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

Handling missing values, outliers in unit value variations, representativity of the indices, data conversion across classifications.

7-9 November 2011, OECD Headquarters, Paris

This paper is for discussion and is the follow up to the work presented by OECD at the WPTGS 2010 (STD/TBS/WPTGS(2010)12) on ITCS: Stocktaking of scope to develop volume indices, UVI. It has been prepared by Blandine Serve and Bettina Wistrom

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**IMPLEMENTING UNIT VALUE INDICES IN THE ANNUAL OECD INTERNATIONAL
TRADE IN COMMODITY STATISTICS (ITCS) DATABASE.**

**HANDLING MISSING VALUES, OUTLIERS IN UNIT VALUE VARIATIONS,
REPRESENTATIVITY OF THE INDICES, DATA CONVERSION ACROSS CLASSIFICATIONS**

STD Statistics Directorate

Blandine Serve, Bettina Wistrom

1. Introduction

1. At the 2010 meeting of the Working Party on Trade in Goods and Services (WPTGS), a preliminary study on the development of Unit Value Indices on OECD International Trade by Commodity Statistics (ITCS) database was presented. The objective of this project which is part of the 2011-12 Program of Work is to implement Unit Value Indexes (UVIs) for most OECD ITCS countries by the end of 2012. Methodologies for identifying outliers and possibly estimating missing values were scheduled for exploration by mid 2011 and the document at hand presents the relevant findings.

2. The main purpose of this work is the construction of UVIs and quantity indices of exports and imports. Although UVIs are only proxies for export and import price indices and the corresponding quantity indices are only proxies for volume measures, they are available at considerable level of product detail and in a timely manner. Many analytical questions can be addressed with UVI and quantity indices – they include the analysis of terms of trade, price and non-price competitiveness in exports and imports and the transmission of inflation via foreign trade.

3. This report describes the issues met so far when dealing with missing values and identifying outliers on annual merchandise trade values and quantities. The work takes into account methodologies used by other international organisations, in particular Eurostat and the UNSD, other institutions like the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) and work by Switzerland, Italy and Mexico.

4. A short survey on “Which OECD country is compiling UVI”¹ was performed in the context of the last WPTGS. It highlighted the need for some methodological work to be done as some countries were envisaging starting producing UVIs or improving their methodology in the near future. This is also a recommendation of the new IMTS².

¹ A compilation of answers was made please refer to annex I

² IMTS 2010 is downloadable at <http://unstats.un.org/unsd/trade/EG-IMTS/IMTS%202010%20-%20as%20submitted%20to%20editor.pdf> chapter 10 section A

5. The structure of the paper is the following; first the raw trade data under consideration are described. Then the choice of the denominator for compiling a Unit Value (quantity or net weight) is discussed. Problems related to classification changes are highlighted in a third section. The Paasche, Laspeyres and Fisher formula used to generate indexes are described afterwards. Different methodologies tested to deal with missing values (as far as possible) and Outlier detection are then presented. Concerns are raised about first results on two digit level indexes. To conclude some comparisons with price and volume indices extracted from other frameworks (Annual National Accounts) and organizations (CEPII and Eurostat) are carried out.

A) Data selection, and Limits

6. The database used to compile Unit Values Indices is the OECD ITCS database. The International Trade by Commodity Statistics database (ITCS) provides detailed annual export and import data for each OECD member country by commodity (following SITC, HS, ISIC revision 3 classifications) and by partner country in terms of value and quantity. This database is part of the UNSD/OECD joint process database. This section covers choices taken by the OECD secretariat, and “limits” encountered to work on coherent series.

A.1 Valuation and scope

7. Goods are internationally traded under different valuations. The OECD secretariat kept the CIF valuation (cost insurance freight) for imports and FOB valuation (Free on Board) for exports as this is how customs data are reported in ITCS. Others institutions have proceeded differently, for instance, CEPII estimates transport cost in order to obtain a FOB-FOB valuation bilateral trade.

8. In the future, OECD might also calculate indices based on import FOB values as this supplementary field is requested in the IMTS 2010.³

9. At this stage of the project, indexes are compiled for all OECD member countries at a partner world level. This choice was made to avoid small transactions that could create more breaks in series and more outliers.

10. The IMTS recommends the use of the general trade system, and the record of origin/ last known destination. However some countries report with the special system and disseminate data by country of consignment. ITCS exports and imports contain respectively re-exports and re-imports flows. No correction is made by the OECD.

A.2 Representativity of commodities

11. The HS1988 classification holds about 5000 products on a period going from 1988 to the latest year. Using commodity series from this classification implies issues of changing composition and breaks in series for each new version of the HS classification.

12. The note spelling out the Mexican methodology⁴ explains that chapters 98 and 99 were omitted from calculations as these chapters are used by customs authorities to register special trade movements which cannot be identified or classified elsewhere. It corresponds to less than 4% of total imports and less than 1% exports. Confidential trade and small transactions that do include less than 10 operations a month

³ IMTS rev 2010 : <http://unstats.un.org/unsd/trade/EG-IMTS/IMTS%202010%20-%20as%20submitted%20to%20editor.pdf>

⁴ Zetina (2011) Mexican Export and Import Unit Values Indices Methodological notes, banco de Mexico

are also excluded. The OECD has not taken into account these confidential, special trade and not allocated elsewhere chapters either. The whole chapter 99 corresponding to “confidential and not allocated trade” holds no quantity. Therefore, no Unit Value can be computed.

13. In order to increase the reliability of UVI, the Swiss methodology⁵ is splitting all HS codes in 2 groups:

- **Representative positions:** These cover HS codes that are considered as sufficiently stable. Their growth is likely to correspond to the actual price movement. UVI calculations are based on this group only. In October 2005, this group included 69% of the HS codes that correspond to 93% of trade import values. For exports, only 49% of HS codes were used for 92% of export values.
- **Non representative positions:** Unit Values calculated on those codes show exaggerated fluctuations without real meaning in terms of price evolution. It could also be positions with a very low level of merchandises traffic. In October 2005, non representative positions corresponded to 31% of positions at imports for 7% of imports values. On the export side, 51% of HS codes for 8% of export values.

14. Switzerland also conducts once a year, a discriminant analysis to assess the degree of representativity for each HS code using indicators like coefficients of variation (before and after correcting for extremes values), or the numbers of period without data. Furthermore, precious metal, gems, artwork and antiquity trade which are by definition random and unstable, are excluded from the universe of representative positions.

15. UNSD is also preparing UVIs, but only at for manufactured goods export, fuel import and total imports and exports indexes.⁶

16. For the time being, the OECD secretariat is making computations on all 6 digits level commodities (the most detailed level available in ITCS), of the HS1988 classification, in order to generate indices at the total level. Indices will be generated at a more disaggregated level (2 and 4 digits levels) at a later stage. Currently, no selection of pertinent basket of goods is performed, nor any deletion of specific products with high level of volatility (as ICT goods, components of aircrafts, petroleum...) is effected.

B) Dealing with the quantity dimension

17. Heterogeneity of quantity information is one of the main issues when calculating UVI. The 13 standard quantity units as defined by WCO (See annex II) are not always applied to the same products across countries and are moreover often missing.

B.1 Net Weight versus Standard Quantity Unit

18. As both “net weights” and “Standard quantity units” (with 13 different codes) information are available in ITCS, which one should be used as the denominator to compile Unit Values?

19. UNSD estimated⁷ that over recent years, 75% of supplementary quantities provided (that are measures of quantities in the most accurate standard quantity units) are referring to weights in kilograms⁸.

