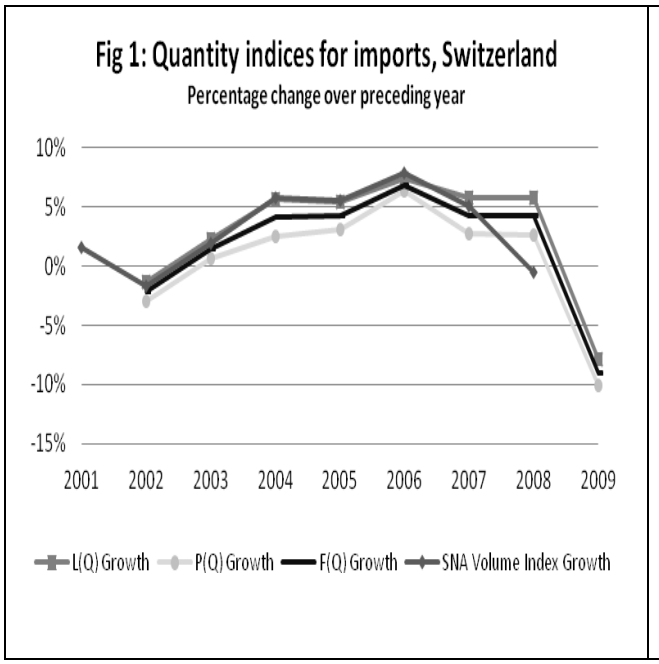
4. An example on actual data: comparing the results for six countries

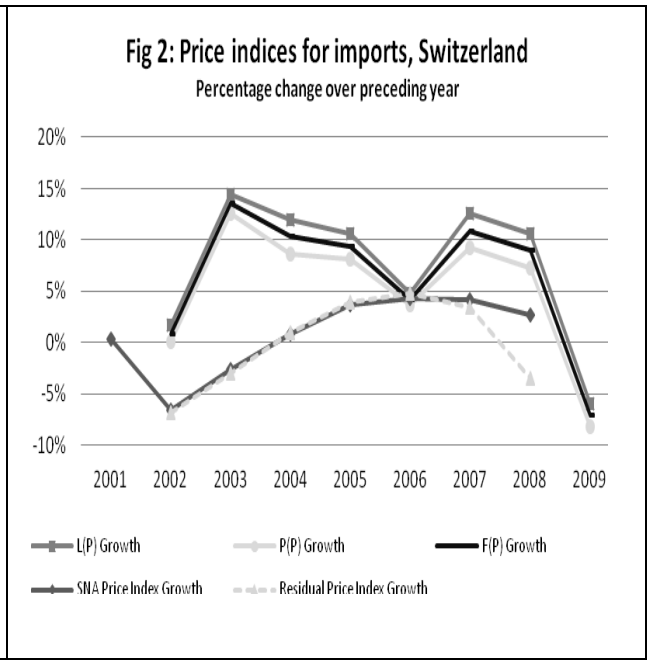
43. OECD has calculated chained Laspeyres, Paasche and Fisher price and quantity import indices for 6 countries at total level: Switzerland, Italy, Germany, France, Japan and Canada on HS 96 data for the period starting in 2000. These indices were calculated without any outliers deletion, nor estimations for missing values, on raw data extracted directly from the OECD International Trade by Commodity Statistics database (ITCS).

44. The year to year percentage change of the calculated import quantity and price indices are compared with the year to year percentage change of import volume (P.71.VIXOB) and price (P.71.DOB) indices available in the OECD annual national accounts database.

45. This comparison shows that quantity indices, as calculated by OECD and downloaded from national accounts, give closer results than price indices for Switzerland, Italy, and Germany (figures 1 to 6). As noted earlier in the paper, price indices might be more sensitive to changes in quality and composition of commodity groups, this might explain that, without any outlier/missing data treatment, quantity indices can appear less volatile.

