EUROPEAN COMMISSION
EUROSTAT

Directorate G: Global Business Statistics
Unit G3: Short-term Statistics; Tourism

Doc. Eurostat/G3 STS TF Chain-Linking SEP 2012 EN

FINAL REPORT

TASK FORCE CHAIN-LINKING IN STS

MEETINGS OF THE SHORT-TERM STATISTICS TF

LUXEMBOURG, 10-11 NOVEMBER 2010

LUXEMBOURG, 28-29 JUNE 2012

Contents

1. EXECUTIVE SUMMARY

The current STS regulation allows to update the weights used for calculation of indices in STS every five years or more frequently, meaning yearly in combination with annual chain-linking.

From a methodological point of view, annually chained indices are often considered as a superior approach for short-term statistics because of the use of more recent weighting information. However, there is also some concern about the amount of resources required for the implementation of such an approach, on the one hand, and also for the regular, annual work of updating the weights.

The STS Task Force on chain-linking was created to collect experiences on both methodological and practical aspects, from countries that have already implemented the annual update of weights and chain-linking in STS nationally (see Chapter 3 for price indices and 4 for volume indices), and to issue recommendations to those countries intending to implement such an approach. The Task Force members' reports on positive aspects and problems encountered as well as on the initial and routine costs faced are subject of Chapter 7.

The recommendations of the Task Force are presented in Chapter 8. In brief:

- the Task Force recommends to implement the annual update of weights and chain-linking for price and volume indices in STS in situations where the economic structure is developing fast;

- recognising however that not all Member States will be able to implement such an approach in the short term, the Task Force found that it is more relevant to have one common target method for the chain-linking of a given STS indicator rather than having all Member States changing from the five-yearly rebasing to the annual update of weights and chain-linking;

- the common target methodology for the chain-linking of STS price indices, recommended by the Task Force , is the one-month overlap for monthly indices and the one-quarter overlap in the case of quarterly indices, using December and the fourth quarter, respectively, as link periods;

- for the chain-linking of STS volume indices the recommended common target methodology is the annual overlap technique;

- in order to achieve comparability of data across countries and facilitate the calculation of European aggregates, countries willing to implement the annual update of weights in STS in combination with chain-linking are strongly advised to follow the recommendations regarding these common target methodologies.

A glossary and standard techniques for annual chain-linking in STS are presented in Chapter 2. Chapter 5 is a brief excursion on nominal indices – for which chain-linking is not relevant. Building up a chained index on an index with a previously fixed base year is the subject of Chapter 6. Chapter 9 contains the Task Force conclusions regarding the methodology of chain-linking in STS. Finally the Members of the Task Force are listed under Chapter 10.

All documents from the Task Force are available on CIRCABC:

https://circabc.europa.eu/w/browse/5bacd0b8-7a6e-498c-b4fa-d68f86e3d212

2. GLOSSARY AND STANDARD TECHNIQUES FOR CHAIN-LINKING IN STS

2.1. Chain-linked index

Chain-linking means constructing long-run price or volume measures by cumulating movements in short-term indices with different base periods. For example, a period-to-period chain-linked index measuring the changes from period 0 to t $\left(\text{i.e., } CI_{0\to t}\right)$ can be constructed by multiplying a series of short-term indices measuring the change from one period to the next as follows:

$$CI_{0\to t} = I_{0\to 1} \times I_{1\to 2} \times I_{2\to 3} \times I_{3\to 4} \times \cdots \times I_{t-1\to t} = \prod_{\tau=1}^{t} I_{\tau-1\to\tau}$$

where $I_{t-1\to t}$ represents a price or volume index measuring the change from period t – 1 to t, with period t – 1 as base and reference period. Chain-linked indices do not have a particular base or weight period. Each link $I_{t-1\to t}$ of the chain-linked index has a base period and weight period, and the base and weight period are changing from link to link.

The chain-linked index will constitute a period-to-period chain-linked Laspeyres volume index series if, for each link, the short-term indices $I_{t-1\to t}$ are constructed as Laspeyres volume indices with the previous period as base and reference period. That is, if

$$I_{(t-1)\to t} = LQ_{(t-1)\to t} = \sum_i \frac{q_{i,t}}{q_{i,t-1}} \times w_{i,t-1} = \frac{\sum_i p_{i,t-1} \times q_{i,t}}{\sum_i p_{i,t-1} \times q_{i,t-1}} = \frac{\sum_i p_{i,t-1} \times q_{i,t}}{V_{t-1}}$$

where

$LQ_{t-1\to t}$ represents a Laspeyres volume index measuring the volume change from period t –1 to t, with period t – 1 as base and reference period;

$p_{i,t-1}$ is the price of item i in period t–1 (the "price weights");

$q_{i,t}$ is the quantity of item i in period t;

$w_{i,t-1}$ is the base period "share weight," that is, the item's share in the total value of period t–1; and

V_{t-1} is the total value at current prices in period t–1.

Similarly, the chain-linked index will constitute a period-to-period chain-linked Laspeyres price index series if, for each link, the short-term indices $I_{t-1 \to t}$ are constructed as Laspeyres price indices with the previous period as base and reference period. That is, if

$$I_{(t-1) \to t} = LP_{(t-1) \to t} = \sum_i \frac{p_{i,t}}{p_{i,t-1}} \times w_{i,t-1} = \frac{\sum_i q_{i,t-1} \times p_{i,t}}{\sum_i q_{i,t-1} \times p_{i,t-1}} = \frac{\sum_i q_{i,t-1} \times p_{i,t}}{V_{t-1}}$$

where

$LP_{t-1 \to t}$ represents a Laspeyres price index measuring the price change from period t –1 to t, with period t – 1 as base and reference period;

Growth rates and index numbers computed for series that contain negatives or zeroes generally are misleading and meaningless.

Chain-linking should not be done more frequently than annually. This is mainly because short-term volatility in relative prices (e.g., caused by sampling errors and seasonal effects) can cause volume measures that are chain-linked more frequently than annually to show substantial drift, particularly so for nonsuperlative index formulas like Laspeyres and Paasche. Similarly, short-term volatility in relative quantities can cause price measures that are chain-linked more frequently than annually to show substantial drift. The purpose of chain-linking is to take into account long-term trends in changes in relative prices, not temporary short-term variations.

2.2. Fixed base year index

Fixed weight indices have their weight structure fixed at a particular point in time. These weights are used to compute indices over an extended period. Constant price/volume estimates use the average prices/quantities of a particular period, the base period, to weight together the corresponding quantities/prices. Constant price/quantity data have the advantage for the users of the component series being additive, unlike alternative volume/price measures.

The pattern of relative prices/quantities in the base year, however, might be less representative of the economic conditions for periods farther away from the base year. Therefore, from time to time it is necessary to update the base period to adopt weights that better reflect the current conditions and changes in the economic structure.

In STS in general the change of base periods is currently every 5 years. Different base periods, and thus different sets of price/quantity weights, give different perspectives. One the one hand, when the weights are updated every 5 years the entire time series can be re-calculated based on the new set of weights. On the other hand, if the base period is changed and data for the distant past is not recalculated (rebased), a consistent time series can be obtained by linking fife year chunks of data each of these having been calculated on its own base year and weighting system. This latter approach will lead a five-yearly chain of Laspeyres or Paasche indices. Indeed this process can be accelerated to yield annual chaining which is the principle subject of this glossary.

Note the linking should be done for each series, aggregates as well as subcomponents of the aggregates, independently of any aggregation or accounting relationship between the series. In general, five-yearly chain-linking implies that the index time series is not revised for its entire history when the base year and index weights are changed. It is therefore necessary that the discrete intervals (5 years) of the component indexes are aggregated by using weights from these intervals. In this case, the index is compiled for a succession of different segments while keeping the original weights for each past segment fixed.

2.3. Annual chain-linked index

Annual chain-linking of monthly/quarterly data implies that each link in the chain is constructed using the chosen index number formula with the average of the previous year (*t–1*) as base and reference period. The resulting short-term monthly/quarterly indices must subsequently be linked to form long, consistent time series expressed on a fixed reference period.

The chain-linked Laspeyres type volume measures should be derived by compiling monthly/quarterly estimates at the average prices of the previous year. The Laspeyres and Paasche annually chain-linked monthly/quarterly volume index formulas for each short-term link in the chain are given as

• Short-term link in annually chain-linked Laspeyres:

$$LQ_{(\overline{t-1})\rightarrow(m,t)} = \frac{\sum_i \overline{p}_{i,t-1} \times q_{i,m,t}}{\sum_i \overline{p}_{i,t-1} \times \overline{q}_{i,t-1}}$$

• Short-term link in annually chain-linked Paasche:

$$PQ_{(\overline{t-1})\rightarrow(m,t)} = \frac{\sum_i p_{i,m,t} \times q_{i,m,t}}{\sum_i p_{i,m,t} \times \overline{q}_{i,t-1}}$$

where

$\overline{p}_{i,t-1}$ is the quantity-weighted annual arithmetic average of the price of item *i* in each month/quarter of year *t-1*;

$p_{i,m,t-1}$ is the price of item *i* in month/quarter *m* of year *t-1*; and

$\bar{q}_{i,t-1}$ is the average quantity of item *i* in year *t-1*.

Similarly, the chain-linked Laspeyres type price measures should be derived by compiling monthly/quarterly estimates at the average quantities of the previous year. The Laspeyres and Paasche annually chain-linked monthly/quarterly price index formulas for each short-term link in the chain are given as follows

• Short-term link in annually chain-linked Laspeyres:

$$LP_{(\overline{t-1})\rightarrow(m,t)} = \frac{\sum_i \bar{q}_{i,t-1} \times p_{i,m,t}}{\sum_i \bar{q}_{i,t-1} \times \bar{p}_{i,t-1}}$$

• Short-term link in annually chain-linked Paasche:

$$PP_{(\overline{t-1})\rightarrow(m,t)} = \frac{\sum_i q_{i,m,t} \times p_{i,m,t}}{\sum_i q_{i,m,t} \times \bar{p}_{i,t-1}}$$

The weights of an annual chain-linked index are typically updated once a year. Technically an annual chain-linked index can limit the annual update to the weights, without introducing or removing new or old products (at the elementary aggregate level), reporting units and representative products. On the other hand the annual re-weighting can also involve drawing a new sample of products and a new list of reporting units.

2.4. Techniques for annual chain-linking of monthly/quarterly data

As the chain-linked Laspeyres type **volume measures** are derived by compiling monthly/quarterly estimates at the average prices of the previous year, the price basis changes also each year. The resulting breaks do not lead to a continuous volume series. By chain-linking the monthly/quarterly data the break resulting from the annual change in the price basis is eliminated. For monthly/quarterly data there are three different techniques, annual overlap (AO), one-month overlap (MO)/one-quarter overlap (QO) and over-the-year (OTY).

The technique of using annual overlaps (AO) for volume measures implies compiling estimates for each month/quarter at the weighted annual average prices of the previous year, with subsequent linking using the corresponding annual data to provide linking factors to scale the monthly/quarterly data upward or downward. A formal presentation of the annually chain-linked monthly/quarterly Laspeyres volume index for measuring the overall change from the average of year *0* (the reference year) to month/quarter *m* of year *t*:

$$CLQ^{AO-L}_{(\bar{0})\rightarrow(m,t)} = \left(\prod_{s=1}^{t-1} \frac{\sum_i \bar{p}_{i,s-1} \times \bar{q}_{i,s}}{\sum_i \bar{p}_{i,s-1} \times \bar{q}_{i,s-1}} \right) \times \frac{\sum_i \bar{p}_{i,t-1} \times q_{i,m,t}}{\sum_i \bar{p}_{i,t-1} \times \bar{q}_{i,t-1}}$$

Using the annual overlap technique the annually chain-linked monthly/quarterly Laspeyres index aggregates to the corresponding direct annual index. The annual overlap technique may introduce a step between each link. This means that the development of the monthly index from December to January might be influenced by changes in the weighting.

The technique of one-month overlaps (MO) for volume measures requires compiling estimates for the overlap month (December) at the weighted annual average prices of the current year in addition to estimates at the average prices of the previous year. The ratio between the estimates for the linking month at the average prices of the current year and at the average prices of the previous year then provides the linking factor to scale the monthly data up or down. A formal presentation of the one-month chain-linked monthly Laspeyres volume index for measuring the overall change from the average of year *0* (the reference year) to month *m* of year *t*:

$$CLQ^{MO-L}_{(\bar{0})\rightarrow(m,t)} = \frac{\sum_i \bar{p}_{i,0} \times q_{i,12,1}}{\sum_i \bar{p}_{i,0} \times \bar{q}_{i,0}} \times \left(\prod_{s=2}^{t-1} \frac{\sum_i \bar{p}_{i,s-1} \times q_{i,12,s}}{\sum_i \bar{p}_{i,s-1} \times q_{i,12,s-1}} \right) \times \frac{\sum_i \bar{p}_{i,t-1} \times q_{i,m,t}}{\sum_i \bar{p}_{i,t-1} \times q_{i,12,t-1}}$$

The last factor is the link from month *m* of year *t* to December of the previous year, both expressed at prices of *t-1*. The first factor initiates the chain by comparing December of year *1* not to December of year *0*, but to the average of year *0* (making year *0* the reference year 100).

The one-month overlap technique does not result in data that aggregate exactly to the corresponding direct annual index. The one-month overlap provides the smoothest transition between each link.

The technique of one-quarter overlaps (QO) for volume measures requires compiling estimates for the overlap quarter (fourth quarter) at the weighted annual average prices of the current year in addition to estimates at the average prices of the previous year. The ratio between the estimates for the linking quarter at the average prices of the current year and at the average prices of the previous year then provides the linking factor to scale the quarterly data up or down. A formal presentation of the one-quarter chain-linked quarterly Laspeyres volume index for measuring the overall change from the average of year *0* (the reference year) to quarter *m* of year *t*:

$$CLQ^{QO-L}_{(\bar{0})\rightarrow(m,t)} = \frac{\sum_i \bar{p}_{i,0} \times q_{i,4,1}}{\sum_i \bar{p}_{i,0} \times \bar{q}_{i,0}} \times \left(\prod_{s=2}^{t-1} \frac{\sum_i \bar{p}_{i,s-1} \times q_{i,4,s}}{\sum_i \bar{p}_{i,s-1} \times q_{i,4,s-1}} \right) \times \frac{\sum_i \bar{p}_{i,t-1} \times q_{i,m,t}}{\sum_i \bar{p}_{i,t-1} \times q_{i,4,t-1}}$$

The last factor is the link from quarter *m* of year *t* to the fourth quarter of the previous year, both expressed at prices of *t-1*. The first factor initiates the chain by comparing the fourth

quarter of year *1* not to the fourth quarter of year *0*, but to the average of year *0* (making year *0* the reference year 100).

The one-quarter overlap technique does not result in data that aggregate exactly to the corresponding direct annual index. The one-quarter overlap provides the smoothest transition between each link for quarterly data.

The over-the-year technique (OTY) for volume measures requires compiling estimates for each month/quarter at the weighted annual average prices of the current year in addition to estimates at the average prices of the previous year. The year-on-year changes in these constant price data are then used to extrapolate the monthly/quarterly constant price data of the chosen reference period. A formal presentation of the over-the-year chain-linked monthly Laspeyres volume index for measuring the overall change from the average of year *0* (the reference year) to month/quarter *m* of year *t*:

$$CLQ_{(\bar{0})\rightarrow(m,t)}^{OTY-L}=\frac{\sum_i \bar{p}_{i,0}\times q_{i,m,1}}{\sum_i \bar{p}_{i,0}\times \bar{q}_{i,0}}\times\left(\prod_{s=2}^{t-1}\frac{\sum_i \bar{p}_{i,s-1}\times q_{i,m,s}}{\sum_i \bar{p}_{i,s-1}\times q_{i,m,s-1}}\right)\times\frac{\sum_i \bar{p}_{i,t-1}\times q_{i,m,t}}{\sum_i \bar{p}_{i,t-1}\times q_{i,m,t-1}}$$

The last factor is the link from month/quarter *m* of year *t* to month/quarter *m* of the previous year, both expressed at prices of *t-1*. The chain product is different for every *m.* The first factor initiates the chain by comparing month/quarter *m* of year *1* not to month/quarter *m* of year *0*, but to the average of year *0* (making year *0* the reference year 100).

The over-the-year technique does not result in data that aggregate exactly to the corresponding direct annual index. All growth rates with respect to the previous period might be influenced by changes in the weighting. In situations with strong changes in relative prices, the over-the-year technique can result in distorted seasonal patterns in the linked series.

Similarly, chain-linked Laspeyres type **price measures** are derived by compiling monthly/quarterly estimates at the average quantities of the previous year, the quantity basis also changes each year. The resulting breaks do not lead to a continuous price series. By chain-linking the monthly/quarterly data the break resulting from the annual change in the quantity basis is eliminated.