⁵ Administration fédérale des douanes AFD section statistiques, 2006, indices du commerce extérieur suisse guide d'utilisateur available at <http://www.ezv.admin.ch/themen/00504/00505/00511/index.html?lang=fr>

⁶ UNSD, 2007, presentation at International Workshop on Country Practices in Compilation of International Merchandise Trade Statistics, 12-16 November 2007, Addis Ababa

In a 2000 document from Eurostat⁹, evidence from indirect test on European data suggests that weight seems to have been measured more reliably than standard quantity units in the past. In order to check the availability of these dimensions for the year 2009, the OECD secretariat calculated the share of trade values for which information either on weights or in quantities is available. As it can be seen in the table 1 below, in most cases, weights in kilogram seem to be more widely available than the supplementary quantity.

Table 1: % of 2009 exports values of ITCS database that remain after removing empty quantity/ weight

Countries	After deletion of		Countries	After deletion of	
	empty qty	empty weight		empty qty	empty weight
Australia	89%	91%	Japan	72%	86%
Austria	88%	95%	Korea	74%	100%
Belgium	94%	97%	Luxembourg	94%	93%
Canada	87%	87%	Mexico	95%	94%
Chile	100%	100%	Netherlands	73%	79%
Czech Rep.	83%	98%	New Zealand	92%	97%
Denmark	89%	95%	Norway	96%	96%
Estonia	86%	89%	Poland	88%	98%
Finland	85%	98%	Portugal	87%	93%
France	92%	93%	Slovakia	89%	100%
Germany	76%	92%	Slovenia	93%	98%
Greece	96%	98%	Spain	94%	97%
Hungary	81%	93%	Sweden	87%	95%
Iceland	97%	99%	Switzerland	85%	98%
Ireland	90%	96%	Turkey	95%	96%
Israel	57%	47%	United Kingdom	79%	94%
Italy	88%	97%	USA	81%	77%

20. For calculating UVIs, Eurostat uses “Net mass” as quantity, except if supplementary units exist¹⁰. Supplementary Units are the standard quantity units for specific commodities on 8 digits of the combined nomenclature as defined by Eurostat. This means that supplementary units are harmonised and persistent for commodities that are most commonly traded. There is unfortunately no such persistence in the case of standard quantity units for OECD/UNSD countries in the joint process database. The unit of measurement may change between countries and over time which is distorting the calculations of UVIs.

21. In order to deal with the issue of the non persistence of a quantity code attached to a specific commodity, CEPII¹¹ converts quantities that are not reported in tons with implicit rate of conversion for those heterogeneous units.

⁷ UNSD, comtrade knowledge forum 2009 <http://comtrade.un.org/cf/forums/post/6.aspx>

⁸ UNSD, 2007, standard unit values , <http://unstats.un.org/unsd/tradekb/Attachment59.aspx>

⁹ Eurostat, (2000) Calculation of Unit Value Indices based on External Trade data (Trend Application) STD/NA/ITS (2000)18.

¹⁰ Eurostat, 2009, Training course on trade indices “Calculation of Unit Value Indices at Eurostat” made in Beirut, 14-16 December 2009 css.escwa.org.lb/sd/1153/3.ppt

¹¹ Gaulier , Zignago, (2008) BACI : A world Database of International Trade at the product level the 95-2004 version CEPII page 9

22. Given the observations made above and the wider availability of the dimension, the OECD chose to use “Net weight in kilograms” as the denominator to compile Unit Values.

B.2 Control, Estimation of missing weights and construction of the Standard Unit Values (SUV)

23. The UNSD has set up a methodology to check the coherence of data, detect outliers for weight and quantity variables and to estimate missing quantity/weight. This checking system came into force in 2006 in the joint UN-OECD data processing system¹². Box 1 gives a description of the methodology in place¹³.

BOX 1: How net weight is processed (extract of UNSD, Quantity and Weight Data in UN document)

Step 1) to maximise the utility of the available information, when possible, missing net weight are sourced from supplementary unit reported in kg.

Step 2) If, within the same 6-digit commodity flow of a country, the trade value share of the data with properly reported net weight pass a certain threshold (20% for OECD countries), the value/ weight ratio of the properly reported data estimates the missing weight information.

Step 3) Otherwise, when no data has been provided or, up to 2009, when the net weight provided is considered ‘extreme’, a net weight estimation using Standard Unit Value is performed.

UNSD is calculating at the end of the year for each 6-digit commodity/year/flow a “standard unit value” that could be defined as median unit value (after elimination of outliers) of a sample of Unit Value of available data of the latest reporting year. The sample of unit values must have specific characteristics. Taking as reference the year 2006, those were:

- 1) The sample of unit values must come from more than 2 reporting countries
- 2) There must be at least 30 observations in the sample
- 3) The relative standard deviation must be less than or equal to 1.75 or
- 4) The relative standard deviation is between 1.75 and 3, provided that its multimodality index is less than 2.
- 5) The trade value corresponding to outliers must be less than 10% of the total trade value.

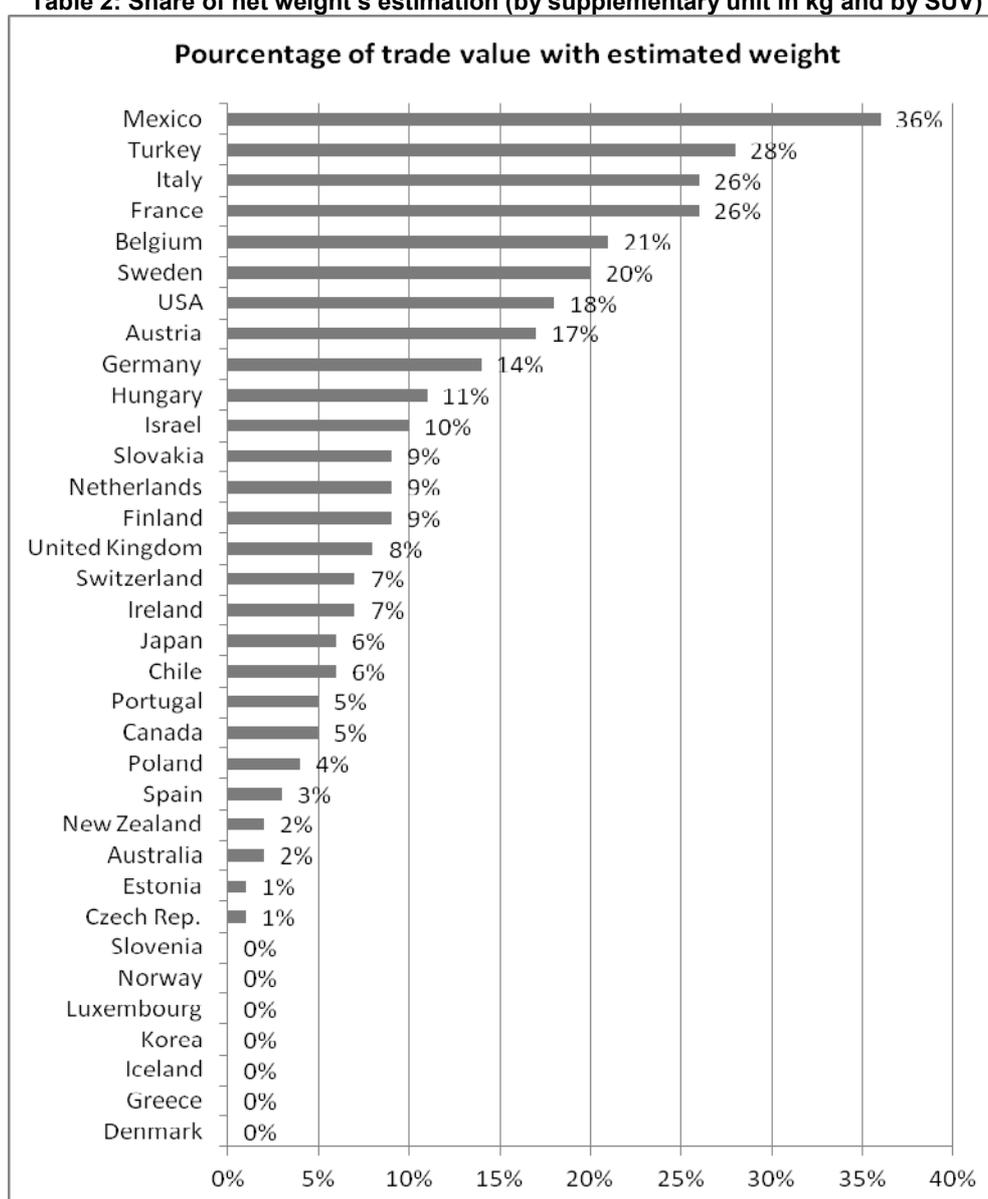
For a majority of commodities, the Unit Values calculated on the basis of value and weight data exhibit a high degree of variability. The distribution of UV series, (as most of economic variable) is asymmetric around its mean and right tailed. Applying a logarithmic transformation helps restoring symmetry in UV series. A study made by UNSD¹⁴ indicates that the symmetry is restored using log transformation for more than 50% cases.