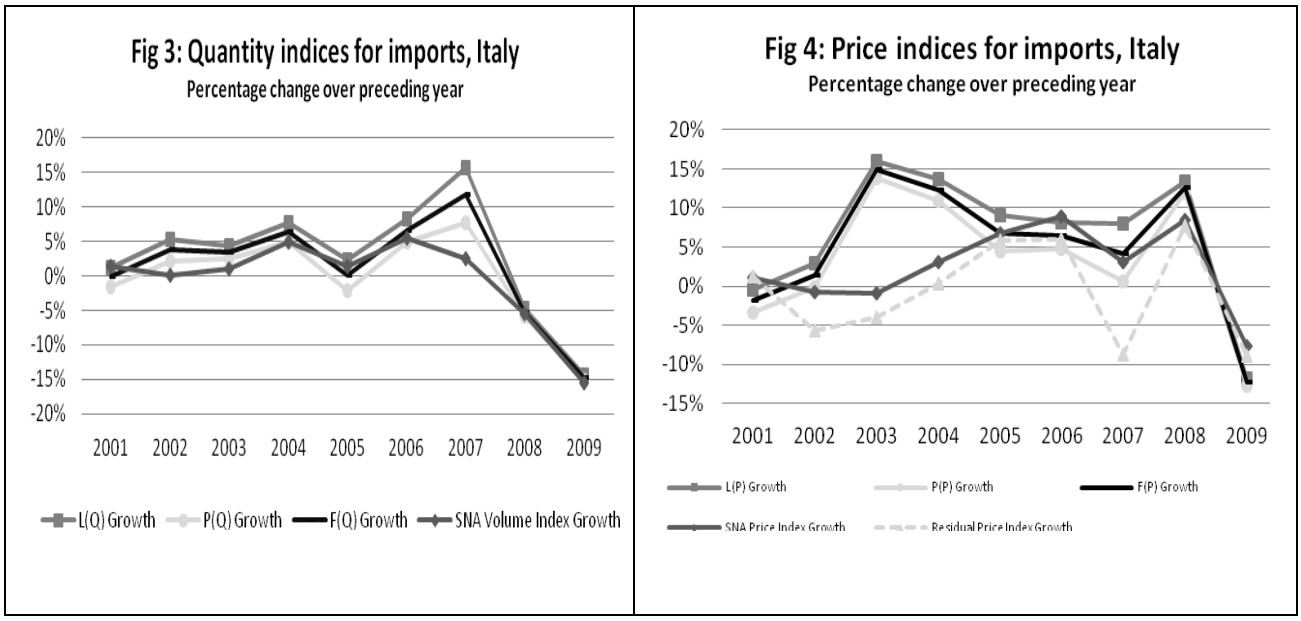
Switzerland chained Quantity and Price Indices