The technique of using annual overlaps (AO) for price measures implies compiling estimates for each month/quarter at the weighted annual average quantities of the previous year, with subsequent linking using the corresponding annual data to provide linking factors to scale the monthly/quarterly data upward or downward. A formal presentation of the annually chain-linked monthly/quarterly Laspeyres price index for measuring the overall change from the average of year *0* (the reference year) to month/quarter *m* of year *t*:

$$CLP_{(\bar{0})\rightarrow(m,t)}^{AO-L}=\left(\prod_{s=1}^{t-1}\frac{\sum_i \bar{q}_{i,s-1}\times \bar{p}_{i,s}}{\sum_i \bar{q}_{i,s-1}\times \bar{p}_{i,s-1}}\right)\times\frac{\sum_i \bar{q}_{i,t-1}\times p_{i,m,t}}{\sum_i \bar{q}_{i,t-1}\times \bar{p}_{i,t-1}}$$

The technique of one-month overlaps (MO) for price measures requires compiling estimates for the overlap month (December) at the weighted annual average quantities of the current

year in addition to estimates at the average quantities of the previous year. The ratio between the estimates for the linking month at the average quantities of the current year and at the average quantities of the previous year then provides the linking factor to scale the monthly data up or down. A formal presentation of the one-month chain-linked monthly Laspeyres price index for measuring the overall change from the average of year *0* (the reference year) to month *m* of year *t*:

$$CLP^{MO-L}_{(\bar{0})\rightarrow(m,t)} = \frac{\sum_i \bar{q}_{i,0} \times p_{i,12,1}}{\sum_i \bar{q}_{i,0} \times \bar{p}_{i,0}} \times \left(\prod_{s=2}^{t-1} \frac{\sum_i \bar{q}_{i,s-1} \times p_{i,12,s}}{\sum_i \bar{q}_{i,s-1} \times p_{i,12,s-1}} \right) \times \frac{\sum_i \bar{q}_{i,t-1} \times p_{i,m,t}}{\sum_i \bar{q}_{i,t-1} \times p_{i,12,t-1}}$$

The last factor is the link from month *m* of year *t* to December of the previous year, both expressed at quantities of *t-1*. The first factor initiates the chain by comparing December of year *1* not to December of year *0*, but to the average of year *0* (making year *0* the reference year 100).

The technique of <u>one-quarter overlaps (QO)</u> for price measures requires compiling estimates for the overlap quarter (fourth quarter) at the weighted annual average quantities of the current year in addition to estimates at the average quantities of the previous year. The ratio between the estimates for the linking quarter at the average quantities of the current year and at the average quantities of the previous year then provides the linking factor to scale the quarterly data up or down. A formal presentation of the one-quarter chain-linked quarterly Laspeyres price index for measuring the overall change from the average of year *0* (the reference year) to quarter *m* of year *t*:

$$CLP^{QO-L}_{(\bar{0})\rightarrow(m,t)} = \frac{\sum_i \bar{q}_{i,0} \times p_{i,4,1}}{\sum_i \bar{q}_{i,0} \times \bar{p}_{i,0}} \times \left(\prod_{s=2}^{t-1} \frac{\sum_i \bar{q}_{i,s-1} \times p_{i,4,s}}{\sum_i \bar{q}_{i,s-1} \times p_{i,4,s-1}} \right) \times \frac{\sum_i \bar{q}_{i,t-1} \times p_{i,m,t}}{\sum_i \bar{q}_{i,t-1} \times p_{i,4,t-1}}$$

The last factor is the link from quarter *m* of year *t* to the fourth quarter of the previous year, both expressed at quantities of *t-1*. The first factor initiates the chain by comparing the fourth quarter of year *1* not to the fourth quarter of year *0*, but to the average of year *0* (making year *0* the reference year 100).

The <u>over-the-year technique (OTY)</u> for price measures requires compiling estimates for each month/quarter at the weighted annual average quantities of the current year in addition to estimates at the average quantities of the previous year. The year-on-year changes in these constant quantity data are then used to extrapolate the monthly/quarterly constant quantity data of the chosen reference period. A formal presentation of the over-the-year chain-linked monthly Laspeyres volume index for measuring the overall change from the average of year *0* (the reference year) to month/quarter *m* of year *t*:

$$CLP^{OTY-L}_{(\bar{0})\rightarrow(m,t)} = \frac{\sum_i \bar{q}_{i,0} \times p_{i,m,1}}{\sum_i \bar{q}_{i,0} \times \bar{p}_{i,0}} \times \left(\prod_{s=2}^{t-1} \frac{\sum_i \bar{q}_{i,s-1} \times p_{i,m,s}}{\sum_i \bar{q}_{i,s-1} \times p_{i,m,s-1}} \right) \times \frac{\sum_i \bar{q}_{i,t-1} \times p_{i,m,t}}{\sum_i \bar{q}_{i,t-1} \times p_{i,m,t-1}}$$

The chain product is different for every *m.* In situations with strong changes in relative quantities, the over-the-year technique can result in distorted seasonal patterns in the linked series.

To conclude, while standard price statistics compilation exclusively uses the one-month/one-quarter overlap technique, the annual overlap technique may be more practical for Laspeyres type volume measures. The over-the-year technique should be avoided.

2.5. Chaining period

For the one-month overlap (MO) December of the previous year is the month chosen as the link of the chain. In December of the year Y-1 the new calculation base for the year Y is set up. Such a work implies the updating of the selection of products (at the elementary aggregate level), the list of reporting units and the set of representative products. For price indices starting from January in year Y, the denominator of the ratios will be given by the price quotation at time December of year Y-1 (such a denominator, for the items entered in the new calculation base is equal to 100).

For the one-quarter overlap (QO) the last quarter of the previous year is the quarter chosen as the link of the chain.

The average month/quarter of the previous year is chosen as the link in the chain for the annual overlap technique (AO).

The corresponding period (month/quarter) in the previous year is chosen as the link for the over-the-year technique (OTY).

2.6. Base period

The base period is the base of the price or quantity ratios being weighted together at the elementary level of aggregation (e.g., period *0* is the base for the quantity ratio $\frac{q_{i,t}}{p_{i,0}}$).

2.7. Weighting reference period

The weighting reference period is the period from which the weights are taken. The weighting reference period is equal to the base period for a fixed-base Laspeyres index and to the current period for a fixed-base Paasche index. An index is said to be annually chain-linked if its weights system is annually updated. The chain approach does not re-calculate the entire historical series whenever the weights are updated but rather links together the two index series to produce a coherent time series. The chain-linked index is compiled for a succession of different segments while keeping the original weights for each past segment fixed.

For an annual chain-linked volume index the base-period for the price weights is the annual average of the previous year. The prices of one particular month/quarter are not suitable as price weights for volume measures, because of seasonal fluctuations and other short-term volatilities in relative prices. Use of weighted annual average prices reduces these effects. Therefore, weighted annual average prices are more representative for the other months/quarters of the year. The prices of the corresponding month/quarter of the previous year or the corresponding quarter of a fixed “base year” are not suitable as price weights for

volume measures because the derived volume measures only allow the current month/quarter to be compared with the same month/quarter of the previous year or years. Series of year-to-year changes do not constitute time series that allow different periods to be compared and cannot be linked together to form such time series. In particular, because they involve using different prices for each month/quarter of the year, they do not allow different months/quarters within the same year to be compared. The prices of the previous month/quarter are also not suitable as price weights for Laspeyres-type volume measures for the following two reasons. First, the use of different price weights for each month/quarter of the year does not allow the months/quarters within the same year to be aggregated and compared with their corresponding direct annual estimates. Second, if the month-to-month/quarter-to-quarter changes are linked together to form a time series, short-term volatility in relative prices may cause the monthly/quarterly chain-linked measures to show substantial drift compared to corresponding direct measures.

2.8. Reference period

In the reference period the index series is expressed as equal to 100. The reference period can be changed by simply dividing the index series with its level in any period chosen as the new reference period. For purposes of presentation the reference period of the annual chain-linked index is set to equal 100. Changing the reference period simply consists in a rescaling practice and can be done at any time. The rescaling coefficient is simply the arithmetic mean of the 12-monthly/4-quarterly indices in the year of the new reference period. The rescaling does not affect either the month-to-month/quarter-to-quarter index rate of change or the 12-month/4-quarter index rate of change.

2.9. Benchmarking the chained series to the annual chained series

When consistency between monthly/quarterly and annual data is an issue, the consistency can be forced on the monthly/quarterly data using benchmarking techniques. Benchmarking techniques can be necessary even if the basic requirement that monthly/quarterly and the annual measures are based on the same methods of compilation and presentation (i.e., same index formula and reference period) is met. If benchmarking techniques are used, the periods after the last base year might be constrained and this should not lead to a break in the series.

2.10. Level for performing chain-linking

The aggregation of the lower-level indices to obtain the higher levels ones, up to the overall index, should grant (apart from rounding issues) the same result as if the total index had been compiled in one step. There might be a significant growth difference if chain-linking is implemented at a more detailed level, e.g. 4-digit level against more broadly 2 digit level. How are indices below the level of chain-linking calculated? If 4 digit series are compiled from lower level series, lower level aggregation might take place using the fixed based method.

2.11. Calculation of elementary indices

For price indices the first step in compiling concerns price relatives. Each price relative is the quotient of the ratio between the current monthly price (numerator) and the base price (denominator). The denominator is equal to the base monthly/quarterly price used for the annual chain linking.

For the one-month overlap the base period price is December of the previous year. The price relative formula is $p_{i,m,t} = \frac{p_{i,m,t}}{p_{i,12,t}} \times 100$

In a second step price relatives are aggregated to obtain the elementary price index. The index is also known as the elementary product index.

2.12. Calculation of higher level indices

The elementary product indices are aggregated as weighted averages (typically as a Laspeyres-type index) to provide a set of synthetic indices up to the overall index. The weights are updated annually. The time series using yearly updated weights are chain-linked.

2.13. Source of weights

Structural business statistics (SBS), the Prodcom survey, national accounts data, the foreign trade statistics and sales data are often used as the basis for the annual weights update. However, a number of countries are not satisfied with the timeliness of these weights, referring frequently to two years before the reporting period (*t-2*).

For the PPI concerning the lowest level of index detail or product indices, the most widely used source for weights is the Prodcom survey although national accounts data are also used; some countries also have weights presented using the CPA. For higher level indices the source of weights for the PPI normally concerns the value of turnover from SBS or from national accounts, and in some cases Prodcom data.

For STS, the preferred source of weights is SBS. This is the only source with the necessary detail available for all Member States. For the sake of comparability across countries, it is furthermore desirable that all Member States are using the same source of weights.

2.14. Year of weights

The use of annual chain-linking implies the annual update of weights. However, the question is if for the calculation of January or the first quarter of the current year *t* the weights are already available for the previous year *t-1*.

2.15. Other sources used to update weights to t-1

The use of recent weights leads to a trade-off between timeliness and accuracy. If weights refer to year *t-2* they are updated in order to make them representative for year *t-1*. Different estimation methods based on national accounts, monthly turnover statistics or price updating are used in different countries to update the weights to year *t-1*, e.g. in Norway SBS data is available for *t-2* and thus not considered as being sufficiently timely for calculating the IPI, SBS data is projected to *t-1* using national accounts.

2.16. For volume indices: at which stage to perform seasonal adjustment

In practice, the most straight-forward approach is to apply seasonal adjustment to chain-linked indices rather than to series of values at previous year's prices. The reason is that such series do not constitute a true time series, and thus distorts the seasonal adjusted results because the

change of base from December to January or quarter four to quarter one will be seen as a seasonal pattern.

The annual-overlap technique might lead to a break from December to January or from the fourth quarter of a year to the first quarter of the following year. If changes in relative prices across detailed components go into the same direction and have a similar impact in some consecutive years, there is a risk that the annual overlap chain-linking techniques may create an "artificial" seasonality to the volume series. Therefore, it is generally recommended and most common in practice that seasonal adjustment is carried out after chain-linking. However, the use of different price bases in the chaining process may have an impact on the seasonal factors, and the seasonal adjustment may consequently not be able to perfectly correct for seasonality in the volumes.

The over-the-year technique impacts the infra-annual profile of a series. Therefore, from the perspective of seasonal adjustment, the use of the over-the-year technique is not recommended.

3. PRACTICAL EXAMPLES FROM COUNTRIES ON ANNUAL CHAIN-LINKING OF PRICE INDICES

In the following country examples are presented. The text contributions cover the points from the glossary and standard techniques of the previous chapter.

3.1. Norway PPI

3.1.1. Method applied

The Norwegian PPI is calculated using a chained Laspeyres formula, in which the weights are updated annually. This methodology was implemented in 2001. However, since the weights and base period are not exactly the same it is more correct to describe it as chained Young index.

Prior to the year 2001, the Norwegian PPI was calculated using a fixed base year formula. The method of chain-linking and updating the weights, was primarily implemented because of the flexibility in terms of including new representative goods, and also to improve the timeliness of the weights.

3.1.2. Chaining period

The chained index is obtained using a monthly overlap (MO). The chaining period is always December year t-1. Thus, the chained index is a series of chained Laspeyres indices.

3.1.3. Weight period

The source of the weights is t-3, but they are updated to refer to year t-1, the same year as the base year.

3.1.4. Is the chained series benchmarked to the annual chained series

The chained series are not benchmarked to the annual series.

3.1.5. At what level is chain-linking performed

The chain linking is performed at every level in the aggregation, which is six from-digit CPA, third and second level of the standard industrial classification (SIC 2007) as well as on aggregates comprising several SIC series (such as PPI total). Because the PPI is comprised of indices for the domestic and exports market, it means there are three sets of chain linking factors; domestic, exports and PPI total.

3.1.6. Calculation of elementary indices

The elementary level in the Norwegian PPI is the HS – the Harmonized System. An index is calculated for every HS that is included in the set of weights as the geometric average of the price changes for the products classified within the respective HS. The price changes are adjusted for quality changes, based on various techniques, as well as checked through various error checking procedures before included in the calculation of the elementary index. Missing price observations are estimated in the elementary level, based on the price changes of products classified within the same HS as the missing observation, provided there are at least the five actual price (not imputed) n the respective HS. If this condition is broken the missing price is estimated based on the lowest possible level of the aggregation catalogue in which there at least five actual price observations: First the respective CPA, then according to the hierarchical structure of SIC or ultimately estimated as no price change.

3.1.7. Calculation of higher level indices

The elementary indices are then linked to their respective CPA according to annual correspondence tables. The CPA index is calculated as the weighted average of the set of linked elementary indices – the HS. From the CPA according to the hierarchical structure of SIC, and also to the main industrial groupings. This is performed separately in both markets in which the goods are sold; domestic and/or export market. Finally, the PPI aggregates are calculated the same way, using the weights in the elementary level calculated as the relative importance of the elementary level across the domestic and/or the export market, thus the weight of any PPI elementary level constitute the relative importance of the elementary level across both markets comprising the PPI.

3.1.8. Source of weights

The source of the weights is the latest available final calculation of the National Accounts. The statistical unit of the national accounts used in the weight is *producer values, base values in current price,* in the national version of CPA.

To calculate distribution keys from CPA to the elementary level, the sources used are the annual PRODCOM survey, as well as export and import values from foreign trade statistics.

3.1.9. Year of weights

The final NA usually refers to year t-3, but they are updated to represent t-1.

3.1.10. Are other sources used to update weights to T-1

The weights are updated to year t-I using the quarterly national accounts. This is performed for production value and export value. The domestic market weights are then defined as the updated production values minus the updated export values.

In addition, the sources involved in calculating distribution formulas mentioned in A8.

3.1.11. Outline of the workflow: which step is done when

1. Calculate distribution keys from CPA to HS

2. Updating to t-1 and distribute according to distribution keys

3. Establish base period

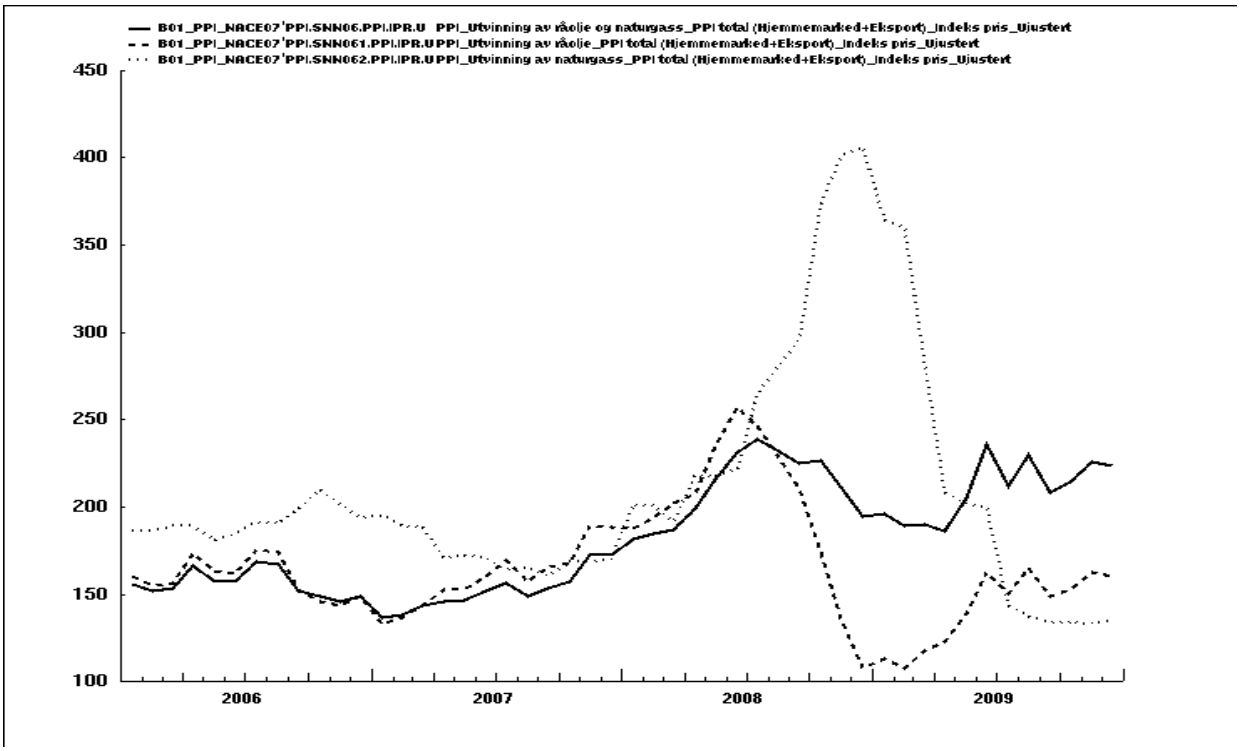
- Restart short term indices (I_0=100)

- Long term indices for base period

5. Calculate weights for every level in the aggregation catalogue

3.2. French comments on the Norwegian case of inconsistency in aggregation and on the correction to apply to weights in case of chaining

During the first meeting of the task force "*chain linking in STS?*", 10-11 November 2010, Cathrine BERJORDET, of Norway, showed us a strange phenomenon on products "06 - *crude petroleum and natural gas*" (aggregate), "06.10 - *crude petroleum*" and "06.20 - *natural gas*" (components) in July 2009, due to chain-linking:



It is well known that a chain-linked Laspeyres index does not keep the interesting property of "consistency in aggregation", but the fact that components indices 06.10 and 06.20 were both equal to 150 or about in July 2009, while aggregated index 06 overpassed 200, was a serious argument against the relevance of chain-linked indices.