¹² Please refer to UNSD, 2009, Quantity and Weight Data in UN comtrade <http://unstats.un.org/unsd/tradekb/Knowledgebase/Quantity-and-Weight-Data-in-UN-Comtrade?Keywords=suv> (item 8c) page 7 Ronald Jansen)

¹³ For more information on impact of quantity estimation, please refer to the note <http://unstats.un.org/unsd/trade/EG-IMTS/EG-IMTS%20197.8%20-%20UN%20Comtrade%20Quantity%20Report.pdf>

Table 2 below displays the share of trade value for which estimation on weights was performed. This means for example in the case of France that 26% of the quantities of its total trade were estimated by the Common OECD-UNSD processing system. It must be noted that if quantity information related to large value six digit commodity items is inadequately reported (*Components of aircrafts* could be an example), and all other quantities related to small values are very well reported, the indicator would still indicate a large share of estimated weights.¹⁴

Table 2: Share of net weight's estimation (by supplementary unit in kg and by SUV)



¹⁴

For more information please refer to UNSD, 2009, Quantity and Weight Data in UN comtrade <http://unstats.un.org/unsd/tradekb/Knowledgebase/Quantity-and-Weight-Data-in-UN-Comtrade?Keywords=suv>

C) Issue of Quality changes, specific focus on Conversion across classifications

24. When calculating unit values based on customs returns at the six digit level, the quality of the product can't be monitored as it is the case in price measurement based on establishment surveys¹⁵. So when referring to quality changes, in the present note, we will focus on conversion across classifications, as usually, revised classification aim at providing finer definitions of the commodities under consideration.

25. OECD aims at calculating quantity and unit value indices on long time series at total, 2 digit and 4 digit level based on six digit series (from 1988 to 2010). This means that these series will incorporate four different versions of HS (HS 88, HS 96, HS 2002 and HS 2007). Box 2 discusses some of these conversion issues.

¹⁵ Export and Import Price Index Manual, IMF, ILO, OECD, Eurostat, UNECE, WB, p. 165, Paragraph 8.7.

Box 2: Conversion Issues

Each change of the Harmonised System classification introduces correspondence issues. For instance HS1996 is more detailed at the six digit level than HS1988. So it is likely that several commodity codes in HS1996 could be bundled into only one HS1988 commodity code. This is the case of the commodity 020739 in HS1988. The same phenomenon will occur for other revisions of HS. As a consequence, HS1988 will end up being, in most cases, an aggregate version of the latter revisions. However some HS1988 series will not find a match in the revised versions, this is for instance the case of item 020750 in HS1988 which finds no correspondence in HS1996. Its content is then dispatched across other commodities.

Composition change on series at 6 digits level is likely to happen at each classification change. Those changes may, as a consequence, imply breaks in 6 digits series.

HS1996-HS1988 conversion: Extract of position 0207 Meat, edible offal of domestic poultry

HS1996	HS1996 label	HS1988	HS1988 labels
020713	020713: Cuts & edible offal of species Gallus domestics, fresh/chilled	020739	020739: Poultry cuts & offal, except livers, fresh or chilled
020726	020726: Cuts & edible offal of turkey, fresh/chilled	020739	020739: Poultry cuts & offal, except livers, fresh or chilled
020735	020735: Meat & edible meat offal of ducks/geese/guinea fowls (excl. of...	020739	020739: Poultry cuts & offal, except livers, fresh or chilled
020714	020714: Cuts & edible offal of species Gallus domesticus, frozen	020741	020741: Fowl cuts & offal, domestic, except livers, frozen
020727	020727: Cuts & edible offal of turkey, frozen	020742	020742: Turkey cuts & offal, except livers, frozen
020736	020736: Meat & edible meat offal of ducks/geese/guinea fowls (excl. of...	020743	020743: Duck, goose, guinea fowl cuts, offal not liver, froze
...	...	020750	020750: Poultry livers, domestic, frozen

In HS 1988, the commodity 020739 Poultry cuts & offal, except livers, fresh or chilled is feeded with 3 HS1996 series:

- 020735: Meat & edible meat offal of ducks/geese/guinea fowls
- 020726: Cuts & edible offal of turkey, fresh/chilled
- 020713: Cuts & edible offal of species Gallus domesticus, fresh/chilled

The correlation table, (not shown here), indicates that the HS1988 series 020750: Poultry livers, domestic, frozen is not used after HS1996. This series is discontinued in favour of:

- 020743: Duck, goose, guinea fowl cuts, offal not liver, froze
- 020742: Turkey cuts & offal, except livers, frozen
- 020741: Fowl cuts & offal, domestic, except livers, frozen

27. OECD is using chained indices as they take into account more dynamically changes in composition when defined as “classification regrouping”. When these regroupings take place and as in the case of chained indices, the reference year is the preceding year, the impact of the change of composition will only affect the indices on the year where the new versions of HS enter into force.

28. The OECD is expecting to face the same sort of issue when computing 2-digits indices as some conversion of 6 digits products are impacting badly the composition of certain HS chapter¹⁷.

D) Index number

D.1 Calculating Unit Values

29. As weights in kilograms is the chosen denominator, unit values are calculated as the ratio of values in dollars (current value) and weight in kilograms. The unit values are consequently expressed in dollars per kilo.

D.2 Calculating Laspeyres, Paasche and Fisher quantity and price indexes

30. As discussed in the note presented at the 2010 WPTGS¹⁸, the target indices to be calculated by OECD are Laspeyres, Paasche and Fisher indexes of a chained type so the reference year would then be revised each year. The base year of the index itself would be the first year of the HS classification used, in this case HS1988 (i.e 1988=100). The index number formulas are presented below.

Laspeyres Quantity index

31. 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

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

Paasche Quantity index

32. 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.

¹⁷ Please refer to the annex Table D - Commodities converted in another chapter of HS, many-to-many relationships of the paper STD/SES/WPTGS(2009)14 downloadable at <http://unstats.un.org/unsd/tradekb/Attachment220.aspx> to have the full list of 6 digits that change chapters while changing the f HS version.