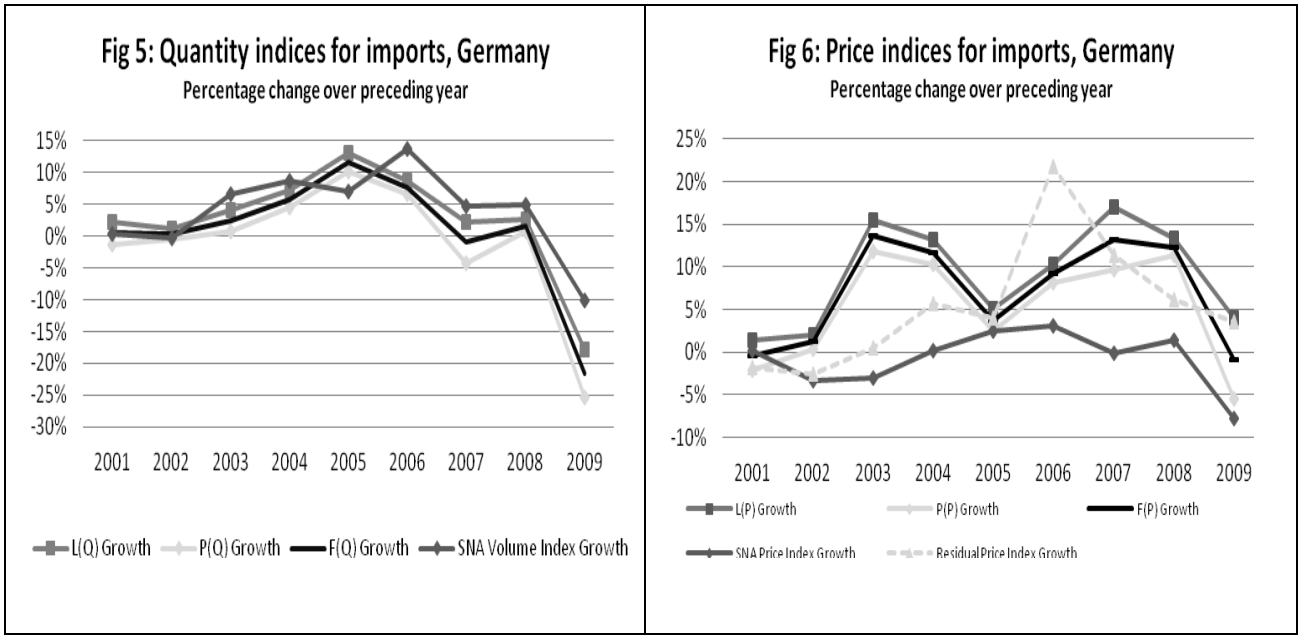
46. In National Accounts, the formula used for volume index calculation is usually a Laspeyres. This seems to be confirmed in Swiss data where the year to year growth rate of the calculated Laspeyres for volume match with the year to year growth rate of the National Accounts volume index (figure 1). On the other hand, (figure 2), the price index directly calculated by OECD differs from the national accounts price index (illustrating changes in the quality mix of the traded goods ?) whereas the calculated residual price index (obtained by deflating the value index series by the quantity index series) corresponds, up to 2007, to the national accounts deflator. This verifies in practice and in relation with actual national accounts figures, that the product of a Laspeyres volume index and the corresponding Paasche price index is equal to the change in the value, at current prices, of the trade series between period 0 and t.

Italy chained Quantity and Price Indices



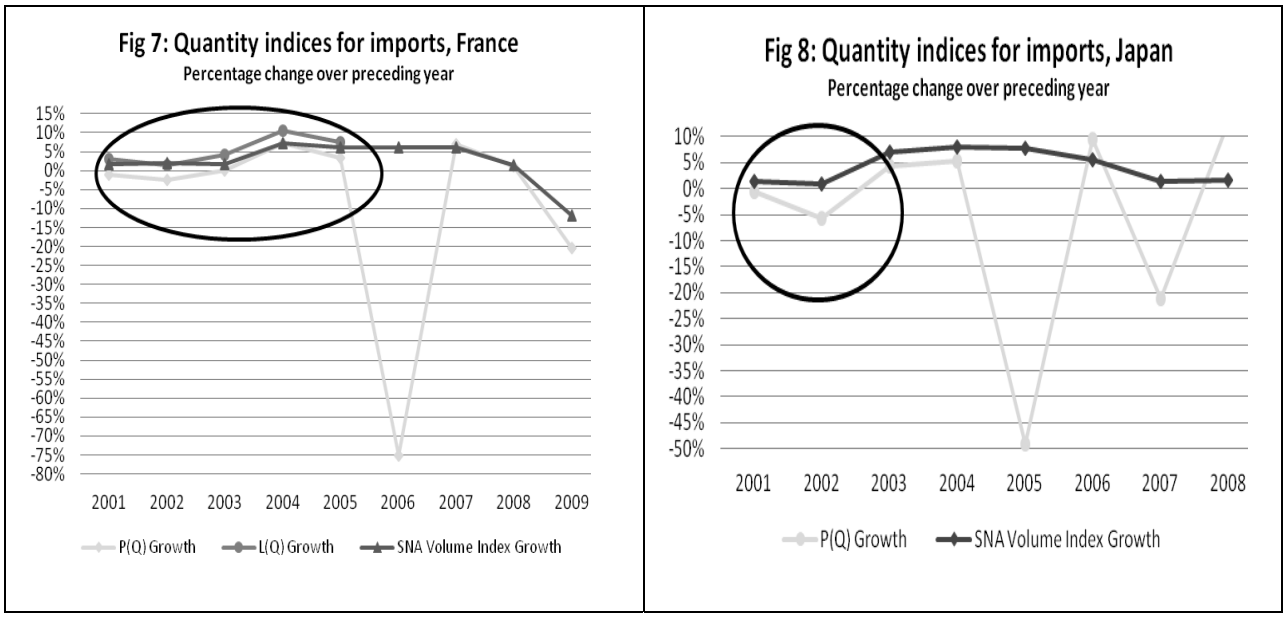
47. For Italy (figures 3 and 4), the calculated import quantity indices and national accounts volume indices match fairly until 2006 and then drift apart. The calculated residual index show broadly the same patterns (however amplified) as the national accounts deflator. Calculated price indices are affected by large variations which should be further investigated by looking at more disaggregated data.