During the meeting, I expressed the idea that the phenomenon was due to the direct use of weights "year n-1" (~ "average year n-1") combined with an overlap on "December n-1" price index, without correction.

The absence of correction is confirmed by the Norwegian June 2012 presentation on chain-linking in PPI:

Weight period does not exactly match the base period:

Weight period: t-1

Base period: Dec year t-1

Strictly speaking, I think that the Norwegians should have written:

base period: (average year) t-1

reference period: Dec year t-1

In the Latvian presentation of the same first meeting of the TF, we could read that a correction was applied (between average year n-2 and December n-1): In order to ensure the symmetry of weights and price base periods, the weights applied for the calculation of the PPI are price-updated to base prices (December of the previous year).

The principle of this correction is quite simple to understand. The hypothesis of fixed quantities combined with absolute prices is equivalent with price-updated values combined with monthly changes.

Let us consider the monthly change of price of an aggregate according to the Laspeyres formula:

$$I_p^{m/m-1} = \frac{\sum p_m q_b}{\sum p_{m-1} q_b} = \frac{(\sum (p_b q_b) * p_{m-1} / p_b) * p_m / p_{m-1}}{\sum (p_b q_b) * p_{m-1} / p_b}$$

Monthly changes

Fixed quantities of base period b

Initial weights

Price-updating of weights

When fixed base Laspeyres indices give place to chain-linked Laspeyres indices, the update of values between period b and year n-2 or n-1 means implicitly update of quantities and update of prices between period b and year n-2 or n-1, but update of prices between (average) year n-2 or n-1 and December n-1 (in the case of explicit one-month-overlap on December n-1) is still missing (the Laspeyres index between December n-1 and month m takes implicitly

into account the update of prices since December n-1)… and the difference between average year 2008 and December 2008 was quite large for crude petroleum!

With an explicit one-month-overlap on December n-1, the previous formula becomes:

$$I_p^{m/Dec\_n-1} = \frac{\sum p_m q_b}{\sum p_{Dec\_n-1} q_b} = \frac{(\sum (p_b q_b) * p_{Dec\_n-1} / p_b) * p_m / p_{Dec\_n-1}}{\sum (p_b q_b) * p_{Dec\_n-1} / p_b}$$

Correction to apply to the weights of year n-2 or n-1 until December n-1 in case of explicit one-month

With an implicit one-month-overlap on December n-1, as in the French case, where all elementary indices remain in a fixed reference (but not in a fixed base), the previous formula suggests:

$$I_p^{m/ref} = \frac{\sum p_m q_b}{\sum p_{ref} q_b} = \frac{(\sum (p_b q_b) * p_{ref} / p_b) * p_m / p_{ref}}{\sum (p_b q_b) * p_{ref} / p_b}$$

General correction to apply to the weights in case of update of the base

But this absolute index would be true only if the change of base period had occurred since the beginning (it would then be a Löwe index). In fact, the system of chain-linking transforms it into this true formula (division of $I_p^{m/ref}$ by $I_p^{m-1/ref}$):

$$I_p^{m/ref} = I_p^{m-1/ref} * \frac{(\sum (p_b q_b) * p_{ref} / p_b) * p_m / p_{ref}}{(\sum (p_b q_b) * p_{ref} / p_b) * p_{m-1} / p_{ref}} = I_p^{m-1/ref} * \frac{(\sum (p_b q_b) / i_p^{b/ref}) * i_p^{m/ref}}{(\sum (p_b q_b) / i_p^{b/ref}) * i_p^{m-1/ref}}$$

Correction to apply to the French weights (implicit one-month overlap)

Indeed, the French PPI is compiled with a monthly chaining, and it has seemed us easier to move it toward a monthly chained index in which the weights are updated annually, according to this formula we can read in the presentation of Bert M. BALK in the first meeting of the TF:

A chained index: For month m of year t relative to some base year 0, a price index can be defined as:

$$P^{tm,0} \equiv P^{Lo}(p^{tm}, p^{t-1,12}; x^{t-1}) \times P^{Lo}(p^{t-1,12}, p^{t-2,12}; x^{t-2}) \times P^{Lo}(p^{t-2,12}, p^{t-3,12}; x^{t-3}) \times \cdots$$

$$\times P^{Lo}(p^{1,12}, p^{0,12}; x^{0}) \times P^{Lo}(p^{0,12}, p^{0}; x^{0})$$

This can be written as a monthly chained index with the weights are updated annually.

In this case, the weights update needs a correction for the asymmetry between the base period (year n-2 or n-1) and the reference period (can be December n-1 or the reference of the chain-linked indices). The division of the new weights by the price index of the new base year in the reference period is a general rule (true for December n-1 in case of explicit one-month overlap or for the reference year of the chain-linked indices in case of implicit one-month overlap).

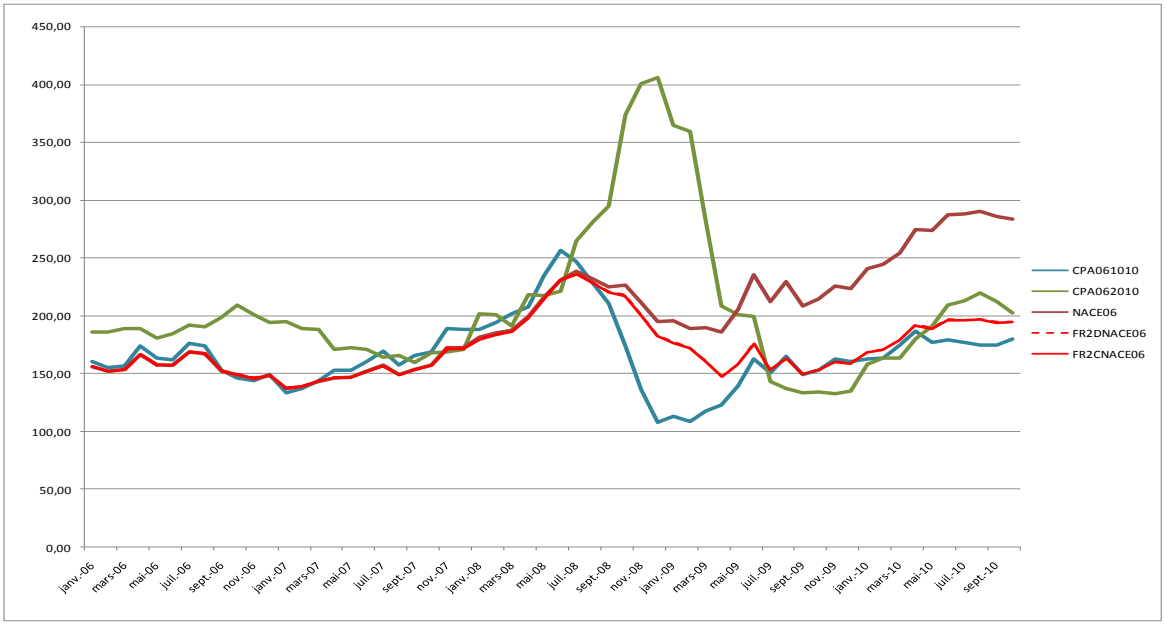
For this system of direct formulas in reference year (implicit one-month overlap), this correction can be interpreted like this:

the monthly chaining is equivalent to a permanent update of the prices since the reference period;

the update of weights is equivalent to an update of quantities and of prices between the reference period and the new base period (base = period of the new quantities / weights taken into account);

hence, the update of prices between the reference period and the new base period has been counted twice! A correction must be applied for once.

After the first meeting of the Task Force, Statistics Norway sent me all the figures: weights, "short term" indices and "long term" indices of products 06.10 and 06.20. In July 2011, I was in contact with Espen KRISTIANSEN. I was then able to re-compile the chained indices in the Norwegian way ("long term" indices without correction on the weights of year n-1), in the Norwegian way with the correction I had proposed and in the French way (chained indices without intermediate in December n-1, *i.e.* implicit one-month overlap) I was planning. The last two series were very close (and cannot be distinguished on the graph below) and much better for the consistency in aggregation, even if not perfect (see some months in 2007):



In the French project "Papaye", we have decided that if we discover an aggregate (like 06 in this example) out of the interval formed by its components, we will replace it by an absolute average for the concerned month:

$$I_p^{m/ref} = \frac{(\sum(p_b q_b)/i_p^{b/ref}) * i_p^{m/ref}}{(\sum(p_b q_b)/i_p^{b/ref})}$$

Note: at the occasion of a recent mission in Ukraine, I noticed that the Ukrainian PPI had been chain-linked for more than twenty years (in three steps: reference month m-1, reference December n-1, fixed reference year), thanks to an original Swedish technical assistance.

Since the beginning, it seems that this correction $* p_{Dec\_n-1} / p_b$ (coefficient) was applied for the annual update of the weights:

PPI

(percent)

			2010												Σ1	2011											Coefficient	Value of output in 2010 before correction	Value of output for 2012 after correction
			jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec		jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec			
Industry		to previose month	101,9	101,9	103,0	103,0	104,4	99,5	99,8	100,9	100,1	102,4	99,7	100,9		101,3	104,8	102,1	103,4	102,6	100,5	100,1	100,5	101,2	98,2	100,6	98,2			
		to december of 2009 year	101,9	103,8	107,0	110,2	115,0	114,4	114,2	115,2	115,3	118,1	117,8	118,8	1351,8	120,4	126,1	128,8	133,2	136,6	137,3	137,5	138,1	139,8	137,3	138,1	135,6	120,4	2583119758	3109905040
Mining and quarrying	C	to previose month	101,2	105,5	106,1	105,6	114,5	100,0	99,3	102,5	100,1	101,0	100,4	102,1		102,9	111,2	101,7	102,2	101,0	100,8	100,9	100,4	100,8	101,2	100,1	99,8			
		to december of 2009 year	101,2	106,8	113,3	119,6	137,0	137,0	136,0	139,4	139,5	140,9	141,5	144,5	1556,7	148,7	165,3	168,1	171,8	173,5	174,9	176,5	177,2	178,6	180,8	181,0	180,6	139,2	617061950,2	859044166
Mining and quarrying of energy produc	CA	to previose month	100,5	107,4	109,3	106,5	102,8	99,4	100,0	105,1	100,3	101,3	99,9	101,6		102,7	100,9	103,9	100,5	100,9	100,8	102,5	99,9	100,9	102,5	99,7	100,1			
		to december of 2009 year	100,5	107,9	118,0	125,6	129,2	128,4	128,4	134,9	135,3	137,1	137,0	139,2	1521,5	142,9	144,2	149,8	150,6	151,9	153,1	157,0	156,8	158,2	162,2	161,7	161,9	127,7	354446831,9	452467674
Mining and quarrying, except of energ	CB	to previose month	101,9	103,7	102,9	104,6	125,7	100,5	98,8	100,3	99,9	100,7	100,8	102,5		103,2	122,3	99,7	103,7	101,1	100,8	99,4	100,9	100,7	100,0	100,4	99,5			
		to december of 2009 year	101,9	105,7	108,7	113,7	144,1	144,8	143,1	143,5	143,4	144,4	145,5	149,2	1588,0	153,9	188,3	187,7	194,7	196,8	198,4	197,2	199,0	200,3	200,3	201,1	200,1	151,2	268832798,6	406576492
Manufacturing	D	to previose month	101,3	102,4	102,0	103,4	102,0	98,8	99,5	100,7	101,3	102,1	101,3	101,2		101,3	102,9	102,1	102,2	100,9	100,8	101,4	100,8	100,3	99,2	98,7	99,3			
		to december of 2009 year	101,3	103,7	105,8	109,4	111,6	110,3	109,7	110,5	111,9	114,3	115,7	117,1	1321,3	118,7	122,1	124,7	127,4	128,5	129,6	131,4	132,4	132,8	131,8	130,1	129,2	117,3		
Manufacture of food products, beverages and tob	DA	to previose month	102,9	102,1	101,0	100,2	99,8	99,9	101,1	102,0	103,0	102,4	101,5	101,5		100,8	100,9	101,5	101,2	100,8	101,1	101,4	101,1	100,7	99,5	99,6	100,4			
		to december of 2009 year	102,9	105,1	106,1	106,3	106,1	106,0	107,2	109,3	112,6	115,3	117,0	118,8	1312,7	119,7	120,8	122,6	124,1	125,1	126,5	128,2	129,6	130,5	129,9	129,4	129,9	118,7		
Light industry	DB+DC	to previose month	100,7	100,4	100,3	100,4	101,4	100,9	100,7	100,4	100,8	102,1	101,8	101,0		101,5	101,4	101,5	101,2	100,4	100,9	100,3	100,8	100,3	100,3	99,9	99,9			
		to december of 2009 year	100,7	101,1	101,4	101,8	103,2	104,2	104,9	105,3	106,2	108,4	110,3	111,4	1259,0	113,1	114,7	116,4	117,8	118,3	119,3	119,7	120,7	121,0	121,4	121,3	121,1	115,5		
manufacture of textiles and textile products	DB	to previose month	100,9	100,1	100,2	100,3	101,8	101,0	100,9	100,5	100,7	101,7	101,6	100,8		102,0	101,8	101,4	101,7	100,5	100,8	100,4	100,8	100,3	100,0	99,9	99,8			

Test calculations were performed in the Ukrainian way with the Norwegian figures, and resulted into the same figures as in the Norwegian aggregation when no correction was applied, and as in the French proposals when the usual Ukrainian correction was applied.

3.3. France PPI, SPPI and import prices

3.3.1. Calendar: not yet implemented (wait until next October)

French PPI (including SPPI and import prices) has not yet been converted into chained indicators. The project "Papaye", which sounds like "PPI" in French, intends to introduce chain-linking together with other improvements or changes in Autumn 2012 (1st of October 2012 exactly), in reference 2010. That is for production, and for each level of classification. For dissemination of aggregates (CPA 4 digits and above), until February 2013, French PPI will remain in fixed base Laspeyres, base and reference year 2005, thanks to a parallel program of compilation under Excel. On February 2013, the new series in reference 2010 - chain-linked - will be disseminated instead of the former series in reference 2005 - fixed base Laspeyres.

3.3.2. Method applied: one-month overlap (PPI and import prices) or one-quarter overlap (SPPI), i.e. target methodology

Annual weights will be refreshed every month of May, corresponding to definitive indices for month of January (PPI and import prices), and provisional indices for first quarter (SPPI).

Mathematically, formulas will be equivalent with a one-month overlap in December (PPI and import prices) or a one-quarter overlap in fourth quarter (SPPI), but we will not use an index reference 100 in last December or in last fourth quarter as an intermediate for compilation, neither an index reference 100 for last month or last quarter: rather, we will change the annual weights, in order that our chain-linked indices - which have always been compiled by monthly

chain-linking in reference 2000, now 2005, soon 2010 - take into account new annual turnovers and new annual amounts for all periods of the same year, based on data of year n-2 corrected on price changes since that year. If data of year n-1 become available on May, we will of course use them, but we will only update annual weights once a year, on May.

Our current system of compilation / aggregation relies already on a monthly chaining in reference 2005 (with fixed weights):

$$SIVAL_{jt} = SIVAL_{jt-1} \times \frac{\sum SIVAL_{it} \times SIPOND_{it} \times 1\,(SI_{t-1})}{\sum SIVAL_{it-1} \times SIPOND_{it} \times 1\,(SI_{t}) \times 1\,(SI_{t-1})}$$

Hence, the idea of chain-linking is only to change the weights (SIPOND) consistently, once a year.