¹⁸ Serve Wistrom 2010 Implementing quantity and unit value indices in the OECD ITCS database OECD

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

Laspeyres and Paasche price indexes

33. 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 a 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)

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

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

34. Unit values indices are sensitive to exchange rates fluctuations. To have trade values expressed in dollars in the ITCS database, a conversion based on trade-weighted average exchange rate is made. If one decomposes the price component of the unit value indices formula as a multiplication of a price in national currency multiplied by an exchange rate, the impact of an eventual fluctuation of exchange rates on unit values indices would be revealed. This algebraic property is not true for quantity indexes formula, the exchange rate component in this case, vanishes from the numerator and denominator.

Fisher Quantity and Price indexes

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). Fisher quantity and price indices is written as follows:

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

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

E) Exploring processes dealing with Missing values

35. In OECD countries, the coverage of merchandise trade by customs is usually quite extensive. For instance, according to French customs, 95% of Imports and 97% of Exports are recorded by French customs. However dealing with missing information (being values in dollars or quantities i.e. weight in kilogram) is an important issue when calculating Unit Value Indices.

36. The OECD has envisaged the generation of an algorithm in order to manage missing values in the data, made available from customs and aggregated at a partner world level. This has to be done with caution; no missing value should be calculated for a series which is terminated by definition. Different methods used across several institutions including the following:

E.1 Carry Forward method

37. The IMF Export and Import Price Index Manual¹⁹ discusses treatment of missing price information and in particular the “carry-forward” method (XMPIM, section 10.208). Two options are envisaged, either to assume that the missing price change will be the same as in some other set of price change or to assume that the price from this specific commodity type would not change (XPMI page 185). In both cases, this method has to be used with precautions.

38. This methodology had been applied by France²⁰ to deal with missing UV at a detailed level. If a UV was missing for a given flow, commodity, geographical zone, the French methodology was allocating to this missing value, the UV that can be found for the same product, the same flow and a different partner zone. This index was calculated assuming that in the aggregation, for the missing indices, the growth is null²¹.

E.2 Aggregation of products

39. Eurostat deals with discontinuities by aggregating commodities for which there is a change in the CN nomenclature, over 2 years in order to produce an aggregate with the same definition in both years²².

E.3 Moving Average

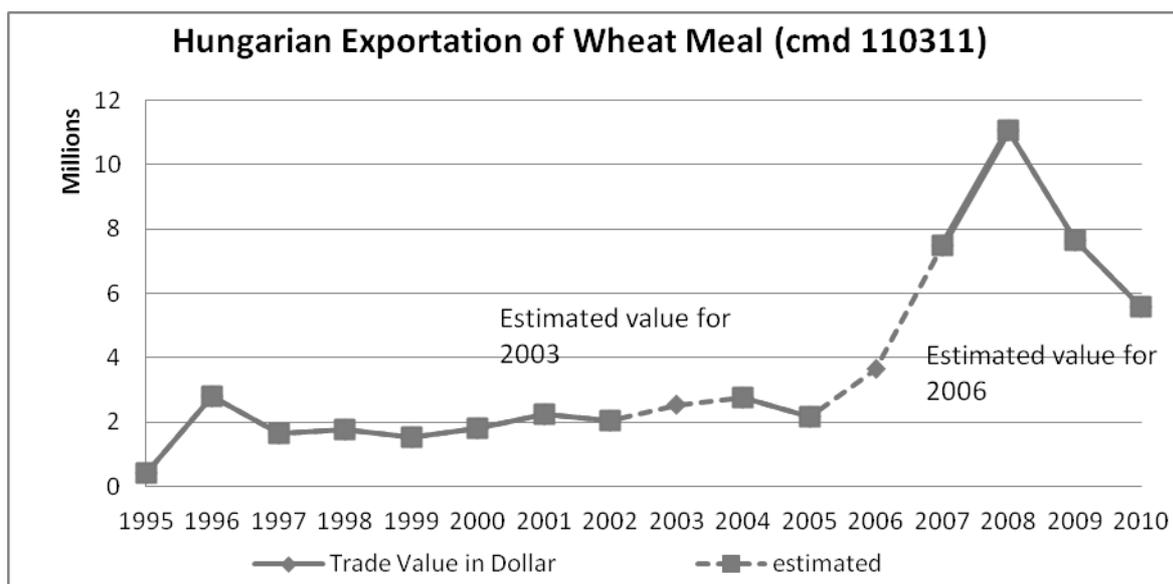
40. The OECD tried the moving average method in order to estimate missing trade values in dollars. Moving averages were centred on 5 years in order to smooth the impact of classification changes. This estimation was only made when the total sum of the estimated values for a chapter was less than 10%.

¹⁹ Export and Import Price Index Manual, IMF, ILO, OECD, Eurostat, UNECE, WB

²⁰ INSEE, 2007, indice de valeur et volume du commerce extérieur rénovés nouvelle méthodologie INSEE <http://www.indices.insee.fr/bsweb/html/F/ivurenove.pdf>

²¹ Laouisset, 2002 Méthodologie des nouveaux indices de valeur unitaire du commerce extérieur INSEE

²² Eurostat, (2010) Calculation of unit value indices based on external trade data (NICE application) page 5



41. As noted above, moving average were calculated on values but not on quantities, nor on Unit Value as it is a well-known fact that quantities are less reliable than trade values in customs records²³. The issue was to generate a quantity that was consistent with the estimated value as the quantity information is used in the formula index.

42. Therefore, the OECD estimated quantities (Net Weight in kilo) using Standard Unit Values (SUV) stemming from the UNSD/OECD processing system²⁴. This estimation is based on a worldwide trade SUV. It doesn't take into account regional differences, distances or countries preferences. Estimation of SUV only starts with 2000 data. It must be underlined that using a common Unit Value at a 6 digits commodity over reporters is a strong hypothesis. It might aggregate a number of different products for which price and quantity may vary. However, using SUV for quantity estimation was consistent with UNSD/OECD joint process on quantity.

E.4 Comparison of methods

43. A comparison of indices built from these data, using the methods for estimating missing values described above, was performed. Indices disseminated by CEPII Eurostat and SNA were used as references. Results show that indices based on raw data were more correlated with reference indices than any of those with an estimation of missing values. The question is then, if the OECD should adopt another methodology or should simply drop its attempt to estimate the missing values.

F) Identifying Outliers

44. An outlier is an observation that deviates markedly from other members of a sample. However, depending on how the term "outlier" is defined, different algorithms can be generated. For instance, CEPII defines an outlier as an unusual variation of the unit value compared to the median variation of UVs. Another way of defining outliers is, as an observation that is over the field's limits of acceptable values.

²³ As it is said in the Export and Import Price Index Manual page 71 "errors in UN indices attributed mainly to change in the mix of the heterogeneous items recorded in customs document but it was also attributed to the often poor quality of recorded data on quantities."

²⁴ Please refer to section B

Mexican and Italian researchers²⁵ use the Asymmetric Fence Method (AFM) to identify outliers in series with more than 100 elements and the Mean Absolute Deviation (MAD) for less than 100.

F.1 UNSD/ OECD joint process system

45. The UNSD built a methodology that identifies “extreme weight and value data”²⁶ that also tries to deal with variability, asymmetry and multi-modality issues of Unit value series. In order to do so, different filters are applied to the data:

Filter 1) The Unit Value of the commodity for a country is compared first to a coefficient of 10 multiplies by the maximum (and one of the minimum divided by 10) of the last five years historical unit values of the considered country when commodity flows are above 0.00005*total Exports (or Imports).

Filter 2) for commodity flows bigger than \$50.000, the unit value is compared to computed thresholds based on the Standard Unit Value (as defined in section B) for the targeted commodity. In order to determine the upper/ lower limit of acceptance²⁷, a Tukey outlier detection method (also known as “Box-Plot”) is used: with this method, a lower and upper limits of acceptable unit values is obtained by taking 1.5 times the inter quartile range and subtract/add these to, respectively the 25th and 75th percentile. These calculations are done on the log-transformed UV series that is more centrally distributed than the original unit value data (usually skewed).