Germany chained Quantity and Price Indices

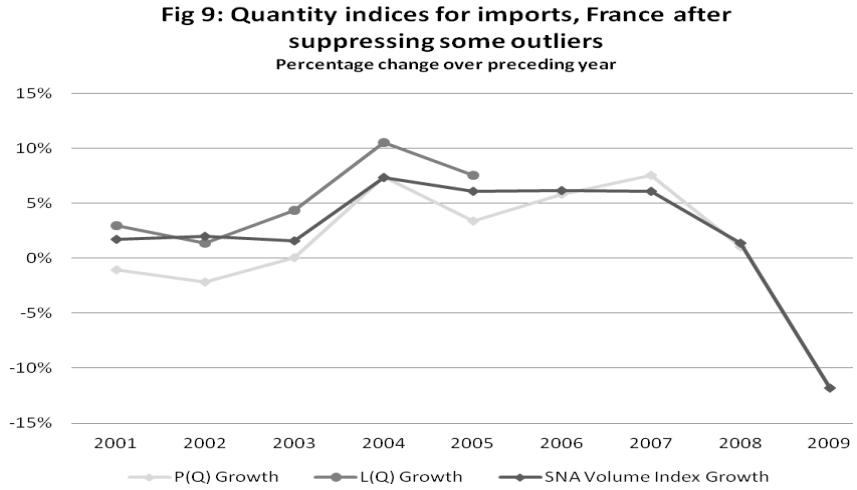


48. For Germany (figures 5 and 6), OECD calculated quantity indices and national accounts volume indices poorly match. The OECD calculated residual import price index calculated by the OECD doesn't correspond to the national accounts deflator. Here also the calculated import price index presents large variations that underscore the need for more work on the quality of the raw data.

France and Japan chained Quantity Indices

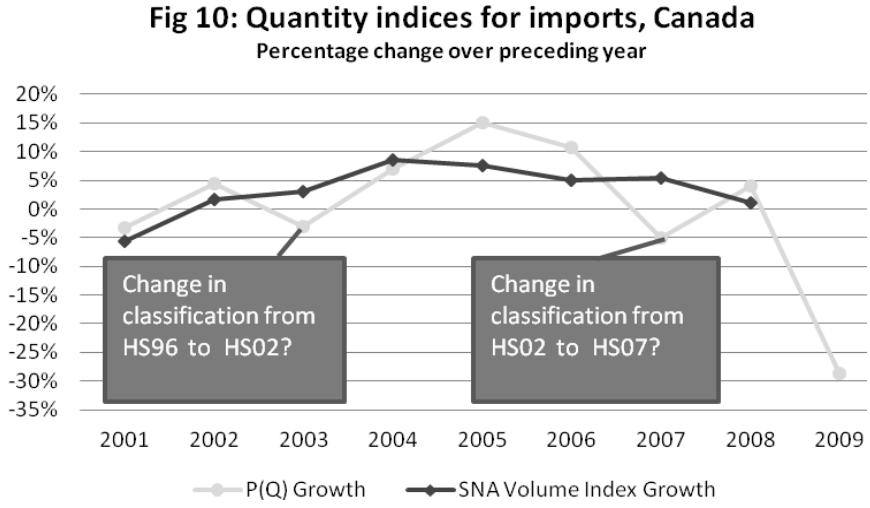


49. Looking at quantity indices calculated for France (figure 7) and Japan (figure 8), data highlighted in the blue circle seem to correspond broadly to SNA volume indices (figures 7, 8). The series are then affected either by missing values or outliers and consequently show large variations that obviously have been dealt with in national accounts index series.