3.3.3. Chaining period

Strictly speaking, chaining is (always) made with month m-1 or quarter q-1, but formulas will be equivalent to chain-linking with December or last quarter of year n-1, except that the content in elementary prices or products indices can

3.3.4. Weight period

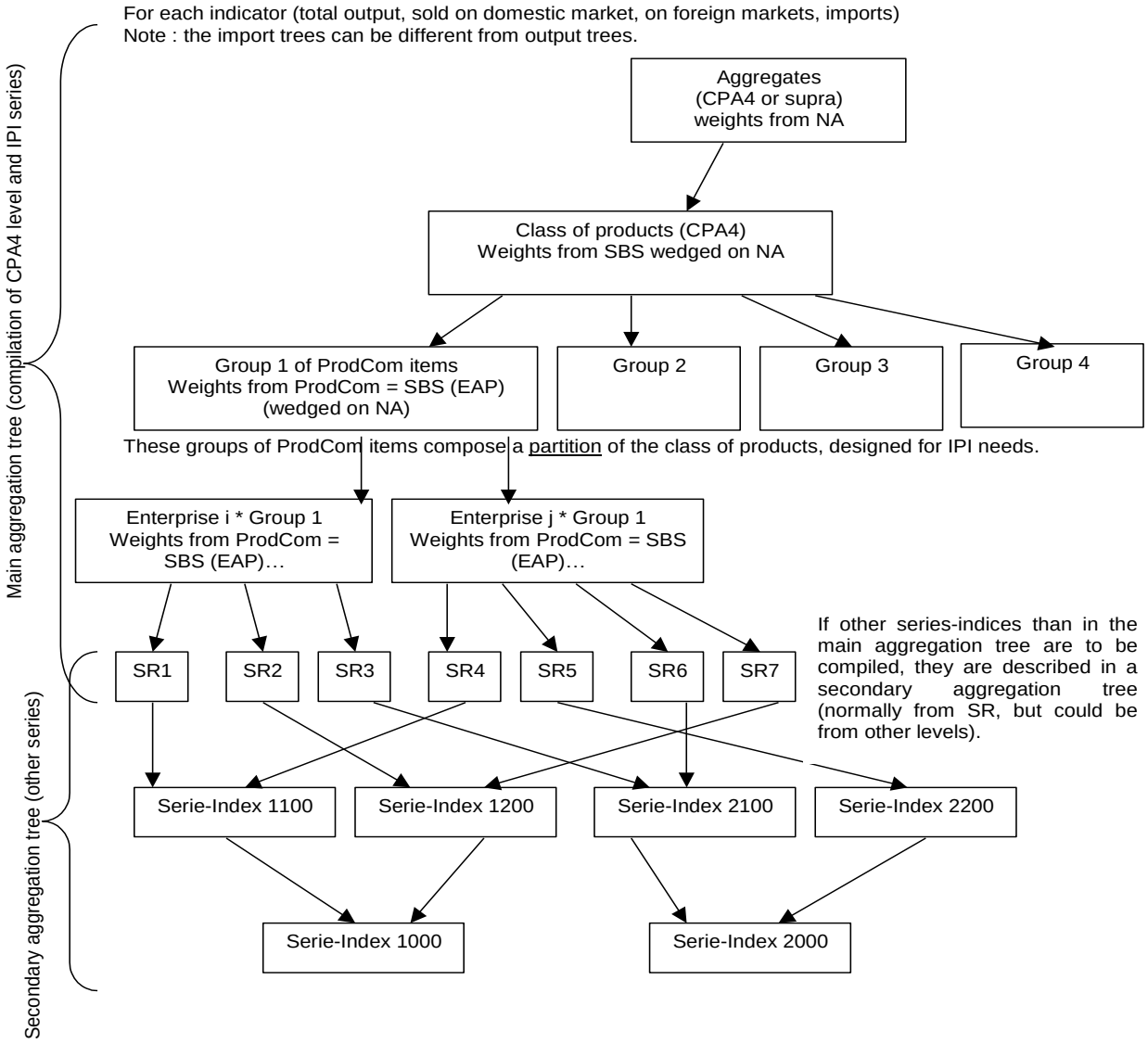
We expect year n-2 and we hope in medium term year n-1, available on May of year n, for indices since January or first quarter of year n. For higher levels, NA should provide weights on year n-1.

3.3.5. Levels of chain-linking: all

The idea of project Papaye is that chain-linking would be operated at each level, *i.e.* for elementary indices (from SBS-ProdCom or customs data, for each firm), for medium level indices (from SBS-ProdCom or customs data, for each sub-class of products) and for aggregates (from National Accounts and SBS or customs data).

Main aggregation trees and secondary aggregation trees for future PPI

Compilation of weights, in a top-down approach



3.3.6. Are other sources used to update weights to T-1?

At highest levels, National Accounts should provide weights on year n-1.

For elementary and medium level indices, sources (SBS-ProdCom and customs) should only concern year n-2 in near future, but it could happen in medium term that these sources would be available on year n-1 in time for the update occurring in May.

Even if weights concern only year n-2, a correction is applied to these sources in order to provide relevant weights, as if the price changes between year n-2 and December (or fourth quarter) n-1 were applied in order to extrapolate sources on December n-1; but as we remain in chain-linked indices reference 2010, we have only to divide by annual average price indices of year n-2 in reference 2010, which is equivalent.

If, at highest levels, new weights rely on amounts of year n-1, the correction will consist on a division by annual average price indices of year n-1 in reference 2010.

Weights are made additive in a top-down logic.

3.4. Turkey PPI

3.4.1. Method applied

PPI is calculated using a chained Laspeyres formula, in which the weights are updated annually. This methodology was implemented in 2003, inspired by CPI/ HICP works of Turkey which is also chained Laspeyres and was updated at the same time with PPI. Economic crisis prior to 2003 (in the years 1998 and 2002) made it difficult to define an appropriate base year for Turkey.

3.4.2. Chaining period

December of the previous year (December year t-1) is the chaining period. The one-month-overlap technique is used for annual chain-linking.

3.4.3. Weight period

The source of the weights is t-2, but they are updated to refer to year t-1, the same year as the base year.

3.4.4. Is the chained series benchmarked to the annual chained series

The chained series are not benchmarked to the annual series.

3.4.5. At what level is chain-linking performed

The chain linking is performed at most detailed level in the aggregation, which is from 10 digit national Prodcom (ProdTR) to NACE sections.

3.4.6. Calculation of elementary indices

Weighted arithmetic average of prices is used to combine basic price observation to the first level.

3.4.7. Calculation of higher level indices

From the ProdCom according to the hierarchical structure of CPA/NACE: Aggregation of lower level indices according to CPA (6 -4 -3 -2 and main sections)

$$I_{JAN2012(Dec2011=100)} = \sum_i w_{2010(dec2011)i} \frac{p_{JAN2012i}}{p_{DEC2011i}} \longrightarrow \textbf{base period: December 2011}$$

$$I_{JAN2012} = I_{DEC2011} \text{ x } I_{JAN2012\ (Dec2011=100)} \longrightarrow \textbf{reference year: 2003}$$

The chaining period is December t-1.

3.4.8. Source of weights

The source of the weights is the National Accounts. Principally most detailed level from the National Accounts should be used as source, currently 3 digit groups of CPA. The statistical unit of the national accounts used in the weight is producer sales. Industrial production data (4

digit and lower details, local units and enterprises) and Prodcom statistics (now only for cross-check, t-2 data are not available for PPI) used for lower level weights.

3.4.9. Year of weights

The weights refer to year t-2, but they are updated to December of year t-1.

3.4.10. Are other sources used to update weights to T-1

Weights are price updated to t-1.

3.4.11. Outline of the workflow: which step is done when

1. Annual update of basket of goods (from October to December):

Selection of new top-selling products and local units from the Industrial Production data (t-2 for calculation and plus last updated data for decision of coverage) as well as elimination of products and local units from the sample. PPI questionnaires are sent.

2. Annual update of weights (in January): combine the weighting information from the national accounts and the production survey with the updated basket of goods (amount of work is approx. 1 month). Calculate weights for every level in the aggregation.

3. Make new tables with new weights and new basket (in January).

4. Compilation of chain-linking PPI (every month)

3.5. Croatia PPI

3.5.1. Method applied

The Croatian PPI is annually chain-linked Laspeyres type index. PPI weights are being updating annually using PRODCOM data (i.e. national more detailed version) since 1998. The base period is December of previous year. However, since the weights for PPI relate to a whole year but the corresponding base period is a single month, the PPI is actually an annually chain-linked Young index. The same methods for calculation of PPI on domestic market have being applied from 1962 when actually calculation of the PPI on domestic market started in Croatia (long tradition).

Since January 2011, calculation of both separate PPI on non-domestic market and composite PPI total are being started besides PPI on domestic market using the same method of calculation.

3.5.2. Chaining period

The PPI is annually chain-linked using a monthly overlap. The chaining period is December of previous year (t-1). The base period is also the December of previous year. Because the weights relate to a whole year but the corresponding base period is a single month (December), the PPI is more precisely an annually chain-linked Young index then Laspeyres.

3.5.3. Weight period

The weights period is t-2 but they are updated regularly to refer to year t-1, the same year as the base year.

3.5.4. Is the chained series benchmarked to the annual chained series

The chained series is not benchmarked.

3.5.5. At what level is chain-linking performed

The chain linking is performed at each level of aggregation starting from ten-digit product level of PRODCOM based national nomenclature to hierarchical level of NKD 2007 (=NACE Rev.2) classes, groups and divisions as well as on aggregate sub-indices levels (PPI on domestic and non-domestic market) and PPI total.

3.5.6. Calculation of elementary indices

Croatian elementary price indices for each (elementary) representative product/item of national based PRODCOM nomenclature are being calculated from data on individual prices by dividing individual prices of a current month by individual prices of a base period (December of a previous year).

3.5.7. Calculation of higher level indices

Croatian higher level indices, that is, aggregate price indices of a classes, groups, divisions and sections of the NKD 2007. (= NACE Rev.2) as well as for MIGs are being calculated by a weighted arithmetic mean from elementary indices according to the modified Laspeyres formula (i.e. Young formula):

$$I = \frac{\sum \frac{P_n}{P_0} xW_0}{\sum W_0} x100$$

Whereby:

I is an index of a class, group, division or section and the total index

Pn is a price in a current period (month)

Po is a price in a base period (December previous year)

Wo is a relative sale structure in a base period.

3.5.8. Source of weights

The source of the weights for NACE Rev.2/CPA 2008 higher hieratical levels (4-digits, 3 digits, 2 digits, MIGs) is production sold volumes and values of annual PRODCOM based survey for both domestic and non-domestic market (so cold relative base structure).

The source of the weights for elementary product/item price indices on 10-digit levels are based on production enterprises information on production sold (enterprise-product combination).

3.5.9. Year of weights

Weights refer to year t-2, but they are partially updated to represent year t-1.

3.5.10. Are other sources used to update weights to T-1

The weights are updated to year t-1 for elementary product/item prices using enterprises information.

3.5.11. Outline of the workflow: which step is done when

PRODCOM is used as a sampling frame for Croatian PPI. The PRODCOM survey is a near census of relevant enterprises; all those with an employment of at least 10 are sampled, accounting for 95% of production sold on domestic and non-domestic market The PPI sample survey consists of all enterprise-product combinations covering those products which account for 80% of those NACE classes with a sold production value on domestic market of at least €3000 and on non-domestic market of at least €2000. The selection of enterprises has being done according to their share in the production of selected products, separately for domestic and non-domestic market. For each such enterprise-product combination, the price of one item is collected per month. The workflow steps are:

Updating of sample frame according to selection criteria from PRODCOM based survey results. Updating sample includes refreshing the sample with new product-items/enterprises as well as eliminating those product-items below the selection criteria (November to December)

Defining the new product-item specification by contacting enterprises directly by phone or e-mail (second half of December to first half of January)

Updating the weights by combining information from PRODCOM results with updated product-items (basket of goods). Distribution of weights to all hieratical levels concerns in PPI calculation (December/January).

Uploading the updated PPI databases with new weights and new product-items specifications making final software settings for regular data collection (PPI survey is CAWI based), processing, validation, computing and dissemination (January)

Opening dedicated web-site for new PPI data collection (16th of January each year)

Data collection (CAWI), validation, processing and computing the chain-linking PPI (second half of January to 8th of February)

Analysing the chain-linking PPIs (possible correction – go back to individual data), preparation for publications and finally dissemination to national users and Eurostat (+15 at latest)

Note:

The PPI monthly survey for 2012 covers for PPI data collection on the domestic market, the sample for 1 555 item prices within the selected PRODCOM products in 1165 enterprises, while for the PPI on the non-domestic market it covers 831 item prices within the selected PRODCOM products in 509 enterprises.

3.6. Austria PPI

3.6.1. Method applied

In Austria a chain-linked Laspeyres price index is used for PPI.

The PPI should meet the following requirements:

- Compilation of indices for all NACE levels (4- digit, 3-digit, 2-digit, total industry), regardless of whether production was characteristic or non-characteristic

- Compilation of indices for all NACE levels and all CPA levels

- Compilation of indices for the domestic and non-domestic market (export market)

Therefore, the make-matrix (t-3) from the National Accounts (NA) was chosen as source of weights on higher levels. The make-matrix provides information of weights for all NACE levels (4-digit level upwards) as well as for all CPA levels (6-digit level upwards) for the domestic and the non-domestic market (Foreign Trade data). Below, the value of sold production from the Prodcom survey (t-1) is used as a source of weights.

The main reason for the application of chain-linking was to absorb the time lag of 3 years for the availability of the make-matrix. Chain-linking allows the update of weights annually. In addition chain-linking has the advantage that the basket of goods can be updated on an annual basis.

3.6.2. Chaining period

The chaining period is December last year (one-month overlap technique).

3.6.3. Weight period

Last available sources of weights:

PRODCOM survey (t-1) for indices on CPA 6-digit level;

Make-Matrix from National Accounts (NA) (t-3) for indices on NACE 4-digit level and for indices on higher NACE levels (3-digit, 2-digit, MIGS, total industry)

3.6.4. Is the chained series benchmarked to the annual chained series

The chained series is not benchmarked.

3.6.5. At what level is chain-linking performed

From CPA 6-digit level to NACE 2-digit level, MIGS and total industry chain-linking is performed for the total, domestic and non-domestic market.

3.6.6. Calculation of elementary indices

First step: Each price relative is the quotient of the ratio between the current monthly price and the base price

Second step: the price relatives are aggregated (using the geometric mean) to an elementary product index (PRODCOM level). Geometric mean is applied because it is assumed that all products have approximately the same development in all strata.

3.6.7. Source of weights and year of weights

Last available sources of weights:

PRODCOM survey (t-1) for indices on CPA 6-digit level;

Make-Matrix from National Accounts (NA) (t-3) for indices on NACE 4-digit level and for indices on higher NACE levels (3-digit, 2-digit, MIGS, total industry)

3.6.8. Are other sources used of update weights to T-1

A price-update to December of the previous year is performed.

3.6.9. Outline of the workflow

1. Step (November to December)

Annual update of basket of goods: Selection of new top-selling products and local units from the Prodcom survey (t-1) as well as elimination of products and local units from the sample

2. Step (January)

Annual update of weights (in January): combine the weighting information from the make-matrix and the ProdCom survey with the updated basket of goods (amount of work is approx. 1 month)

3. Step (every month)

Compilation of chain-linking PPI (every month)

3.7. Lithuania PPI

Producer price index (PPI) is calculated from 1995 using Laspeyres formula in Statistics Lithuania.

3.7.1. Method applied

The annual chain-linking method is applied. This method was implemented because:

1) It gives a possibility to update a basket of representative products and remove non-existing products annually.

2) Annually revised weights are more accurate and up to date, because the market is changing rapidly.

3.7.2. Chaining period

December is the linking period, of year t-1 (t – reporting year).

3.7.3. Weight period

The weight period is calendar year t-2.

3.7.4. Is the chained series benchmarked to the annual chained series

The chained series is not benchmarked.

3.7.5. At what level is chain-linking performed

At the 4-digit level by NACE Rev.2 chain-linking is performed.

3.7.6. Calculation of elementary indices

The lowest level price indices are the ratios of the individual prices of individual representative products of the current month to the prices for December of the previous year (price reference period).

3.7.7. Calculation of higher level indices

Individual product price indices are aggregated using Laspeyres formula and reference period weights to calculate higher level indices for product headings as well as for NACE Rev. 2 classes (4 digit level), groups (3 digit level), divisions (2 digit level), sections (1 letter level) and the overall index (for industry).

3.7.8. Source of weights

Weights by NACE Rev. 2 are based on statistical data of industrial production sales volume in value estimation when VAT and excises are excluded. Industry Statistics is used as an information source. Weights for individual product price indices are based on production sales volume obtained from enterprises.

3.7.9. Year of weights

The weights refer to the sales volume in the year t-2, while the reference period of prices refers to December of the t-1. The annual weights are price adjusted to align with the price reference period.

3.7.10. Are other sources used to update weights to T-1

No other sources are used to update weights to t-1.

3.7.11. Outline of the workflow: which step is done when

1. Sampling of enterprises (~ in September);

2. Sending of annual statistical questionnaire for the selection of representative industrial products (~ in October);

3. Generation of weightings (~ in November);

4. Data collection, entry validation and processing;

5. Calculation of price indices;

6. Publication.

Steps 1-3 are carried out ones a year, steps 4-6 every month.

3.8. Lithuania SPPI

Service producer price index (SPPI) is published from 2007 in Statistics Lithuania. Statistics Lithuania does not calculate total SPPI, but individual indexes of following activities:

H491_H492 Transport via railways

H4941 Freight transport by road

H495 Transport via pipeline

H501_H502 Sea and coastal water transport

H51 Air transport

H521 Warehousing and storage

H5224 Cargo handling

H531 Postal activities under universal service obligation

H532 Other postal and courier activities

J61 Telecommunications

J62 Computer programming, consultancy and related activities

J631 Data processing, hosting and related activities; web portals

M691 Legal activities

M692 Accounting, bookkeeping and auditing activities; tax consultancy

M702 Management consultancy activities

M71 Architectural and engineering activities; technical testing and analysis

M73 Advertising and market research

N78 Employment activities

N80 Security and investigation activities

N812 Cleaning activities

3.8.1. Method applied

The annual chain-linking method is applied. This method was implemented because:

1) It gives a possibility to update a basket of representative products and remove non-existing products annually.

2) Annually revised weights are more accurate and up to date, because the market is changing rapidly.

3.8.2. Chaining period

The fourth quarter is the linking period, of year t-1 (year t is the reporting year).

3.8.3. Weight period

The weight period is calendar year t-1.

3.8.4. Is the chained series benchmarked to the annual chained series

The chained series is not benchmarked.

3.8.5. At what level is chain-linking performed

At 4 digit-level by NACE Rev. 2 is chai-linking performed.

3.8.6. Calculation of elementary indices

The lowest level price indices are the ratios of the individual prices of individual representative services of the current quarter to the prices for IV quarter of the previous year (price reference period).

3.8.7. Calculation of higher level indices

Individual services price indices are aggregated using Laspeyres formula and reference period weights to calculate higher level indices for services headings CPA (6- and 5-digit level) and NACE Rev.2 (4-digit level) for each respondent.