Filter 3) for commodities that imply trade for more than \$1.000.000, a check on values is also made. Values are compared to the 100*maximum (and minimum/100) of last five years historical value for the country under consideration.

46. Those filters are applied at the commodity level. Those outliers were corrected till 2009 by the UNSD/OECD joint process system. From then, identified outliers are not replaced by any other value. Also, as this process has only been in place since 2006 and as only data as far back as to 2000 are being reprocessed using this new methodology, a more restrictive filter needs to be applied from 1988 on UV series used to compile those indices. The OECD has envisaged and tested different methodologies that are presented below.

F.2 Identifying outliers with an ARIMA model

47. Switzerland²⁸ uses a software called “AUTOBOX” that determines the ARIMA model that best describes the evolution of each UV commodities series. The software is then detecting outliers that don’t fit inside a confidence interval. Those outliers are then replaced by an estimation that is in line with the ARIMA model.

²⁵ Zetina (2011) Mexican Export and Import Unit Values Indices Methodological notes, banco de Mexico and Anitori, Paola and Maria Serena Causo (2008) Outlier Detection and treatment : Quality improvements in the Italian Unit Value Indexes, ISTAT

²⁶ Please refer to Annex II of the note Quantity and Weight Data in UN Comtrade that can be found at <http://unstats.un.org/unsd/trade/EG-IMTS/EG-IMTS%20197.8%20-%20UN%20Comtrade%20Quantity%20Report.pdf>

²⁷ UNSD, May,9th 2005, report on Standard Unit Values statistical issues of UNSD OECD data processing project

²⁸ Administration fédérale des douanes AFD section statistiques, mai 2006, indices du commerce extérieur suisse guide d'utilisateur available at <http://www.ezv.admin.ch/themen/00504/00505/00511/index.html?lang=fr>

48. For items that are scarcely reported, this methodology seems inappropriate. Supplementary information on prices is used by Switzerland to replace extreme values when the trade value of this commodity is high and the calculation of a unit value does not have any meaning (mix of heterogeneous products, for now, it is applied for aircrafts components). Otherwise, the median UV is used to replace an outlier for really unstable but “important” positions that have a strong impact on the indices. Finally, if the original series is more realistic than the corrected one, the original one is proffered.

F.3 Symmetric method based on a year to year measure of unit value variations compared to the median variation.

49. For outliers, the “deletion routine” retained by the CEPII²⁹ could be used as reference. As noted by Gaulier, Zignago³⁰ a few outliers can have a large impact on the accuracy of indexes, outliers being defined as unusual price variations in the product specific distribution of unit value ratios. However, the Export and Import Price Index Manual³¹(par 2.70, 2.71), underlines that the problem with such deletion is twofold. First, there is the implicit effect on the sample representativity and coverage. The second problem is that 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 fluctuations³². Those deletion routines, 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.

50. The idea of the CEPII method is to detect unusual variations of the unit value between two years. This variation is compared to the median variation of the same product on a worldwide level. If the variation of this UV between 2 years is 5 time superior to the median variation of this item between the same two years or 5 times inferior, the UV is rejected.

51. Eurostat is using the same type of method, and looks at the unit value change relative the median value change of a grouping of a flow reporter/partner/products combination. Some research performed by Eurostat³³ shows similar unit value changes variations across reporting countries and related products. Eurostat has therefore divided the raw data by reporter, flow and intra versus extra EU trade, products to constitute “blocks” where every data’s items supposedly behaves the same way. Then, within a block, a first check is made on UV change for one item relative to the median Unit Value change of its block belongs the [0.5 2] interval for the all commodities (except for energy products for which this interval is expanded to [0.25 4]). Items rejected by this process, are then tested, for a second time period in order to double check that the variation is unrealistic. Finally, the invalid Unit Value is replaced by the median unit value of the corresponding block.

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 times above or below the product specific median are deleted. (Gaulier et al, 2008, p.19)

³⁰ Gaulier et al, (2008) BACI : A world Database of International Trade At the Product Level the 95-2004 version CEPII

³¹ Export and Import Price Index Manual, IMF, ILO, OECD, Eurostat, UNECE, WB

³² Nakamura, (2008), Pass-Through in Retail and Wholesale

³³ Eurostat, (2010) Calculation of unit value indices based on external trade data (NICE application)

F.4 Asymmetric Fence method and Mean absolute deviation

52. Those methods suppose that the distribution is not symmetric. The logarithms of the unit values are also used because it has been proved that the log-transformation improves the outlier detection method by reducing the Type I Error (observations that are not outliers but the method would detect as such)³⁴.

53. The outlier detection strategy chosen by Italy is based on a “double filtering”: the first filter is applied to simple unit values at the single transaction level within flow/country/commodities. The second filter is applied to the elementary index distribution at more aggregated levels in order to insure the consistency at the dissemination level.³⁵

54. The selected method for the first filter on unit value levels is an extended version of the Asymmetric Fence Method (AFM) where the log distribution of each stratum is considered. The general formulation is as following:

$$\begin{cases} q_1 - uv_{hs8}^i > k_{AFM} * \max(q_2 - q_1, c * |q_2|) \\ uv_{hs8}^i - q_3 > k_{AFM} * \max(q_3 - q_2, c * |q_2|) \end{cases}$$

Where uv_{hs8}^i is the logarithm of the unit value, q_1 , q_2 and q_3 respectively correspond to the first, the second, and the third quartiles of the population distribution of log unit values of trade, k_{AFM} and c are parameters of the method, that are set to $c = 0.05$ and $k_{AFM} = 1$ ³⁶

Nevertheless, as explained both in the paper from Anitori and Zetina, the method is not efficient if the number of “transactions” is too small. In this case the MAD method is applied. The “transaction” is considered as outlier if the following conditions are satisfied simultaneously:

$$\begin{cases} |uv_{hs8}^i - q_2| > k_{MAD} * MAD_{hs8} \\ |uv_{hs8}^i - q_2| > A * |q_2| \end{cases} \quad \begin{aligned} MAD_{hs8} &= median(uv_{hs8}^i - q_2) \\ \text{with } A &= 0.1 \text{ and } k_{MAD} = 2 \end{aligned}$$

55. The second filter of the Italian methodology is based on the distribution at elementary level, checking the volatility of the indices generated by the previous method and here a trimmed mean is calculated. This means discarding a certain percentage of the lowest and highest values of the elementary indices and computing the mean of the remaining values. This second filter is performed at an aggregated level in series to be publicly disseminated in order to avoid that these are affected by implausible changes.

56. The Mexican methodology³⁷ keeps all trade operations that represent at least 30 per cent of trade of a commodity to compute indices. No outlier detection is made for those operations in order to retain the sample representativity and avoid biases in the estimation.

³⁴ See Thompson and Ozcoskun L. (2007), Thompson *et al.* (1999), and Thompson (2007).

³⁵ Paola Anitori, Maria Serena Causo (2008): Outlier detection and treatment : quality improvements in the Italian Unit Value Indexes ISTAT

³⁶ Zetina, 2011 Mexican Export and Import Unit Values indices Methodological note, Banco de Mexico

F.5 Comparison between different methods for detecting outliers

57. As noted above, the different methodologies explored for dealing with missing values were not really conclusive. Regarding the detection of outliers, no definitive choice has been made yet; however indices built on data where outliers were suppressed following the AFM are more correlated with references indices (Annual National Accounts, CEPII, Eurostat) than indices based on raw data. As to the impact of difference between methodologies, none of them has proven to provide a better match with the reference series with which the OECD indices are compared.