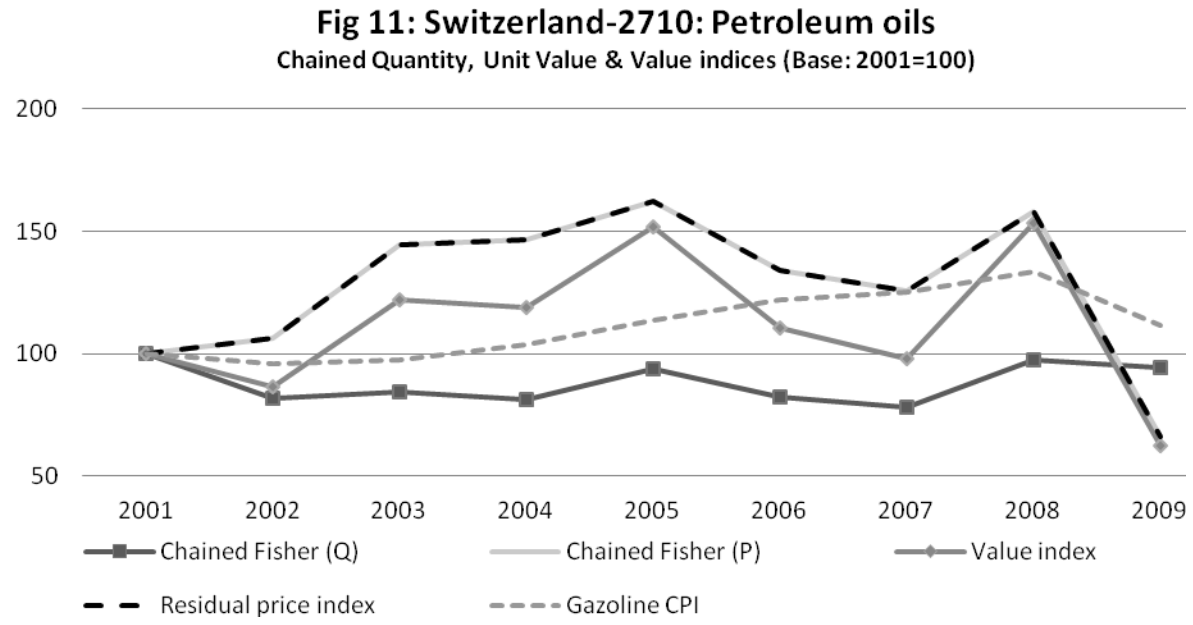
50. In the case of France, quantity indices seem more consistent with SNA series (Figure 9) after removal of commodities that present the largest variations of unit values (unit values that are multiplied by more than 150 from one year to another).