These indices are aggregated into the price indices for services heading as well as for NACE Rev.2 classes (4-digit level), groups (3-digit level), and divisions (2-digit level).

3.8.8. Source of weights

Weights for higher level indices are based on database of turnover by NACE Rev.2 provided by the Transport and Services Statistics Division. Weights for the representative services are based on sales values received from enterprises.

3.8.9. Year of weights

The weights refer to the sales volume in the year t-1, while the reference period of prices refers to IV quarter of the t-1. The annual weights are price adjusted to align with the price reference period.

3.8.10. Are other sources used to update weights to T-1

No other sources are used to update weights to t-1.

3.8.11. Outline of the workflow: which step is done when

1. Sampling of enterprises (~ in October);

2. Sending of annual statistical questionnaires for selection of representative services and weights required to calculate lower level indices (~ end of January);

3. Generation of weightings (~ in March);

4. Data collection, entry, validation and processing;

5. Calculation of price indices;

6. Publication.

Steps 1-3 are carried out ones a year, steps 4-6 - every quarter.

3.9. Lithuania import price index

Import producer price index is published from 2007 in Statistics Lithuania.

3.9.1. Method applied

The annual chain-linking method is applied. This method was implemented because:

1) It gives a possibility to update a basket of representative products and remove non-existing products annually.

2) Annually revised weights are more accurate and up to date, because the market is changing rapidly.

3.9.2. Chaining period

The previous year t-1 is the linking period (year t is the reporting year).

3.9.3. Weight period

The calendar year t-1 is the weight period.

3.9.4. Is the chained series benchmarked to the annual chained series

The chained series is not benchmarked.

3.9.5. At what level is chain-linking performed

At 4 digit-level by CPA chain-linking is performed.

3.9.6. Calculation of elementary indices

The lowest level price indices are the ratios of the prices of individual representative goods of the current month to the average prices of the previous year (price reference period).

3.9.7. Calculation of higher level indices

Individual goods price indices are aggregated using the Laspeyres formula and reference period weights to calculate higher level indices for goods subcategories (6-digit level) of the CPA, as well as for categories (5-digit level), classes (4-digit level), groups (3-digit level), divisions (2-digit level), sections (1-letter level) and the overall IPI.

3.9.8. Source of weights

Weights for the import price index calculation are based on Foreign Trade Statistics data for imports in value terms according to all levels of the CPA. Weights for individual goods price indices are based on imports in value terms obtained from enterprises.

3.9.9. Year of weights

The weights refer to the imports volume in the year *t*-1.

3.9.10. Are other sources used to update weights to T-1

No other sources are used to update weights to t-1.

3.9.11. Outline of the workflow: which step is done when

1. Sampling of enterprises;

2. Sending of annual statistical questionnaires for selection of representative services and weights required to calculate lower level indices;

3. Generation of weightings;

4. Data collection, entry, validation and processing;

5. Calculation of price indices;

6. Publication.

Steps 1-3 are carried out ones a year (~August-October), steps 4-6 every month.

4. PRACTICAL EXAMPLES FROM COUNTRIES ON ANNUAL CHAIN-LINKING OF VOLUME INDICES

In the following country examples profound descriptions are provided on the methods applied in the calculation of the monthly volume indices.

4.1. Finland IPI

4.1.1. Method applied

In Finland, the implementation of the Laspeyres chain index method in the calculation of the monthly index of industrial production began in 2002. Finland implemented the chain index method partly because of some user feedback saying that the base year index did not reflect the structural change of economy quickly enough. For example, the index undervalued electrical and electronics industry and overvalued construction sector in the late 1990s.

4.1.2. Chaining period

Each December is the chaining period.

4.1.3. Weight period

The weights are changed annually. Product and establishment weights are changed in the autumn - from September 2012 onwards 2011 weights are used.

Industry weights are changed at the end of the year - from December 2012 onwards value added and gross value weights from 2011 are used.

4.1.4. Is the chained series benchmarked to the annual chained series

Yes, e.g. at the end of the year 2012, Finland calculates the annual index. From December onwards the annual index from year 2011 is published.

4.1.5. At what level is chain-linking performed

At 3-digit level chain-linking is performed.

4.1.6. Calculation of elementary indices

At establishment level: The establishments report their monthly production volumes/values by product, and the lowest-level elementary index (establishment level) is calculated based on this information. Value-form information is deflated before calculations.

First, the reported current monthly production level of each product is compared against the previous year's average monthly production level of the product. Establishment's paired comparisons are then combined by summing their weighted value. The product-level weights are based on each product's production values from the previous year. The establishment-level volume index is formed by dividing the sum of the weighted paired comparisons by the total of the product weights and multiplying by 100. The calculation formula can be found below.

$$IND_{t*}^{t,m}\left(establishment_j\right) = \frac{\sum_{i=1}^{n}\left[w_i\left[\frac{q_i^{t,m}}{\bar{q}_i^{t-1}}\right]\right]}{\sum_{i=1}^{n} w_i} \times 100.$$

$IND_{t*}^{t,m}(establishment_j)$ = volume index for establishment j on year t, month m and statistical year t*.

w_i = product weight for product i

$q_i^{t,m}$ = production of product i in year t and on month m

$\bar{q}_i^{t-1}$ = average of monthly production of product i in year t-1

n = total number of products of establishment j

t* = statistical year, i.e. the year of index calculation

At stratum level: The industry index is first calculated separately for each stratum. Stratum 1 consists of establishments employing 150 or more employees, stratum 2 of establishments with 50-149 employees and stratum 3 of establishments with less than 50 employees.

To form the stratum-level industry index, a sum of weighted establishment-level indices is first calculated. Either establishment weights (sum of establishment's product weights) or weights based on sampling design are used in weighting. Then, the sum of weighted establishment-level indices is divided by the total sum of establishment and sampling design weights to get the stratum-level industry index. The stratum-level industry index is calculated both for the statistical year t and for the comparison year t-1. The calculation formula can be found below.

Note: VAT data is utilized to calculate the industry index for Stratum 3.

$$IND_{t*}^{t,m}(industry_{aaa}^{S_k}) = \frac{\sum_{i=1}^{n}[W_i \times IND_{t*}^{t,m}(establishment_j)]}{\sum_{i=1}^{n} W_i}$$

$IND_{t*}^{t,m}(industry_{aaa}^{S_k})$ = volume index for Stratum k, industry aaa, year t and month m calculated in statistical year t*

$IND_{t*}^{t,m}(establishment_j)$ = volume index for establishment j, year t and month m calculated in statistical year t*

W_i = establishment weight for establishment i

n = total number of establishments belonging to Stratum k on industry aaa

At industry-level: At this stage of the index calculation process, the stratum-level indices are combined to an industry-level index. Stratum indices are weighted using information on the gross value of companies corresponding to each stratum's size. The gross value information is collected from the Structural Business Statistics information. The industry-level index is calculated for both year t and year t-1. The calculation formula can be found below.

$$IND_{t*}^{t,m}(industry_{aaa}) = \frac{\sum_{k=1}^{p}\left[G_k \times IND_{t*}^{t,m}(industry_{aaa}^{S_k})\right]}{\sum_{k=1}^{p} G_k}$$

$IND_{t*}^{t,m}(industry_{aaa})$ = new volume index for industry aaa, year t and month m calculated in statistical year t*.

$IND_{t*}^{t,m}(industry_{aaa}^{S_k})$ = volume index for Stratum k, year t and month m calculated in statistical year t*.

G_k = weight for stratum k, i.e. gross weight

p = total number of strata on industry aaa ($1 \leq p \leq 3$).

At final industry-level: The final industry-level index is achieved by calculating the relative change between the new index for year t and t-1. The comparison year's index is multiplied by this change and thus the final industrial production index for statistical year t* is formed.

$$IND_{t*,final}^{t,m}(industry_{aaa}) = \frac{IND_{t*}^{t,m}(industry_{aaa})}{IND_{t*}^{t-1,m}(industry_{aaa})} \times IND_{t-1*,final}^{t-1,m}(industry_{aaa})$$

$IND_{t*,final}^{t,m}(industry_{aaa})$ = final industry-level index for industry aaa in year t, month m and statistical year t*.

$IND_{t*}^{t,m}(industry_{aaa})$ = new volume index for industry aaa, year t and month m calculated in statistical year t*.

$\frac{IND_{t*}^{t,m}(industry_{aaa})}{IND_{t*}^{t-1,m}(industry_{aaa})}$ = relative change of the new volume index on industry aaa for year t and month m to the new index of the corresponding month in year t-1 calculated in statistical year t*

$IND_{t-1*,final}^{t-1,m}(industry_{aaa})$ = final industry-level index for year t-1 and month m calculated in statistical year t-1*

4.1.7. Calculation of higher-level indices

The final industry-level indices can be used to calculate varying aggregate indices. The aggregate indices are calculated for both the statistical (current) and the comparison year. In aggregation, the industry is weighted based on its value added in the Structural Business Statistics information. Correspondingly to the calculation of the final industry-level index, the relative change between the statistical and comparison year's new aggregate index is

calculated. The final, corresponding aggregate index from the previous year is multiplied by this change to form the final aggregate index for the statistical year.

4.1.8. Source of weights

Survey data: Product weights (value of establishment's previous year's production of the product) and establishment-level weights (sum of product weights or weights based on sampling design).

Structural Business Statistics: Stratum's gross-value weights and the industry's value added.

4.1.9. Year of weights

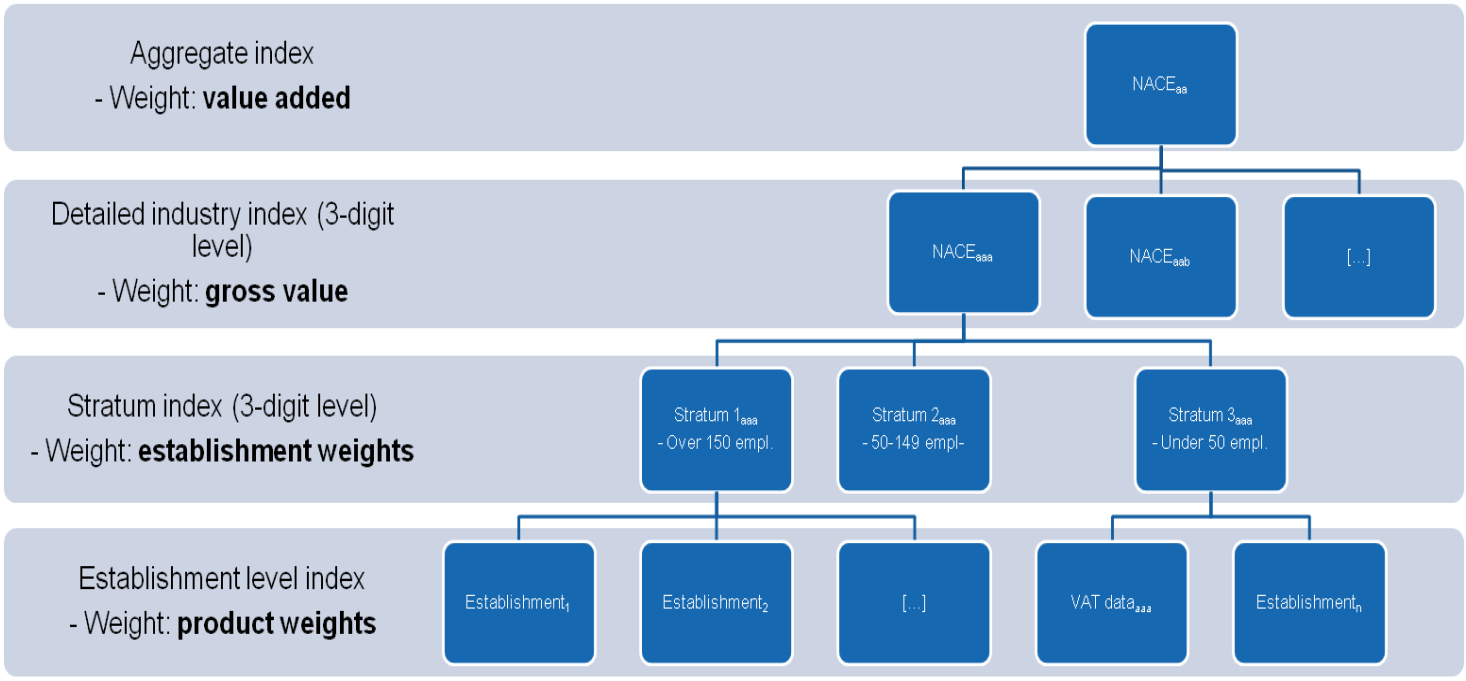
Product and establishment weights from year t-1 are introduced yearly in September.

For example in 2012 from January till October industry weights are from 2010 (t-2) and from November till December IPI uses value added and gross weights based on year 2011 (t-1).

4.1.10. For volume indices: at what level is seasonal adjustment performed

Seasonal adjustment is performed at 3-digit level.

4.1.11. Outline of the workflow



4.2. Croatia IPI

4.2.1. Method applied

The Croatian IPI is partially annually chain-linked Laspeyres type index. IPI weights on aggregates (activity) level are being updating annually using value added information (shares). However, updating weighting coefficient for elementary indices on product level has being done every five years (fix base) since 2005.

Prior to 2005 the annually chain-linked methods for calculation of IPI have been applied on aggregate and elementary indices level. In Croatia actually calculation of the IPI started in 1952 when (long tradition).

4.2.2. Chaining period

The IPI higher level indices are annually chain-linked using an annual overlap (annual average of year t-1).

4.2.3. Weight period

The weights period for calculation of higher level indices (i.e. shares of value added) is t-2 but they are updated regularly to refer to year t-1. The weights period for calculation of elementary indices on product level refers to the fix base period (currently 2005 base year).

4.2.4. Is the chained series benchmarked to the annual chained series

The chained series is not benchmarked.

4.2.5. At what level is chain-linking performed

The chain linking is performed to hieratical level of NKD 2007 (=NACE Rev.2) classes, groups, divisions and sections as well as on aggregate sub-indices levels (MIGs) and IPI total. Series adjusted for working days are also chained according to the method for chaining the unadjusted series.

4.2.6. Calculation of elementary indices

Industrial production volume indices for various levels of the NKD 2007 (= NACE Rev.2) are calculated in two steps according to the Laspeyres formula.

In the first step, elementary indices are calculated from quantity data on production of individual products (summing them up across producers) according to the PRODCOM based national nomenclature (NIPUM) multiplied by adequate weighting coefficient to reach the so cold “mass of values” for each product, which are then summed up to the 4-digit level of NKD 2007 (=NACE Rev.2). Elementary indices are calculating using Laspeyres formula. Weighting coefficients are calculated on the basis of unit values of the annual PRODCOM survey on industrial production for 2005 and are revised every five years.

Production is measured in physical terms by two measurement units, either physical quantities units (products) or effective hours worked (services).

4.2.7. Calculation of higher level indices

Croatian higher level indices are calculating in the second step, in the way that all indices of groups and higher levels of NKD 2007 (= NACE Rev.2) are weighted (multiplied) with shares of value added (so cold activity structure). In this way, the relative importance of individual levels is defined and, at the same time, different levels of coverage are levelled.

The weighs (division structure) was calculated for year t-2 on the basis of the gross value added of factor costs of the Croatian SBS survey results then further corrected with IPI for t-1. The weighs (division structure) are updated at the beginning of every year for the calculation of IPI in a current year.

4.2.8. Source of weights

The source of the weights for NACE Rev.2 hieratical levels (3-digits, 2-digits, Section, MIGs) is the annual SBS survey that are calculating as share of value added at factor cost in the t-2 year then corrected with IPI for t-1 year. Source for IPI is Monthly survey for industrial production.

The source for calculating weighting coefficients for aggregating quantities of products to elementary indices on 4-digit class level is annual PRODCOM survey on industrial production (currently for year 2005).

4.2.9. Year of weights

Weights for higher level indices refer to year t-2, but they are updated to represent year t-1 using the industrial statistics information (IPI for year t-1).

Weights for calculating elementary indices, that are, weighing coefficients refer to year t-5 (fix base year).

4.2.10. Are other sources used to update weights to T-1

Industrial statistics are used to update weights to t-1.

4.2.11. For volume indices: at what level is seasonal adjustment performed

Croatian IPI is compiled as unadjusted, working-day adjusted, seasonally adjusted and trend-cycle indices. IPI adjustments are made for the Industry total, MIGs and Divisions of NKD 2007 (=NACE Rev.2).

TRAMO-SEATS method (regression method) based on ARIMA models, is used for the adjustment, on a time series from January 1998. Direct method is used for the seasonal adjustment of time series. In the seasonal adjustment the impact of the number of workdays, Easter and other national holidays was taken into account in those time series for which the mentioned influences were statistically significant.

4.2.12. Outline of the workflow: which step is done when

In general, SBR and PRODCOM are using as a frame for Croatian Monthly survey on industrial production (cut off survey). The selection of enterprises has being done according

to number of persons employed and share in value added on 4-digit level. The workflow steps are:

1. Updating of sample frame according to selection criteria. Updating sample includes refreshing the sample with new enterprises/local units as well as eliminating those below the selection criteria (December/January)

2. Selection of the new born enterprise and enterprise above selection criteria to be contacting by phone or e-mail (January)

3. Updating the weights by combining information from SBS results and IPI. Distribution of weights to all hieratical levels concerns in IPI calculation (December/January).