58. However, in order to stay consistent with the checks made during the OECD/UNSD joint process, the OECD is thinking about applying the following solution:

1st Check) For recent years, for which data were processed with the OECD/UNSD joint process system, a first check is done using the implemented UNSD method: evaluating the similitude of an UV of a commodity-flow with the previous year “world “distribution.

2nd Check) In a second time, for all years, a second AFM/MAD could complete the process, on all Unit Values available, previously log transformed. The OECD was thinking to use only data from OECD countries to build the reference quartiles of a “yearly commodity flow”. It is more geographically restrictive than the construction of Standard Unit Value, but it would reduce the variability as it can be supposed that quality of products (and UV) among OECD countries is more likely to behave similarly.

G) Dealing with specific products

59. The OECD has not yet implemented a specific process for specific goods where high volatility is well-known for trade in value and quantity. The OECD has also investigated the impact of using low flows (commodities series that show small value of trade). However, the literature has identified some problematic items. The Swiss methodology selects representative commodities to build indices. Eurostat and Italian methods apply different criteria, filters in order to select outliers. Special care is given to energy and metals products³⁸.

60. After testing different methodologies, the OECD notes that some chapters of HS are often flagged as outliers. For each year, flow, country, the OECD counted the number of 6 digits commodities inside a specific chapter that were flag as outliers. The top 3 of these chapters is the following:

chapters	% of outliers within a chapter using symmetric yearly variation detection method	% of outliers within a chapter using AFM MAD detection method
84: Nuclear reactors, boilers, machinery, etc	15%	15%
85: Electrical, electronic equipment	3%	5%
29: Organic chemicals	1%	2%

61. Looking at 4 digit levels, the position *8407 part of aircraft engines* and position *8525 transmission apparatus for radio broadcasting and TV* have large variation in UV. The Unit Values

³⁷ Zetina (2011) Mexican Export and Import Unit Values Indices Methodological notes, banco de mexico

³⁸ Anitori, Paola and Maria Serena Causo (2008) Outlier Detection and treatment Quality improvements in the Italian Unit Value Indexes, ISTAT

Eurostat, (2010) Calculation of unit value indices based on external trade data (NICE application)

compiled on their sub-positions on 6 digits can be seen as a mix of a multitude of heterogeneous products with large differences in prices.

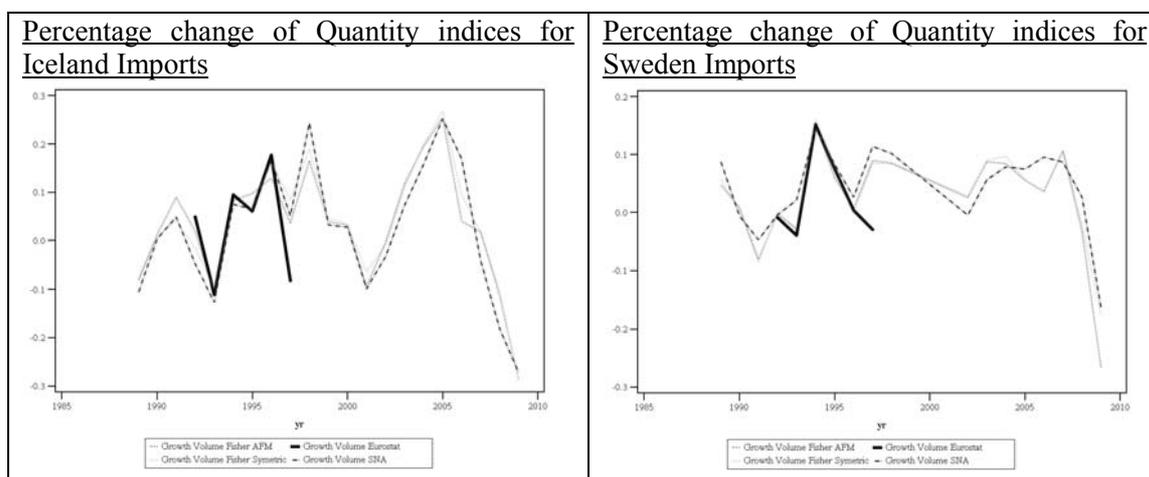
62. Moreover, as Aiginger (1997)³⁹ pointed out that unit values can also be used to measure product's quality within the exchange. There is the possibility to calculate means amongst similar countries and compare the results. For instance, one could assume that German exports to OECD countries represent 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.

H) Comparing OECD results with Annual National Accounts, Eurostat and CEPII

Chained Laspeyres, Paasche and Fisher price and quantity Exports and Imports indices have been computed for the 34 OECD member countries for total exports and imports based on all 6 digits commodities series of the HS1988 classification. Different methodologies have been tested to deal with missing values and to identify outliers. Results shown in this section will only refer to series where identified outliers were dismissed. No estimation of missing values or detected outliers was made as no convincing results were computed. The year to year percentage changes of these indices were compared to indices found:

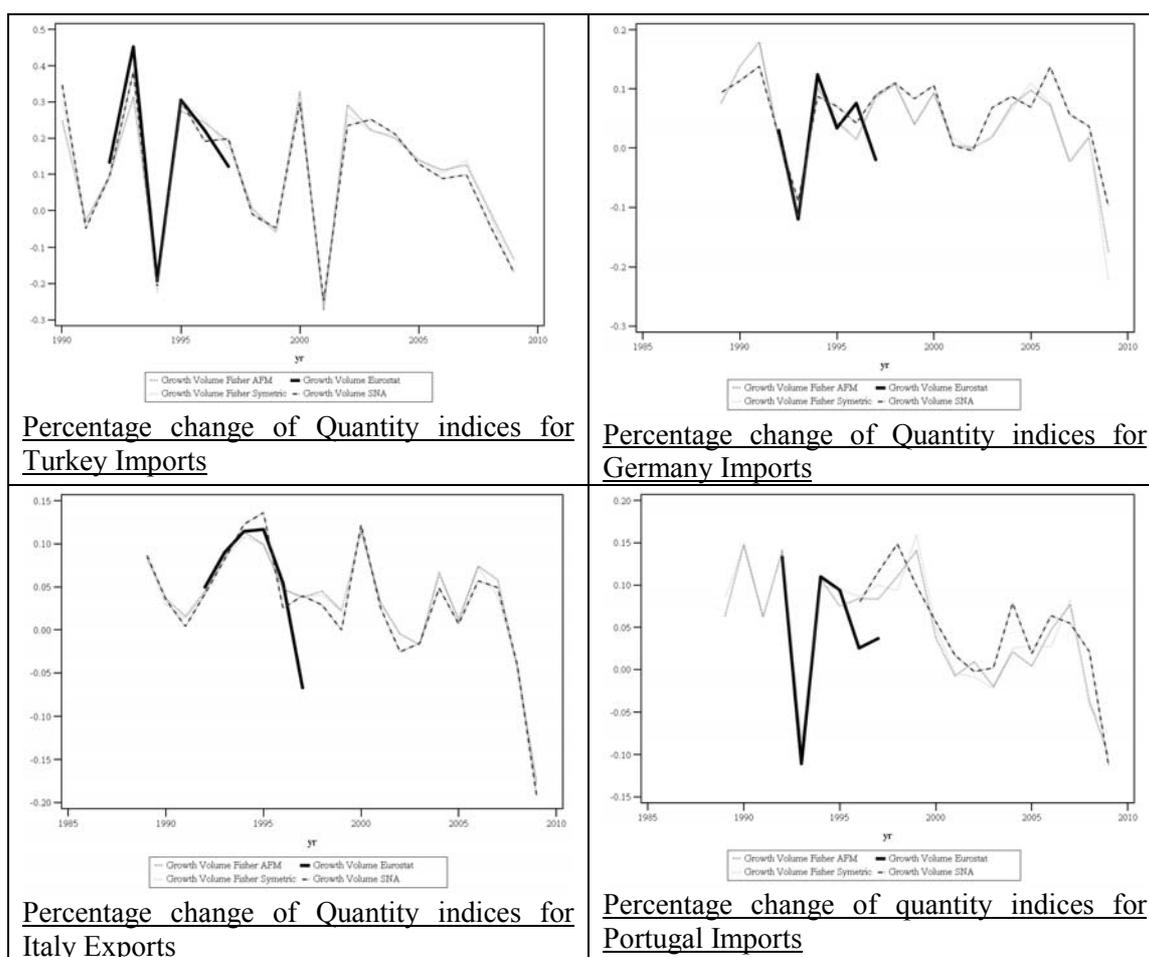
- in Comext database (Trend application computed by Eurostat) http://comext.eurostat.ec.europa.eu/comm/eurostat/comext/appfull_en_http_Server8.htm
- in OECD Annual National Accounts <http://stats.oecd.org/Index.aspx> (SNA)
- in BACI database (computed by CEPII) <http://www.cepii.fr/anglaisgraph/bdd/baci.htm>