Canada chained Quantity Indices

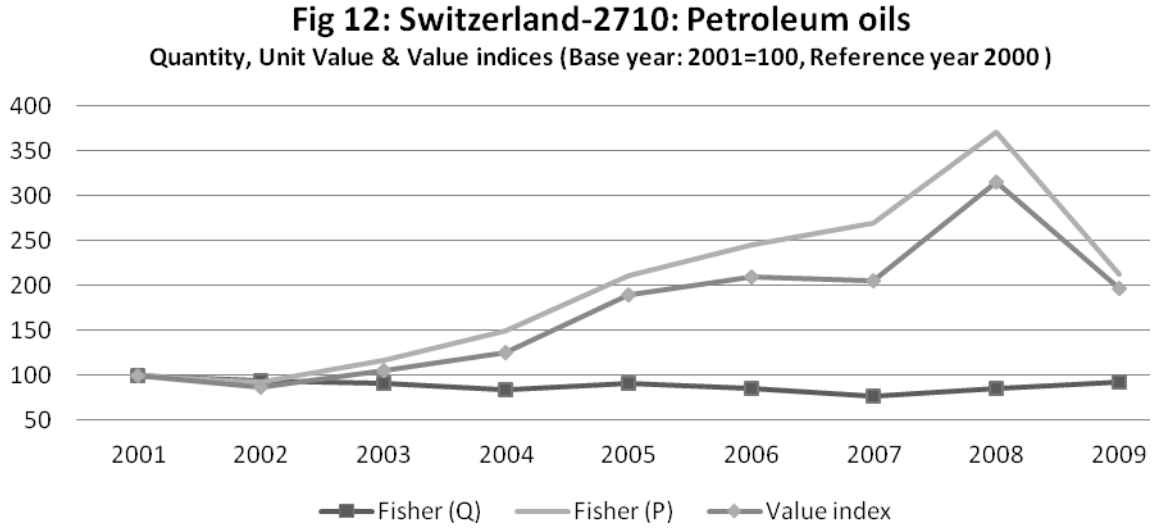


51. Calculated quantity indices for Canada seem to be affected by changes in classifications in the index series (figure 10).

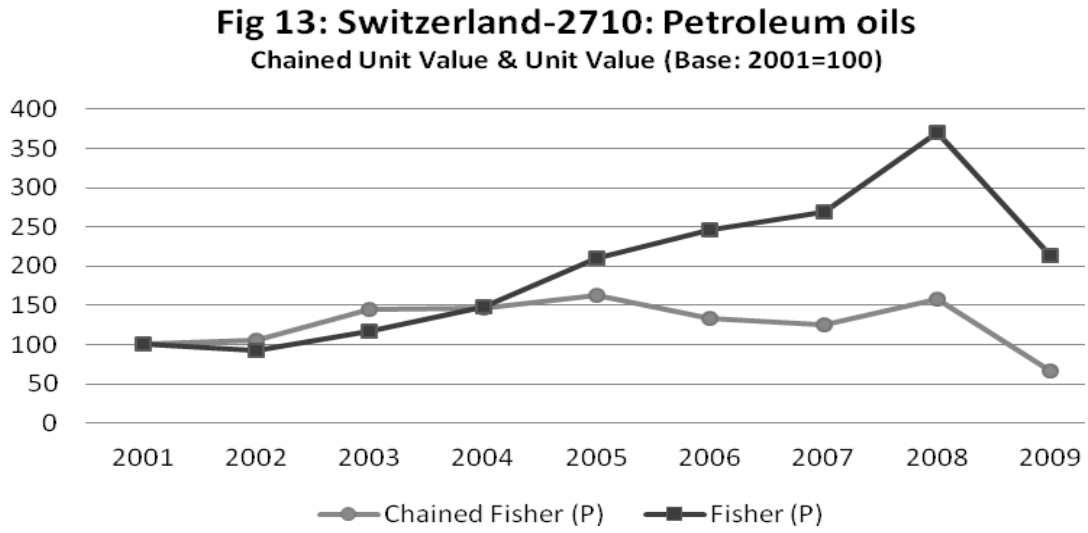
52. The following five figures look at the value indices, at the 4-digit level, factored down to their quantity and unit value components. The “petroleum” example highlights that movements in the import value series for Switzerland are dependent on the variations of the unit value index. The “live poultry” example shows that Swiss import values are correlated with the quantity index.