4. Uploading the updated IPI databases with new weights then making final software settings for regular data collection (IPI survey is CAWI based), processing, validation, computing and dissemination (January/first half of February)

5. Opening dedicated web-site for new IPI data collection (10th of February each year)

6. Data collection (CAWI), validation, processing and computing the chain-linking PPI (second half of January to 20th of February)

7. Analysing the IPIs (possible correction – go back to individual data), preparation for publications and finally dissemination to national users and Eurostat (+35 at latest)

4.3. Slovenia IPI

4.3.1. Calculation

Slovenia calculates and publishes indices on industrial production as follows:

1. Current month on last year basis, e.g. February 2012/ϕ2011 based on reported data (including imputed and deflated data);

2. Current month on previous month, e.g. February 2012/January 2012 = (Feb2012/ϕ2011) / (Jan2012/ϕ2011) using the one-month overlap method;

3. Current month of the current year on current month of the previous year, e.g. February 2012/February 2011 = (Feb2012/ϕ2011) / (Feb2011/ϕ2011) using the over-the-year method;

4. Current period of the current year on current period of the previous year, e.g.

(January - February 2012)/(January - February 2011) $= \frac{\left(\frac{Jan2012}{\phi 2011}\right)+\left(\frac{Feb2012}{\phi 2011}\right)}{\left(\frac{Jan2011}{\phi 2011}\right)+\left(\frac{Feb2011}{\phi 2011}\right)} * 100$

using the over-the-year method.

Indices of current month on last year basis are calculated directly from reported data and all other indices are calculated from these basic indices.

4.3.2. Weights

From 1952 to 2004 Slovenia was collecting quantity data on the production of individual industrial products and services and Slovenia was using weights (which were shares of value added) when aggregating data (calculation of IPI for the higher levels of classification). Shares were based on the data on value added from the year 2000 and were corrected every year with growth of the IPI.

From 2005 (2004) to 2008 Slovenia started collecting value data and for the purpose of calculating weights shares of value added were based on the data on value added from the year 2005 and were also corrected every year with growth of the IPI.

From 2008 on Slovenia is still collecting value data but we adjust weights as soon as the value added data is available (published). Once a year weights are adjusted due to provisional value added data and once a year due to final value added data for a specific year.

Industrial data from January 2011 on is currently still provisional. Since Slovenia has only available value added data for 2010, Slovenia uses it on data (indices) for 2011 and 2012 because until Slovenia publishes final industrial data for 2011, that is possible. This is the reason we use t-1 and also temporarily t-2 weights. As soon as the value added data become available for 2011, Slovenia will use them instead of that for 2010.

4.3.3. Outline of the workflow

January: sampling (a new list of reporting units), updating documentation.

February: Sending questionnaires to reporting units and updating programmes.

March: adjusting weights (and in October), controlling data on new reporting units, adjusting models for seasonal adjustment.

Each month: When data on turnover (domestic, non-domestic, euro area, non-euro area), new orders (domestic, non-domestic, euro area, non-euro area) and stocks in industry is received, Slovenia imputes missing values (for new orders there is imputation of »0«) and deflates all data. Then Slovenia calculates value of production for each reporting unit. Slovenia has defined so called industrial groups (for the purpose of weighted IPI) and in the next step Slovenia calculates value of production for each industrial group. Then Slovenia calculates the aggregated non-weighted IPI for each industrial group. In the end weights are used for calculating aggregated levels. From reported data (imputed, deflated) Slovenia calculates indices for current month on last year basis and then chain-linking is used for the calculation of all other indices. After that seasonal adjustment is performed – only on data series 2005=100.

Slovenia started chain-linking in 2003 with a custom made software. The revision of weights is done very quickly in just a few minutes because of the automated system (Enterprise Guide 4).

Enterprise births and deaths are dealt on a monthly basis. If a new enterprise arise, it is included in the survey and if an enterprise dies, it is excluded from the survey (enterprise is given a status which explains what happened with it) – enterprise is no longer involved in calculating indices.

4.4. United Kingdom IPI

4.4.1. Overview

The United Kingdom IPI is an annually chained Laspeyres-type volume index, which uses the quarterly overlap method and benchmarking to the annual series. This ensures that the quarterly series is consistent with the annual series, while still maintaining the quarterly path. According to the UN SNA 2008 this gives the best results. Following user engagement, this method was considered the most cost effective way to implement chain-linking and meet users' needs. A consistent approach is taken for all of the short term indicators (IPI, IoS, RSI) within the United Kingdom National Accounts. A comparison of the quarterly and the annual overlap techniques can be found in the following sub-chapter.

Chaining is done via a single quarter overlap, with the link period being Q4 of the previous year, up to the latest base year. Data for 2008 and onwards is linked onto the 2007Q4 value, and the index is referenced to 2008 = 100.

For the most part of the times series, the weights period is the previous year. However, for recent years (currently 2009 and onwards), weights are taken from the base year – 2008. This ensures that the series are additive in the most recent years; which was identified as advantageous for our users. The base year updates by one each year, as new weights data become available.

The weights are based on Gross Value Added and are obtained from the Supply Use Tables. In a typical year, 2 years worth of data are open for revisions, and so the final weighting data are not confirmed until 3 years after the year (i.e. 2009 weights will be introduced in 2012).

The quarterly series is benchmarked to the annual chained series to ensure that the annual growth pattern is maintained, and the 4 quarters in a year average to the annual level.

Chain-linking is performed at the Supply Use Table level. At this level, the economy is divided into 114 industries, and typically corresponds to the 2 or 3 digit level of NACE Rev2. This level was decided upon, based on costs, data availability and user requirements; it ensures compliance with ESA 2012 transmission programme which requires data at the A64 level.

The current price series are calculated from data collected in a monthly business survey. Data is collected at a detailed level and summed to SUT-114 level. At this stage, elementary indices are calculated as fixed base indices, by deflating the CP series by an appropriate price index (which could be a PPI, SPPI or HICP etc). Quantities are then expressed in terms of previous year prices and current year prices and unchained indices calculated.

Higher level series are calculated by un-linking the indices, aggregating them together, and then chaining them together by multiplying by a scaling factor.

Seasonal adjustment is performed at the same level that the indices are chain-linked at – SUT-114.

4.4.2. Comparison of quarterly and annual overlap techniques

As mentioned before, the UK Index of Production (IPI), Index of Sevices (IoS) and Retail Sales Index (RSI) are all annually chain-linked indices, using the quarterly overlap technique with benchmarking. This same chain-linking methodology is used consistently throughout the UK national accounts. The UK short term volume indicators (IPI, IOS, RSI) are fully integrated with the quarterly and annual national accounts; that is, monthly estimates are constrained to sum to annual estimates, both in terms of current and constant prices. It is therefore an important requirement for the UK that these basic accounting conventions are preserved within a chain-linked system. A further requirement is that the quarterly system of accounts should provide good measures of growth, with no discontinuities, and it should allow for growth to be estimated over varying period lengths.

The choice of an annually-chained Laspeyres index as the formula for computing annual growth rates is straightforward and unambiguous. However, the specific linking methodology has to take into account a number of factors including consistency with other series, monthly path and annual growth rates. Consultation with key users of these statistics revealed that there was a strong requirement for the best measure of growth for all quarters and coherent data where months sum to years.

A consistent approach to chain-linking has to be taken for the quarterly national accounts and short term volume indicators, in order to ensure consistency between the different series. The quarterly path is best calculated using the quarterly overlap technique (with Q4 being the link period), as using an annual overlap can introduce a jump between Q4 of one year and Q1 of the next. Applying the quarterly overlap to a monthly series ensures consistency with the quarterly series, while maintaining a smooth monthly path. However, on its own, quarterly overlap can lead to divergence between the monthly / quarterly series and the annual series. Thus, the monthly series is benchmarked to the annual series in order to ensure consistency with the annual series and remove any divergence. Consequently, quarterly overlap with benchmarking combines the principal advantages of both quarterly overlap (best intra-year path) and annual overlap (consistency with annual data), and meets the requirements of key users of the data.

The annual overlap and quarterly overlap linking methodologies have been compared, using data from the UK Index of services (Figure 1). Absolute differences are small, totalling less than 0.5 index points over a 15 year period. As expected, within-year movements are invariant of the chain-linking methodology used, but the December – January movements do depend on the specific methodology used. The growth between December of one year and January of the following year is, on average, 0.04 percentage points lower when the annual overlap method is used (Table 1). This is a measure of how much the annual overlap method distorts the December – January movement, and also a measure of the discrepancy introduced by the quarterly overlap method if no benchmarking is carried out.

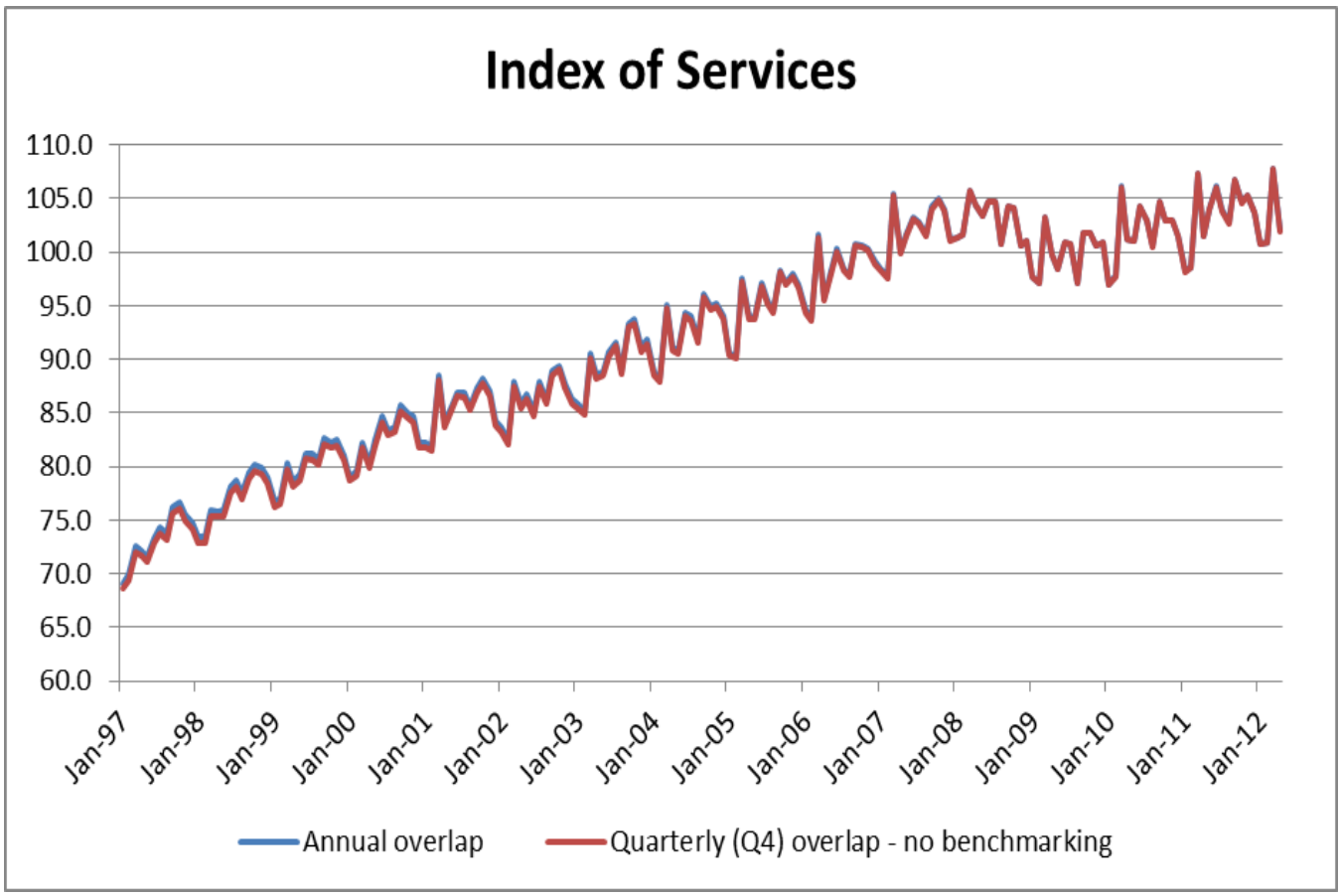


Figure 1: Comparison of the non-seasonally adjusted UK Index of Services compiled using the annual overlap and quarterly overlap without benchmarking methodologies. The two methodologies give almost identical time series, with differences of less than 0.5 index points in 1996 and less than 0.1 in 2012.

		Annual overlap	Q4 overlap	difference
Dec-97	Jan-98	-1.24%	-1.21%	-0.03%
Dec-98	Jan-99	-2.61%	-2.57%	-0.04%
Dec-99	Jan-00	-2.50%	-2.42%	-0.08%
Dec-00	Jan-01	0.85%	0.98%	-0.13%
Dec-01	Jan-02	1.06%	1.08%	-0.02%
Dec-02	Jan-03	0.19%	0.19%	0.00%
Dec-03	Jan-04	-2.38%	-2.31%	-0.07%
Dec-04	Jan-05	-3.03%	-2.97%	-0.06%
Dec-05	Jan-06	-1.41%	-1.35%	-0.05%
Dec-06	Jan-07	0.95%	0.98%	-0.03%
Dec-07	Jan-08	1.57%	1.64%	-0.07%
Dec-08	Jan-09	-3.23%	-3.28%	0.05%
Dec-09	Jan-10	-3.29%	-3.34%	0.05%
	average	-1.16%	-1.12%	-0.04%

Table 1: December – January movements as calculated from the UK IoS using annual overlap and Q4-overlap chain-linking methodologies.

For UK the key advantages of the quarterly overlap and benchmarking to the annual series method are that there is no artificial jump in the monthly series and data are consistent with the annual and quarterly national accounts.

4.5. United Kingdom Retail Sales Index

4.5.1. Overview

The retail sales index (RSI) is an annually chained Laspeyres volume type index. Price deflators used are Consumer Price Indices (CPI's {HICP's}). Commodity price indices are created from aggregating low level CPI's using CPI weights. CPI's are chain-linked Laspeyres indices referenced to 2005=100 and are collated monthly. CPI weights are updated annually using National Accounts Household Expenditure data

RSI's are produced monthly, with the majority of volume measures created by deflating turnover data. Currently the index is referenced to 2008=100 with 2008 being the last base year. Chain-linking is performed at the 4 digit level, separately for large and small/medium businesses.

The link period is the fourth quarter of each year.

4.5.2. The chain-linking method

The RSI is annually chain-linked using the same methods as the UK National Accounts. The basic steps taken in our system to calculate chained volume measures are as follows:

1. Indices below the level of chain-linking are calculated as Laspeyres volume fixed base indices.

2. These indices are multiplied by their respective weights. (Weights based on value of sales proportions calculated from RSI data.)

3. The resultant series are multiplied by their respective weight in the previous year (t-1) and then divided by the sum of all series created in step 2 for year t-1. This creates a monthly series in Previous Year's Prices (PYP).

4. Following the same process as 3 we create a monthly series in Current Year's Prices (CYP) by multiplying by current years (t) weights and dividing by the sum of all series created in step 2 for year t.

5. PYP's and CYP's are then aggregated to the level of chain-linking (4-digit level, separately for Large and Small/Medium businesses).

6. First the system calculates internal scaling factors. Initially these are set to 1 for all time periods after the last base year (i.e. after December of last base year, so if 2006 is the last base year, all scaling factors from January 2007 are set to 1).

7. The system then works backwards to calculate all other scaling factors.

8. For the month of December, scaling factors are calculated as January's scaling factor multiplied by CYP for the link period divided by the PYP for link period.

E.g. December 2004 SF = January 2005 SF x (Q4 2004 CYP/Q4 2004 PYP).

9. These scaling factors are then used for all months back to the next December when the above calculation is repeated.

10. When there are no more previous years prices the last (first) scaling factor is carried backwards to the start of the series.

11. The unconstrained chained volume measure (CVM) is then calculated as:

the CYP series for the time period multiplied by the scaling factor if no PYP's available (usually at the start of the series); or

the PYP series for the time period multiplied by the scaling factor.

12. These unconstrained chained volume measures are then benchmarked to the annual chained volume measures.

13. Periods after the last base year are set to the unconstrained series.

14. Annual chained volume measures are calculated by applying the same steps but to annual indices.

4.5.3. Software

Chain-linking was introduced using standard UK Office for National Statistics (ONS) software. From September 2010 the RSI has been switched to a newly developed system called CORD, which is an Oracle based system. Other National accounts outputs IoP (IPI) and IoS (Services) all use the same method.

4.5.4. Dissemination

Data is disseminated monthly through a Statistical Bulletin http://www.ons.gov.uk/ons/rel/rsi/retail-sales/april-2012/stb-april-2012.html

Tables published include value and volume indices, month on a year ago, month on month, 3 month on 3 month and 3 months on a year ago growth rates.

4.5.5. User requirements/engagement

Following user engagement, annual chain-linking was identified as one of the major user requirements for the RSI.

As a key input into the GDP(O) calculation, both internal (mainly National Accounts) and external users believed the RSI should adopt methods to bring them in-line with National Accounts.

The method used was considered the most cost effective way for the UK to implement chain-linking as the software developed is used for the RSI, Index of Production and Index of Services.

Provided consistency for users across the National Accounts

Chain-linking was introduced alongside a number of other methodological improvements. The article 'Changes to the retail sales methodology' describes all the changes made including chain-linking and the overall impact on the 'all retailing' aggregate.

http://www.ons.gov.uk/ons/guide-method/method-quality/specific/economy/retail-sales/changes-to-retail-sales-methodology.pdf

As there were numerous methods changes made to the RSI at this point in time the impact from chain-linking alone could not be isolated.

Key users including, the Bank of England, Her Majesty's Treasury and the Department for Business, Innovation and Skills were fully consulted on the changes and accepted them as a major improvement to methods.

4.5.6. Other related chain-linking research

As mentioned above the UK has also introduced chain-linking using the same methods as RSI for the Index of Production and Index of Services. Some key points for the approach used for these two indicators are:

1. Weights are based on Gross Value Added and obtained from Supply Use Tables.

2. Chain-linking is performed at the Supply Use Table level (Typically 2-3 digit level of NACE Rev2 for Production and 2-digit level of NACE Rev2 for Services). This ensures we are compliant with the ESA 2010 transmission programme which requires data at the A64 level.