H.1 Comparing Quantity Indices with SNA and COMEXT



³⁹

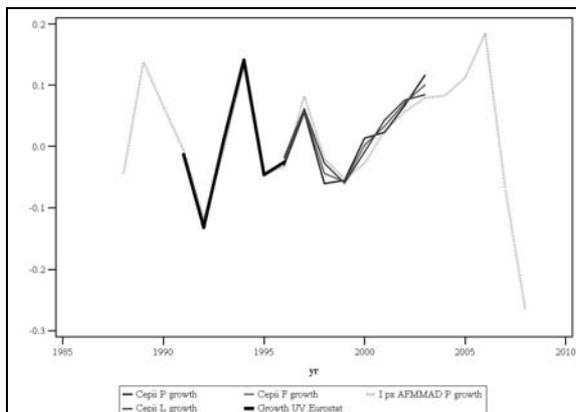
Aiginger, (1997) The use of unit values to discriminate between price and quality competition, Cambridge Journal of Economics



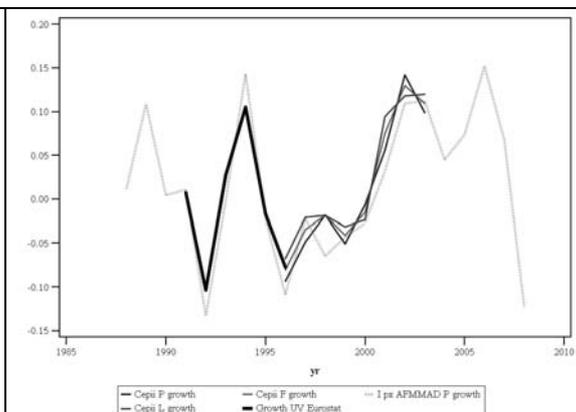
63. The Graphs represent the percentage change over preceding year of Fisher quantity indices. Globally, the OECD is quite satisfied with the match between international indices (compiled by Eurostat and by OECD National Accounts) and those compiled by the OECD for those countries.

64. However for some OECD countries the correlation with references series is not that pronounced. Those graphs also show that the way to detect outliers (asymmetric and symmetric method series in blue) doesn't impact much indices computed at a total level.

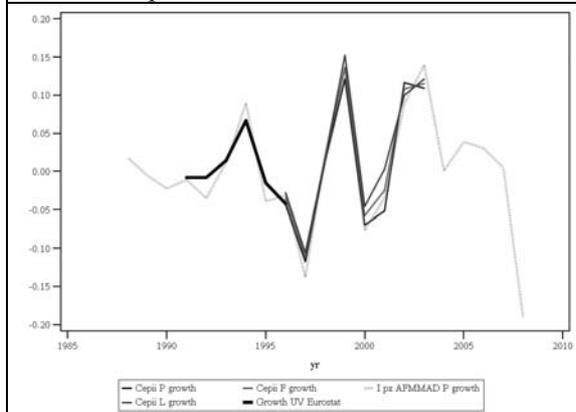
H.2 Comparing UV indices with CEPII and COMEXT



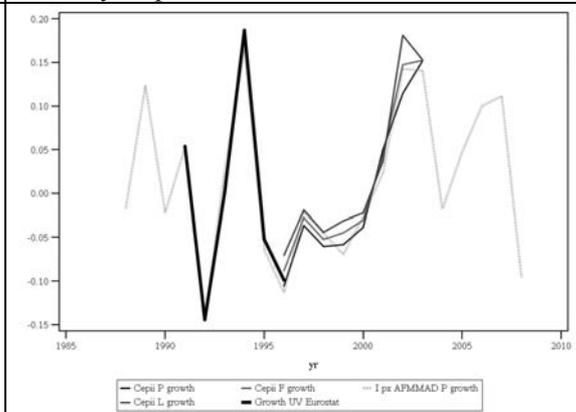
Percentage Change of Unit Values indices for Iceland Export



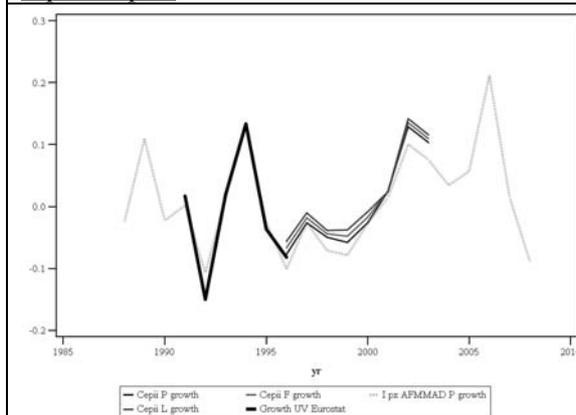
Percentage Change of Unit Values indices for Norway Import



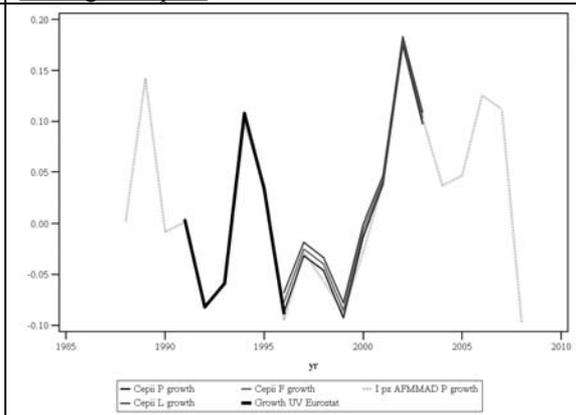
Percentage change of Unit Values indices for Japan Import



Percentage Change of Unit Values indices for Portugal Export



Percentage change of Unit Values indices for Denmark Import



Percentage change of Unit Values indices for Italy Export

65. Those Graphs represent the percentage change over preceding year of unit value indices (only Paasche indices are shown for indices compiled by the OECD). The same conclusion as for Quantity indices can be made: the indices computed by the OECD are reasonably comparable with those computed by Eurostat and the CEPII.

66. Some differences between references series and those built by the OECD can be important for other countries on some specific years. The OECD is wondering if these differences are due to the insufficiency of the filter used by the OECD that let outliers by-pass the detection, or a more complex phenomenon.