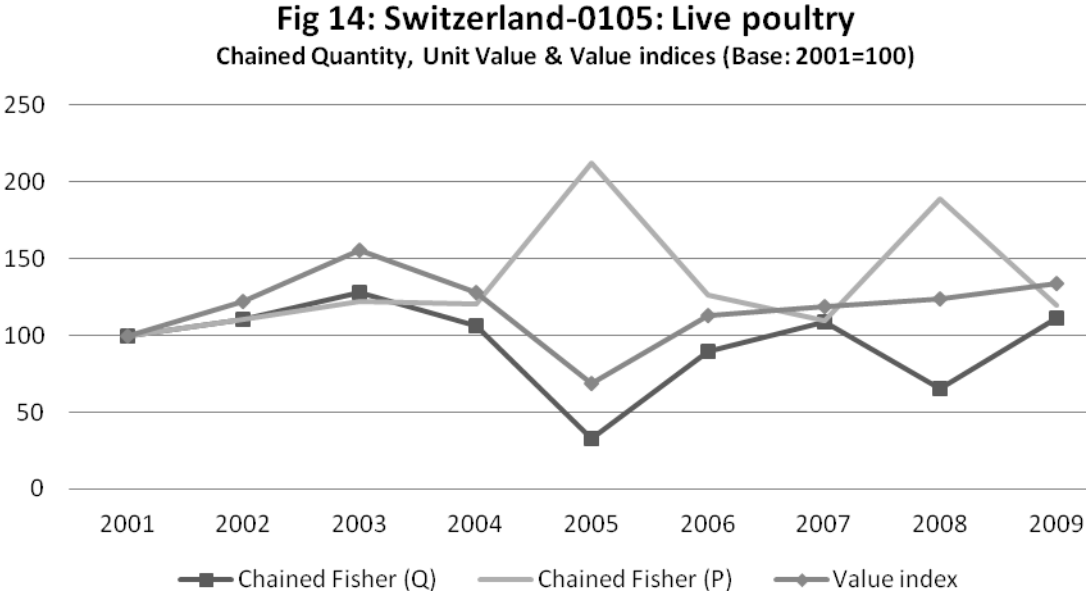
53. The Petroleum 4-digit heading (2710) is composed by only one subheading (271000: Petroleum oils & oils obtained from bituminous minerals, o/than crude), this implies that Laspeyres, Paasche and Fisher indices collapse into a single number. Figure 11 shows the correlation between the value and the price changes, the quantity index remaining relatively plane. The Swiss Consumer Price index referring to Gasoline is shown here to give a sense of price changes at national level. The CPI and unit value index do not match except for the peak in 2008.



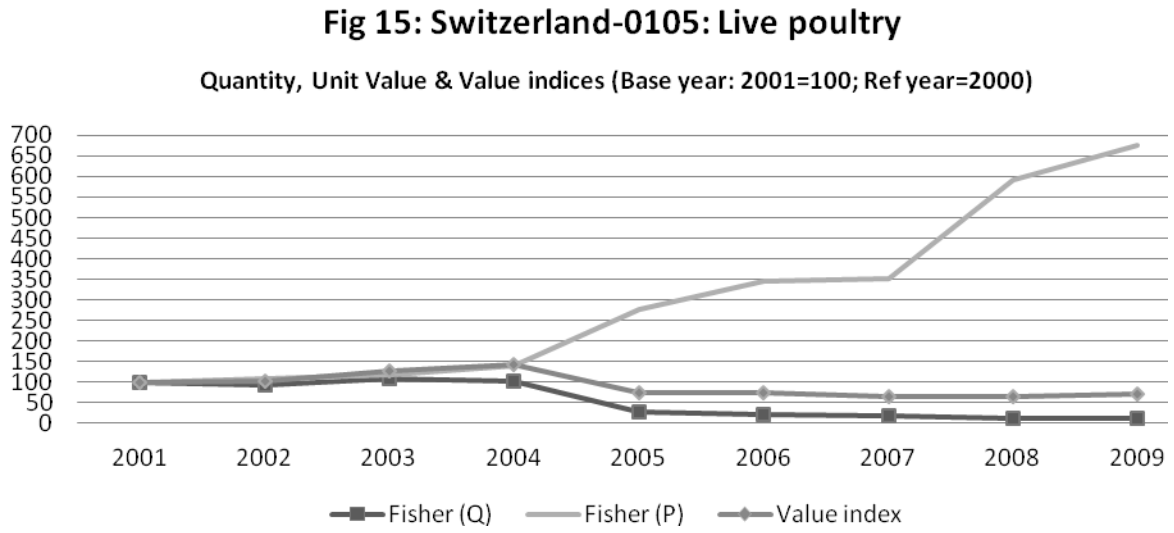
54. The correlation between the unit value index and the value index is even more striking by looking at series indices at constant prices (here with reference year 2000). For petroleum oils, changes in unit values (prices) seem to be the driver for changes in petroleum import values.