3. Level of chain-linking was decided based on costs, availability of data, user needs (particularly National Accounts and the Bank of England).

4. Methods ensure compliance with the ESA95 (and ESA10) regulations.

4.5.7. Basic RSI workflow

1. Calculate turnover series (rotation sample)

2. Deflate turnover (using aggregated CPI's)

3. Seasonally adjust

4. Aggregate and Chain Link

5. NOMINAL INDICES

Annual chain-linking is relevant for price and volume measures. However, for nominal indices, e.g. turnover at current prices or number of persons employed, annual chain-linking is not relevant. The relationship between nominal index, volume index and price index is as follows: the nominal index divided by the volume index equals the price index. If for example the reporting period is January 2012 and the reference year is 2010. It follows for the nominal index, chain-linking is not relevant, the annual chain-linked volume index uses

the annual overlap technique and the resulting annual chain-linked price index is a Paasche index.

6. BUILDING UP A CHAINED INDEX ON A PREVIOUS FIXED ONE (EXAMPLE FROM ITALIAN PPI)

This Task Force contribution deals with the topic of nesting a chained price index on a fixed base one. A brief note has also added and focuses the rate of change index decomposition in chain-linking, on the basis of the results introduced by M. Ribe.

6.1. Chained index formulas

Let us suppose the overall index be made up of k sub-aggregates; at time $Y=y$, the calculation base (CB) index is

[1] $$I_{y,0}^{y,m} = \sum_k I_{y,0}^{y,m}(k) \times w_{y,0}(k)$$

and the reference (RB) base or chained index is

[2] $$CI^{y,m} = I_{y,0}^{y,m} \times \prod_{j=B}^{y-1} I_{j,0}^{j,12}$$

Indeed, the formula [2] is got by developing recursively the equation

[3] $$CI^{y,m} = I_{y,0}^{y,m} \times CI^{y-1,12}$$

with respect to the second term on the right side. In fact

[4] $$CI^{y-1,12} = I_{y-1,0}^{y-1,12} \times CI^{y-2,12}$$

Substituting [4] in [3] we get

[5] $$CI^{y,m} = I_{y,0}^{y,m} \times I_{y-1,0}^{y-1,12} \times CI^{y-2,12}$$

The last term on the right side of the equation [5] can be developed as in [3] and then substituted in [5]. After $y-1$ steps, this recursively approach leads to the chain product in equation [2] (the second factor on the right hand side) so that

[6] $$\prod_{j=B}^{y-1} I_{j,0}^{j,12} = I_B^{B,12} \times I_{1,0}^{1,12} \times \ldots \times I_{y-2,0}^{y-2,12} \times I_{y-1,0}^{y-1,12} = \prod_{j=B}^{y-2} I_{j,0}^{j,12} \times I_{y-1,0}^{y-1,12}$$

Therefore, the equation [2] can be re-written as

[7] $CI^{y,m} = I^{y,m}_{y,0} \times I^{y-1,12}_{y-1,0} \times \prod_{j=B}^{y-2} I^{j,12}_{j,0}$

so that the equations [3] and [7] are equivalent, i.e.

[8] $CI^{y-1,12} \Leftrightarrow I^{y-1,12}_{y-1,0} \times \prod_{j=B}^{y-2} I^{j,12}_{j,0}$

Given the equations [3], [7] and the equivalence [8], it is straightforward to note that

[9] $I^{y,m}_{y,0} = CI^{y,m} \div CI^{y-1,12} \Leftrightarrow I^{y,m}_{y,0} = CI^{y,m} \div \left(I^{y-1,12}_{y-1,0} \times \prod_{j=B}^{y-2} I^{j,12}_{j,0} \right)$

The formula [9] simply shows that once the chained index is appropriately compiled, we can get the CB index by reversing the formula [3] or, equivalently, the formula [7]. In this sense, formulas [3] and [7] are strictly coherent. Trivially, all these formulas – as shown below – refer the overall index; the corresponding formulas for the sub-aggregate can be derived by specifying – for each sub-aggregate – the subscript k.

6.2. Nesting chain-linking on a fixed base price index

In the present context, the index type changeover (ITC) concerns the transition from a fixed base index to a chained one. Depending upon the time when the transition occurs, the chained index can be or not affected by a drift. In particular, if the ITC coincides with the index base changeover (IBC), no drift in the level will affect the chained index. Differently, if the ITC takes place and the index base is still unchanged, the chained index could lye – for any given sub-aggregate k and the overall index as well – up or down its "true" path.

6.2.1. ITC and IBC coincident

This case is rather theoretical. The index is fixed base type up to the time $Y = y-1$ and since the time $Y = y$ the index is chained. Besides, up to until $Y = y-1$ the (fixed) index base is $B0$ ($B0 < y-1$) and since $Y = y$ onwards $B1$ ($B1 = y$, then $B0$ prior $B1$ i.e. $B0 < B1$). To get the index time series expressed in the same base, the linking coefficient from $B0$ to $B1$ is compiled. It's worth noting that in $Y = y$, CB and RB coincide by construction; since $Y = y+1$, RB = $(y,12)$.

A variant of the same case occurs when $B1 < y-1$. In other words, the period chosen as new index base is prior the time when the IBC and ITC take place. As this situation generates a drift in the index level, it will be analysed in 2.2.

6.2.2. ITC later IBC

Let us suppose to be at time $Y = y$, carrying out the ICT. We also make the hypothesis the index base remains unchanged. So doing, the time $Y = y$ separates the index time series in two intervals: on the left, the interval $Y < y$, where the (fixed) base B holds; on the right, the interval $Y \geq y$ where the (reference) base is still B, but the index is annually updated.

In $Y=y$, the simplest way of approaching the chain-linking is to use the short formula [3]. In practice – being α years later B – this choice is very attractive because the chained index is straightforwardly compiled. On the other hand, owing to the CB lag, through this way the coherence (in the sense defined above) of the chained index comes less: equivalently, the index is affected by a drift.

To see this is sufficient to pay our attention on the equations [2] or [7]. Using directly the formula [3] – α years later B – we are actually stopping the recursively product to its next to the last term. Consequently we are not using [3] but its truncated version

[10] $$CI_T^{y,m} = I_{y,0}^{y,m} \times CI_T^{y-1,12}$$

where

[11] $$CI_T^{y,m} \equiv I_{y-1,0}^{y-1,12}$$

Therefore the equation [9] is substituted by

[13] $$I_{y,0}^{y,m} = CI^{y,m} \div CI_T^{y-1,12}$$

Truncating the equation [6] means to get

$$\prod_{j=B}^{y-2} I_{j,0}^{j,12} = 1$$

This position does not hold in practice (especially when α is far from B) because the above product will be less or greater than 1[1]. In particular, we get the *upper drift* if

[14] $$\prod_{j=B}^{y-2} I_{j,0}^{j,12} < 1 \Rightarrow CI_T^{y,m} > CI^{y,\,m} \;\forall\, Y \geq y$$

and the *lower drift* if

[15] $$\prod_{j=B}^{y-2} I_{j,0}^{j,12} > 1 \Rightarrow CI_T^{y,m} < CI^{y,\,m} \;\forall\, Y \geq y$$

6.2.3. Chain-linking drift adjustment

We have seen that the drift in the index level originates when using the short (see truncated) chain-linking formula. Further, as the drift can differently affect the sub-aggregates, some of these could lye up and other down their theoretical path (where the drift is null). The result is that the RB structure is incoherent – in the sense defined above – and not homogeneous

[1] Really, the product could also be equal to one, for some sub-aggregate. Anyway this is rather unlikely, especially when α is far from B.

among the sub-aggregates. To bypass the drift we need to substitute the unknown product in [6] by an estimation

$$[16]\quad \prod_{Y=B}^{y-2} \hat{I}_{j,0}^{Y,12} \rightarrow \prod_{Y=B}^{y-2} \hat{I}_{j,0}^{Y,12}$$

As shown in [16], although the index is supposed to be (monthly and) fixed base type until $Y=y-1$, it is not necessary to re-build up it month by month for the whole backwards period. Moreover, we need only to reconstruct the index for each month of December, i.e. to make an estimation of the index as if it were chained.

It is worth focusing that the partial index re-compilation is really an estimation because we are supposing that both the weights and the enterprises remain unchanged. The annual index updating should concern prices, weights and reporting units but, for our purposes, it is sufficient to update only prices. The simulation is such in this sense.

In detail, the estimation – in $(Y,12)$ – is carried out at price relatives level: each ratio is re-built up by substituting the old denominator $(0,\overline{m})$ [2] with the new one, given by the price surveyed at the time $(Y-1,12)$. Therefore it will holt for $\alpha-1$ times the following substitution

$$[17]\quad I_{FB}^{Y,12} \rightarrow \hat{I}_{j,0}^{Y,12},\ Y=B,...,y-1$$

where the index on the left is the old fixed base one that is going to be replaced by the *estimated-chained* index. So doing finally we get the equation [10] is replaced by the following

$$[18]\quad \hat{CI}^{y,m} = I_{y,0}^{y,m} \times \hat{CI}^{y-1,12}$$

where

$$[19]\quad \hat{CI}^{y-1,12} = I_{y-1,0}^{y-1,12} \times \prod_{j=B}^{y-1} \hat{I}_{j,0}^{j,12}$$

Consequently, the results in [19] are now substituted by

$$[20]\quad I_{y,0}^{y,m} = \begin{cases} \hat{CI}^{y,m} \div \hat{CI}^{y-1,12} \\ \Updownarrow \\ \hat{CI}^{y,m} \div \left(I_{y-1,0}^{y-1,12} \times \prod_{j=B}^{y-2} \hat{I}_{j,0}^{j,12} \right) \end{cases}$$

[2] Usually, in the monthly fixed based index, the denominator of price relatives is given by the monthly mean of prices surveyed in the year base.

Therefore in the following equation

$$[21]\quad C\hat{I}^{y,m} = I_{y,0}^{y,m} \times \prod_{j=B}^{y-1} \hat{I}_{j,0}^{j,12}$$

we find again the consistency of [2]; the estimation of calculation bases leads to the result expected: the drift has been removed.

Up to until now, in re-building up the index, we have implicitly supposed – managing price relatives – that replacing the old price with the new one were straightforward. Indeed, prices and then price relatives of each month of December have to be checked and in case adjusted. As knew, analysing a price relative, the quality change consists in updating its denominator. Estimating the CB, the replacement of the fixed base price in December, $(0,\overline{m})$, with that of the previous year, $(Y-1,12)$, could be affected by an error if we wouldn't take into account the changing in the price relative denominator.

To see this, let the time interval between the months of December of two adjacent years be $[(Y-1,12),(Y,12)], 1 \le Y \le y-1$; supposing that a quality change took place in $m, m \in [(Y-1,12),(Y,12)]$, the above interval is split into two parts: $[(Y-1,12),(Y,m)] \cup [Y,\ge m]$. Until m, i.e. for any month before m, the price relative of k (being k any price time series), is

$$[22]\quad P^{Y,<m}(k) = \frac{p^{Y,<m}(k)}{p^{0}(k)}$$

Since m onwards, i.e. up to $[Y,12]$ the same ratio is

$$[23]\quad P^{Y,\ge m}(k) = \frac{p^{Y,\ge m}(k)}{p^{1}(k)}$$

where $p^1(k)$ is the price relative base embodying the quality change. To estimate the CB at time $Y, 1 \le Y \le y-1$, $p^0(k)$ has to be replaced with $p^{Y-1,12}(k)$. If, in the meanwhile, i.e. in the month m, the price relative denominator changed (because of a quality change), this substitution should provide a biased price relative, being no more comparable the prices at the numerator and denominator. The adjustments works as follows

$$[24]\quad \hat{P}^{Y,12}(k) = \begin{cases} \dfrac{p^{Y,12}(k)}{p^{Y-1,12}(k)} & \text{if no QC took plase} \\ \dfrac{p^{Y,12}(k)}{p^{Y-1,12}(k)} \times \dfrac{p^{Y,<m}(k)}{p^{Y,\ge m}(k)} & \text{if a QC took place} \end{cases}$$

In conclusion, the equations [18] and [19] have been defined by re-building up the index at price relatives level, by applying the results in [24].

6.3. Index dynamics in chain-linking: applied topics

6.3.1. The Ribe's rate of change decomposition

Decomposing the (twelve-month) index rate of change. Let us start from the following equation

$$[25]\quad D_{y,0}^{y,y-1} = \frac{I_{y-1,0}^{y-1,12}}{I_{y-1,m}^{y-1,m}} \times I_{y,0}^{y,m} - 1$$

Adding and subtracting $I_{y-1,0}^{y-1,12}$, on the right side of [25] we get

$$[26]\quad D_{y,0}^{y,y-1} = \underbrace{\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,m}^{y-1,m}} \times \left(I_{y,0}^{y,m} - 1 \right)}_{D_{y,0}^{y,y-1}(\alpha)} + \underbrace{\left(\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,m}^{y-1,m}} - 1 \right)}_{D_{y,0}^{y,y-1}(\beta)}$$

where

$D_{y,0}^{y,y-1}(\alpha)$

and

$D_{y,0}^{y,y-1}(\beta)$

denote respectively the component provided by the current year and that of the previous year, determining the 12-month rate of change.

Supposing the overall index be composed by k elementary aggregates, the 12-month rate of change can be decomposed in k additive sub-components

$$[27]\quad D_{y,0}^{y,y-1} = \sum_k \frac{I_{y-1,0;k}^{y-1,12}}{I_{y-1,0;k}^{y-1,m}} \times I_{y,0;k}^{y,m} - 1$$

$$\equiv \sum_k C_{y-1,m;k}^{y,m}$$

Posing

$$[28.1]\quad I_{y-1,0}^{y,m} = \sum_k I_{y,0;k}^{y,m} \times w_{y,0;k}$$

$$[28.2]\quad I_{y-1,0}^{y-1,12} = \sum_k I_{y-1,0;k}^{y-1,12} \times w_{y-1,0;k}$$

$$[28.3]\quad I_{y-1,0}^{y-1,m} = \sum_k I_{y-1,0;k}^{y-1,m} \times w_{y-1,0;k}$$

and using the result in [26], we have

$$[29]\quad D_{y,0}^{y,y-1}=\sum_k \frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}}\times\left(I_{y,0}^{y,m}-1\right)+\sum_k\left(\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}}-1\right)$$

Posing

$$[30.1]\quad C_{y-1,m}^{y,m}(\alpha)=\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}}\times\left(I_{y,0}^{y,m}-1\right)$$

$$[30.2]\quad C_{y-1,m}^{y,m}(\beta)=\left(\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}}-1\right)$$

we can write the complete formula

$$[31]\quad C_{y-1,m;k}^{y,m}=w_{y,0;k}\times\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}}\times\left(I_{y,0;k}^{y,m}-1\right)$$
$$+\frac{w_{y-1,0}}{I_{y-1,0}^{y-1,m}}\times\left(I_{y0;k}^{y-1,12}-I_{y-1,0;k}^{y-1,m}\right)$$

Therefore, remembering the positions [28.1]-[28.3] we get

$$[32]\quad C_{y-1,m;k}^{y,m}(\alpha)=w_{y,0;k}\times\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}}\times\left(I_{y,0;k}^{y,m}-1\right)$$

$$[33]\quad C_{y-1,m;k}^{y,m}(\beta)=\frac{w_{y-1,0}}{I_{y-1,0}^{y-1,m}}\times\left(I_{y0;k}^{y-1,12}-I_{y-1,0;k}^{y-1,m}\right)$$

6.3.2. Some algebraic topics of the above formulas

Let us consider the equations [32] and [33]. Analysing their parameters, we note that

$$[34.1]\quad C_{y-1,m}^{y,m}(\alpha)=0\Leftrightarrow I_{y,0}^{y,m}=1$$

$$[34.2]\quad C_{y-1,m}^{y,m}(\beta)=0\Leftrightarrow\frac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}}=1$$

It follows that

$$[34.3]\quad C_{y-1,m}^{y,m}=0\Leftrightarrow\begin{cases}I_{y,0}^{y,m}=1\\ \textit{and}\\ I_{y-1,0}^{y-1,12}=I_{y-1,0}^{y-1,m}\end{cases}$$

Further, m=12 is a sufficient condition for

[34.4] $C_{y-1,m}^{y,m}(\beta) = 0$

and it holds .