D) Conclusion

67. This paper examines Unit Value and Quantity indices for total exports and imports. This work includes an identification of outliers and an estimation of missing values. Several solutions were examined. Several additional issues inherent to series used to compile those indices (conversion of HS issue, quality of quantity series) were identified.

68. Different approaches found in the literature were also studied. Their implementation allowed the creation of indices that are comparable with other sources like Eurostat, CEPII and Annual National Accounts indices.

69. The next step is to extend the calculation of exports and imports indices to all partner countries and to a more disaggregated level of commodities (2 and 4 digits of HS). At a later stage, the presentation of quantity and unit value indices following classifications other than HS will be explored to respond to requests by users for trade indices following for instance ISIC, SITC and BEC.

70. A more complete matrix with values and quantity indices will be provided to delegates by mid 2012 for comments at the 2012 WPTGS.

Question to delegates:

Do you have suggestion on how to improve the compilation of UVIs and quantity indices?

Concerning specific issues:

Thresholds: Should a threshold apply to select data in order to improve the comparability between countries (as customs across countries do not record transactions with the same threshold on values and on quantities)?

Measure of Quantity: What is your opinion on the choice of the OECD to use the net weight values instead of supplementary quantities?

HS Conversion issues: Who should one deal with commodities that are subject to HS changes?

Estimation of Missing Values: What kind of methodology do you recommend in light of the OECD's plan to compute indices at a partner level for disaggregated level?

ANNEX I

This documents is a compilation of country responses regarding question 5 d) Country and International Organization's reports on UVI/trade volumes Meeting of the Working Party on International Trade in Goods and Trade in Services Statistics (WPTGS), Paris, 4-6 October 2010.

Country	Country response
Australia	The ABS produces monthly quantity and value information for merchandise trade statistics based on the most detailed level of the import and export classifications (both of which are based on the Harmonized System 2007). The ABS also produces quarterly chain volume measures at a broad level of classification for balance of payments goods and services. The ABS also produces quarterly Export and Import Price Indexes at a broad level of classification.
Austria	In Austria, the foreign trade index is generated as a Fisher chain index with the current reference year 2005 = 100. The basis update is quinquennial and the Fisher chain index involves a unit value index, volume index and a value index for "total", "EU" and "third countries". Creation and publication are carried out quarterly and the current index figures as well as the foreign trade indices for the final years 2008/2009 are available on our homepage (link: http://www.statistik.at/web_de/statistiken/aussenhandel/aussenhandelsindizes/index.html) this publication is available in German only.
Denmark	Currently, Statistics Denmark uses a rather simple method, which may be replaced by a more sophisticated model in the future. How this should be done is not decided on yet, but we look forward to see other countries methods.
Estonia	Estonia does not calculate UVI and trade volume indices at the moment but we are looking forward to start producing such indicators. Therefore we are interested in methodological guidelines and experience of other countries in this field.
Germany	The requested information on volume indices: Currently we calculate and publish two indices: The Laspeyres volume index shows the development of foreign trade adjusted for unit value changes. The Paasche unit value index gives information on changes of the import and export unit values on the basis of the statistical value. Probably starting from 2011 also a Fisher-Index will be calculated and published. All indices are calculated and published monthly according to different nomenclatures (SITC, prodcom, and national classifications) and country groupings (EU, third countries, and total).
Greece	With reference to the agenda item 5(d) of the above-mentioned Meeting and your email dated 8 September 2010, we would like to communicate the following: The external trade indices express the changes occurring in imports-exports between two time periods, the current and the corresponding period of the base year. The changes in the amount of the imports-exports value during the current period as compared to the corresponding value during the base year are due to changes in both prices and quantities of imported or exported commodities. Given the above, it is considered necessary to calculate the following indices: Index on the changes of prices of imported or exported commodities (Unit Value Index). Index on the changes in the volume of imported or exported commodities (Volume Index). The indices are compiled:

	<p>Monthly</p> <p>Cumulatively, for the period of January-surveyed month within the year, and For the four quarters of each year.</p> <p>With reference to the above indices we would like to communicate the following: The Unit Value Index is computed according to the Paasche formula. The Volume Index is computed according to the Laspeyres formula.</p>
Hungary	<p>The price indices for measurement of price level changes in external trade in goods have a hybrid characteristic, so the calculation is based on two sources of data: unit value indices (UVI) are calculated for product groups SITC 0-4 (Food, beverages, tobacco, Crude materials and Fuels) Information from enterprise survey is used for product groups SITC 5-8 (Manufactured goods and Machinery and transport equipment). The price indices are calculated by Fisher-formula, and the Fisher price indices are used for the computation of volume indices. The development of price and volume indices for international trade in services is underway, but the prices are currently collected only for exports. It would be welcome if some description on experiences of other countries in the import price estimation were available by OECD.</p>
Iceland	<p>Fisher unit value indices are calculated monthly based on accumulated customs declarations giving HS6+2 + country import and exports data. The quantity indices are implicitly derived from the calculation of the price indices.</p>
Italy	<p>ISTAT disseminates monthly UVIs and volume indices at CPA 3-digit level and country groupings from 1996. UVIs are calculated by means of the Fisher-formula and then used for the computation of volume indices. In 2008 a robust statistical method for outliers detection and correction of measurement errors has been adopted for computing elementary indices. Trimmed means, instead, are used at the final stage of aggregation.</p>
Mexico	Doesn't have any plan for the development of Unit Value Indices or Trade Indices.
New Zealand	<p>Statistics NZ release a quarterly Overseas Trade Index which incorporates both price and volumes indexes. It's compilation is best described in the technical notes: http://www.stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports/OverseasTradeIndexesVolumes_HOTPJun10qtr/Technical%20Notes.aspx For more general information about the trade indexes http://www.stats.govt.nz/browse_for_stats/industry_sectors/imports_and_exports/overseas-trade-indexes-info-releases.aspx</p>
Sweden	<p>Statistics Sweden calculates quarterly volume indices for foreign trade of goods according to Laspeyres' formula. For this purpose Statistics Sweden uses a) trade values in current prices from the foreign trade statistics on goods and b) export and import price indices calculated in the producer price index system in Statistics Sweden. Statistics Sweden publishes volume indices only for very high levels of SITC and CPA. In order to compare export and import price indices with other calculations/estimations on price changes - for an internal control of data before publishing - Statistics Sweden also calculates unit value indices. For big discrepancies between price indices and unit value indices (for areas where unit values are supposed to be of some quality) Statistics Sweden tries to (depending on resources) look closer at the differences which in some cases could lead to that Statistics Sweden uses some kind of average between unit values and price indices or unit values. Statistics Sweden is very interested to learn more about guidelines and experiences about calculations on unit value indices in other countries and welcome an OECD work in this area.</p>
Switzerland	Regarding a trade volume index, neither exists one for the international trade in services for Switzerland, nor is one scheduled
USA	United States does not calculate any unit value indexes, and has not since the late 1980s. Instead, USA uses a market basket approach, since the UVIs don't distinguish between changes in item mix or the quality of items from changes in price.

ANNEX II: WCO UNITS OF MEASUREMENT

Table 1: WCO units of measurement

Abbreviation	Description
m²	Area in square metres
1000 kWh	Electrical energy in thousands of kilowatt-hours
m	Length in metres
u	Number of items
2u	Number of pairs
l	Volume in liters
kg	Weight in kilograms
1000u	Thousands of items
u(jeu/pack)	Number of packages
12u	Dozen of items
m³	Volume in cubic meters
carat	Weight in carats

<http://unstats.un.org/unsd/trade/EG-IMTS/EG-IMTS%20197.8%20-%20UN%20Comtrade%20Quantity%20Report.pdf>

SOURCES

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2009-08 page 27 a 34