55. Indeed, the **chained** Fisher unit value index presents less variation as it relates to a recent structure of prices (reference year=preceding year) whereas the **constant** Fisher refers to a structure of price further in the past (*i.e.* reference year is 2000) that can lead to measurement distortions but give in case on homogeneous and goods of constant quality a more striking picture of the evolutions.



56. Figure 14 shows the correlation, for the commodity group "Live poultry", between the value and the quantity changes, while the price index is moving almost symmetrically in the opposite direction.



57. Figure 15 presenting indices at constant prices highlights even more clearly the correlation, between value and Fisher quantity indices while the unit values follows a totally different path. For Live poultry, changes in quantities seem to be driving the changes in poultry import values.

5. Next steps.

58. The goal is to have UVI and volume indices for most ITCS countries in 2 years time; consequently we plan in a first stage, to extend this test calculation (on trade data following HS with partner world) to all currently 33 OECD countries by end of this year. Cooperation will be sought with IT colleagues to build a private XMP dataset on OECD.stat.

59. We then plan by July next year, a) to identify outliers (either misreported or "real" but unusual values) and in a second stage b) to estimate missing values either by carrying forward both values and quantities of previous year or by applying more elaborated estimation methods. On both matters consultations with UNSD and CEPII are envisaged as these institutions have done a lot of work in the area.

60. End of 2011, the calculation of exports and imports indices will be extended to all partner countries. At a later stage, the presentation of the price indices following classifications other than HS will be explored as OECD colleagues have raised interest of calculating trade indices following for instance ISIC, SITC and BEC.

61. An interim report will be presented at the next 2011 WPTGS. It is planned to give access to delegates to online exports and imports unit value and volume indices matrix during summer 2012 for comments at the 2012 WPTGS.

6. Questions to WPTGS delegates

- Do member countries calculate Unit Values Indices, or trade import and export indices collected though surveys?

- Possible breaks in HS classification are seen as a main issue in calculating unit values indices. How are countries actually dealing with this?
- Do you identify “representative commodities”?
- Do you include low value transactions? If so, what is the threshold used?
- Or do you basically focus on high value transactions?
- What is the best method to eliminate outliers, still discriminating between signals and noise?
- Any suggestions for other classifications from which to calculate UVIs and Volume indices?

ANNEX 1. UNSD STANDARD UNIT VALUE METHODOLOGY.

The United Nations Statistical Division has set up a method to estimate missing quantity data when these are not reported by countries. Estimation is achieved by applying Standard Unit Values (SUVs) to the dollar values of import or export flows. An SUV is defined as the median of the sample derived from all the records sent by all available reporters to all partners (except the whole world) in a year, after several transformations and a process to exclude outliers from the set of unit value observations.

SUVs are estimated only if the sample of unit values on which it is based fulfills the following reliability criteria (UNSD 2006; *Unit Value: Report by Commodity*)

-- The data must come from at least two reporting countries/regions;

-- There must be at least 50 observations in the sample;

-- The relative standard deviation must be less than or equal to one, or it must be between one and two provided that its multimodality index is less than two;

-- The relative interquartile range must be less than two;

-- The trade value corresponding to outliers must be less than 50% of the total trade value.

A descriptive analysis of the unit value data carried out by UNSD showed that:

-- Unit value data for most commodities exhibit high degree of variability.

-- The distribution of unit values is usually asymmetric around its mean (skewness is usually positive).

-- The data is affected by the presence of outliers.

-- A log-transformation of the unit value data significantly reduces asymmetry, and therefore is more appropriate to construct confidence intervals and rejection thresholds for outliers. Using this criterion, about 4.7% of the observations in the unit value samples were diagnosed as outliers and disregarded from further calculations to obtain Standard Unit Values.

SUVs will be available in the ITCS database starting with the reporting year 2005.

Further information about the computation of SUVs can be found in UNSD (2006); *Unit Value: Report by Commodity*.

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