[34.5] $C_{y-1,m}^{y,m}(\alpha) = \left(I_{y,0}^{y,m} - 1 \right)$

Note that:

[35] $$C_{y-1,m}^{y,m}(\beta) = 0 \Leftrightarrow \begin{cases} \dfrac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}} = 1, \; if \;\; m = 12 \\ \dfrac{I_{y-1,0}^{y-1,12}}{I_{y-1,0}^{y-1,m}} = 1, \; m \neq 12 \Leftrightarrow I_{y-1,0}^{y-1,12} = I_{y-1,0}^{y-1,m} \end{cases}$$

Finally, if

$I_{y,0}^{y,m} = 1$

then

[36] $C_{y-1,m}^{y,m} = C_{y-1,m}^{y,m}(\beta)$

7. COST-BENEFIT ANALYSIS

7.1. Test calculations

7.1.1. France

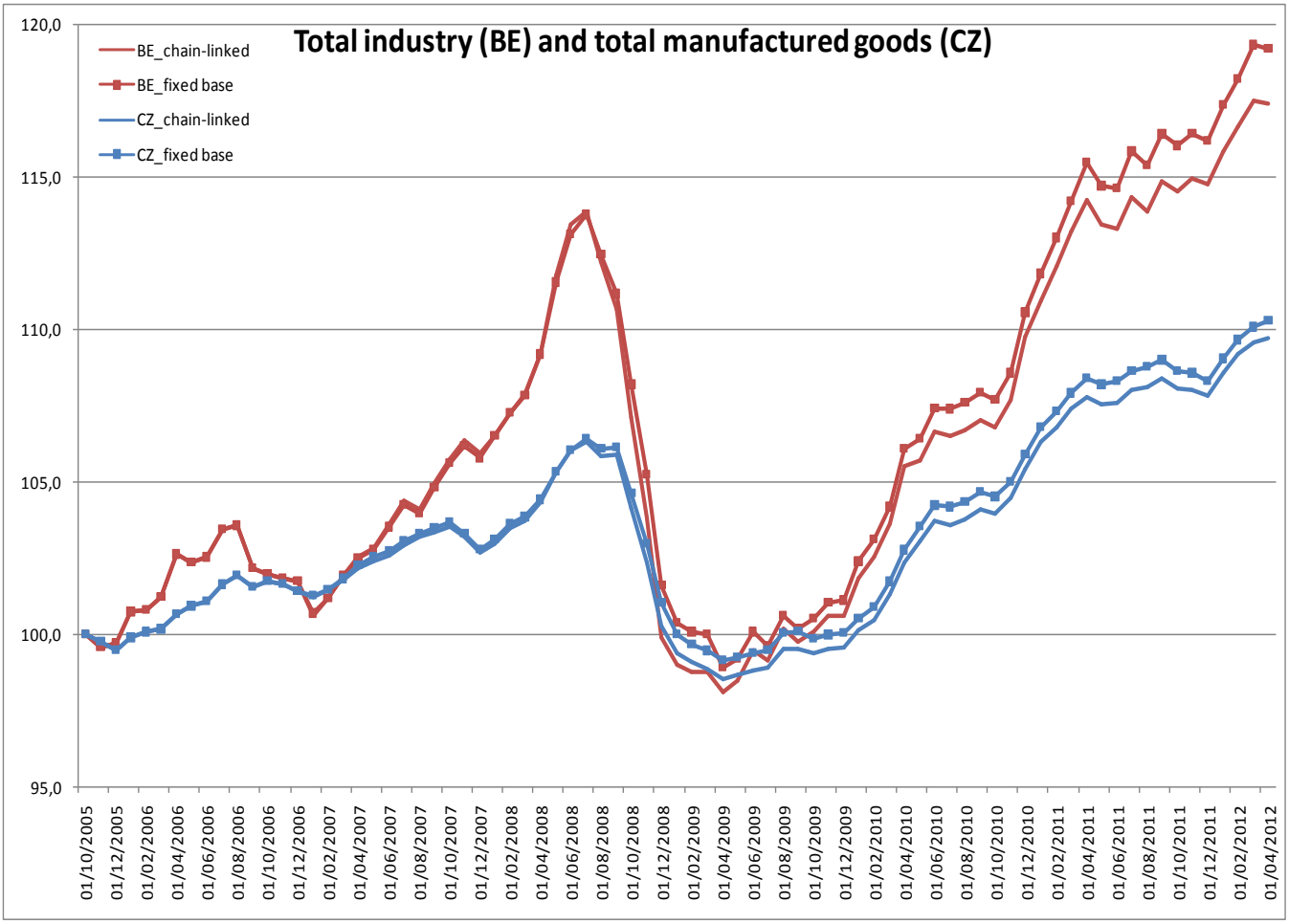
The test calculations have been performed on import prices only. The methods of PPI, S-PPI and import prices are strictly common, except that S-PPI is quarterly.

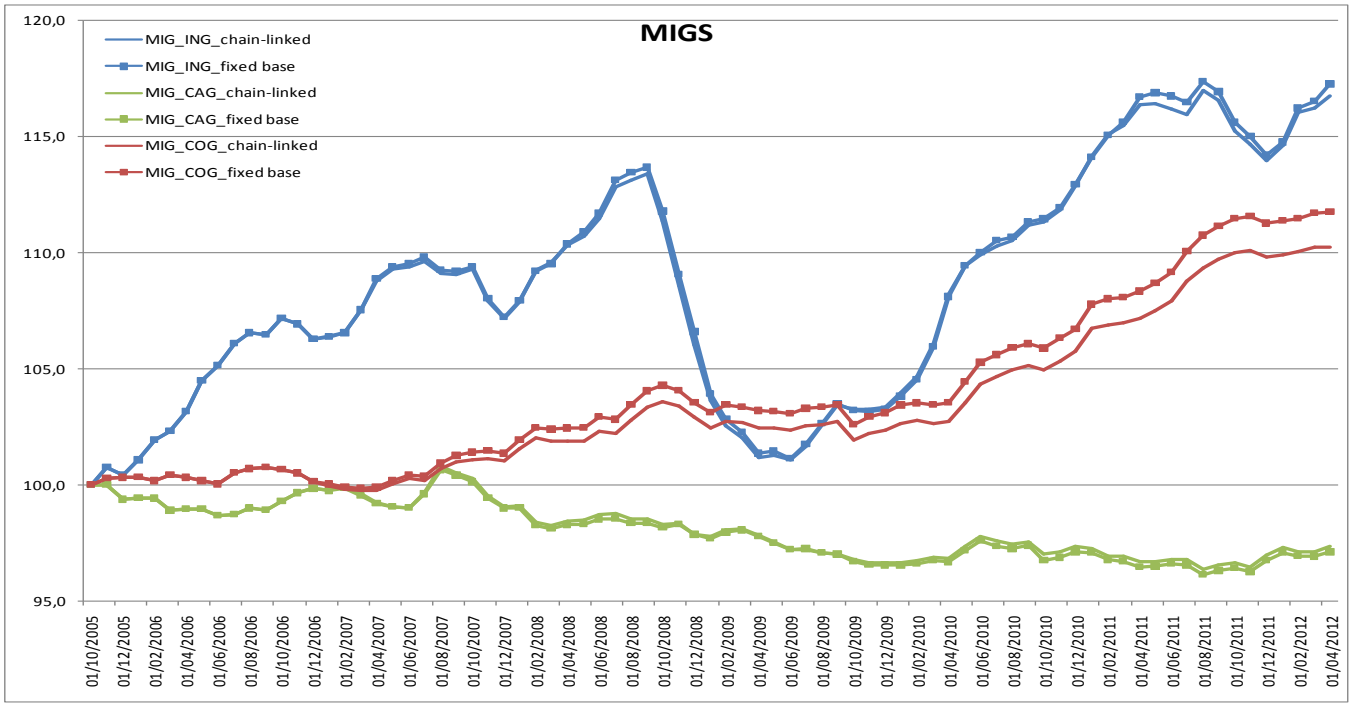
Import prices *via* PPI-like surveys and PPI IT tools have begun only at the end of year 2005. As the common practice in France is to begin the series with value "100" at starting point, when it is later than the reference period (here January 2005), most import prices series are in fact in reference "October 2005" rather than "year 2005". The import prices series transmitted to Eurostat slightly differ from the French series disseminated in France, as UVI have been combined with import prices in order to build an "average year 2005" reference.

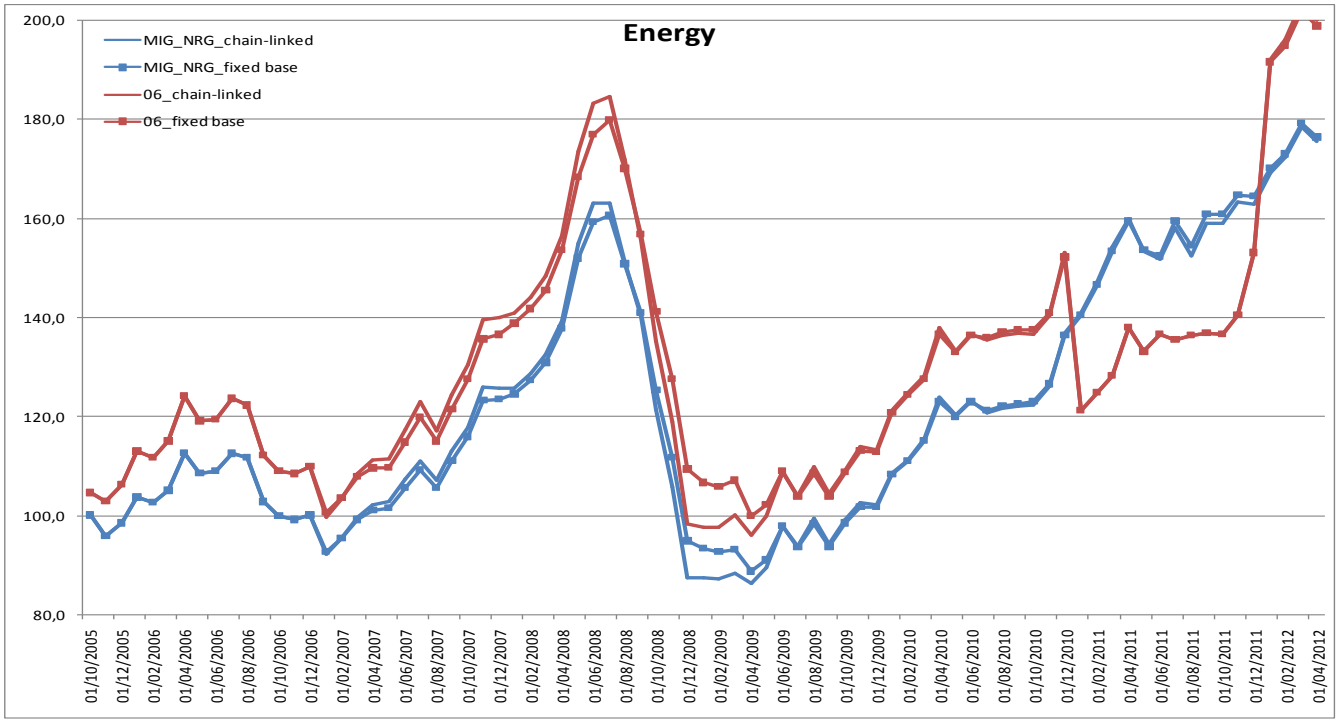
Imports amounts have been re-compiled for years 2005 to 2010, in "current conditions". That means that year n-2 is available on time for weights of year n on May, but not yet amounts of year n-1. Also, new amounts for year 2005 differ from our old estimates, which were relying on a cross-table with CPA rev.1. The old estimates of year 2005 have been used for weights of years 2005 and 2006 ; the new estimates of year 2005 for weights of year 2007; estimates of year 2006 for weights of year 2008, estimates of year 2007 for weights of year 2009, etc. Hence, the chain-linked series will differ from the fixed base series (deriving from old estimates for year 2005) from January 2007 only (because of new estimates) and from January 2008 for true chain-linking causes.

As it has always been described on the short note on French methodology, the weights of year n-2 are corrected by the division by the annual average of import prices of year n-2 in the given product, in reference 2005. The argument is that the current formula of monthly chaining in reference 2005 already takes into account the change in prices since reference period 2005. If the update of weights takes into account the change of quantity and the change of prices between reference period and year n-2, the change of prices between reference period and year n-2 is counted twice. If the reference period was December n-1 as in most countries (target practice), the correction would be the multiplication by Index (December n-1) / Index (average year n-2), as the Ukrainians do for instance.

This test calculation has concerned only aggregation from CPA 4 digits upwards: CPA 4 digits -> CPA 3 digits -> CPA 2 digits -> total industry and manufacturing and MIGS. Excel files content all estimates, but the following charts only describe the consequences on totals and MIGS, quite small in fact, and usually compliant with theory (fixed-base Laspeyres indices are supposed to over-estimate price changes, and chain-linked Laspeyres indices to correct this phenomenon partly).







France has added division "06" to this last graph, as the price changes have been spectacular in commodities 06.10: crude petroleum and 06.20: natural gas, but the result of chain-linking is only apparent during some months at the end of 2008 and at the beginning of 2009.

7.1.2. Ireland

Ireland investigated the impact of various chain linking methods on the compilation of monthly production sub-indices of the MIP. The indices span from January 2005 to May 2011 (2005 =100). 4 digit NACE indices (base 2005 =100) are the component series used to calculate the chain linked combined indices. NACE Rev 2 base-weights are currently only available for 2005, 2008 and 2009. In this analysis we applied;

2005 weights to 2005, 2006 and 2007

2008 weights to 2008 and 2009;

2009 weights to 2010 and 2011

The base-weights are provided in the form of the GVA values for each 4 digit NACE sector and the weights are supplied by CIP (2005, 2008, 2009). The base-weights are used to form combined groups where the contribution of any one 4 digit NACE sectors is simply:

$$\frac{GVA_i}{\sum_{j=1}^{k} GVA_j}$$

Five methods were used to compile the high level NACE Rev 2 indices. The first method presented is simply the current fixed base year (base 2005 = 100). This method is presented simply as a benchmark for the other methods. The second method is similar to the current base year method but in the second method the calculations are using two more fixed base year indices, i.e. (base 2008 = 100) and (base 2009 = 100). In the second method the indices are joined by splicing the indices at appropriate overlapping months. The third method employed is a monthly change linking method

The fourth method uses annual weights

-Change on December t-1, with annual weights.

-Change on December t-1, with weights relative to December.

-Finally, change on year t-1 (average of the monthly production indices).

1) <u>Fixed base year method (currently used method, base year = 2005)</u>

In this method, an index is created by applying production indices for every sector of NACE 10 using the 2005 weights of this sector and summing them to obtain a monthly index for NACE 10. An index is obtained that refers to the production for a month to base year 2005.

$$I_X^{y,m} = {}_{05}I_X^{y,m} = \sum_i I_{X,i}^{y,m} * W_{X,i}^{05}$$

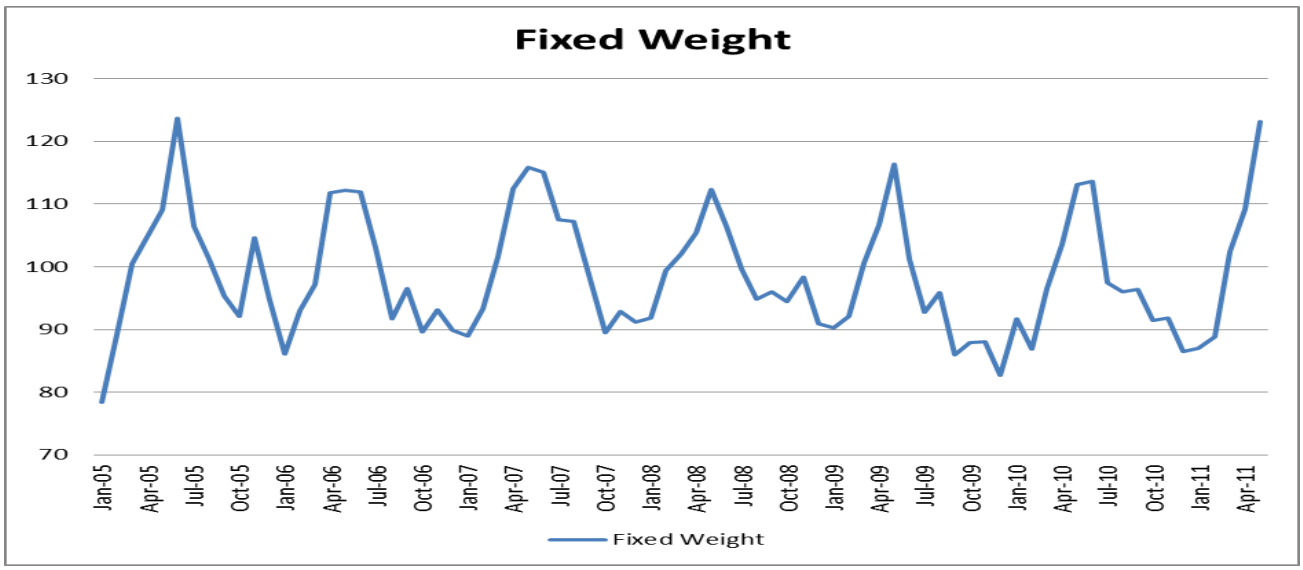
Where ${}_{YY}I_X^{y,m}$ represents the index of production for the sector X at year y and month m, calculated at year YY weights.

$I_X^{y,m}$ represents the final index for production for sector X at year y and month m.

$I_{X,i}^{y,m}$ represents the index of production for the i-eme subsector of sector X at year y and month m

$W_{X,i}^{YY}$ represents the weight of the i-eme subsector on sector X in year YY.

An issue associated with this method is that the weights of the economy change over time. The assumption is that weights become less accurate the further from the base year.



2) **Actualised weights fixed base year method**.

In this method, an index is created by applying to the base indices the more up to date weights. So for the 2005, 2006 and 2007 monthly indices, 2005 weights are applied, for 2008 and 2009 indices, 2008 weights are applied, and for 2010 and 2011 indices 2009 weights are used.

$$_{YY}I_X^{y,m} = \sum_i I_{X,i}^{y,m} * W_i^{YY}$$

The problem encountered with this method is the link between 2 months with different weights, so for example the link between Dec07 and Jan08, as these 2 indices are created with different weights, There will be a poor representative of the change between these 2 months (if calculate Dec07 and Jan08 with the same weights -2005 weights or 2008 weights- a comparable change between this 2 months can be seen, but by using this method the comparison between 2 indices relative to 2 different base years).

To obtain a time series representative of the change, the index is spliced, i.e. rescale the index after 2008 (included) to the index before, and this for every link between 2 different weights indices, take Dec t-1 as a link month (here Dec07, add or remove to after Jan08 the difference between Dec07 at 2005 weights and Dec07 at 2008 weights).

$$I_X^{y,m} = {}_{y-1}I_X^{y,m} + {}_{y-2}I_X^{y-1,12} - {}_{y-1}I_X^{y-1,12}$$

y-1 is the weight we would apply on year y if we had all weights available,

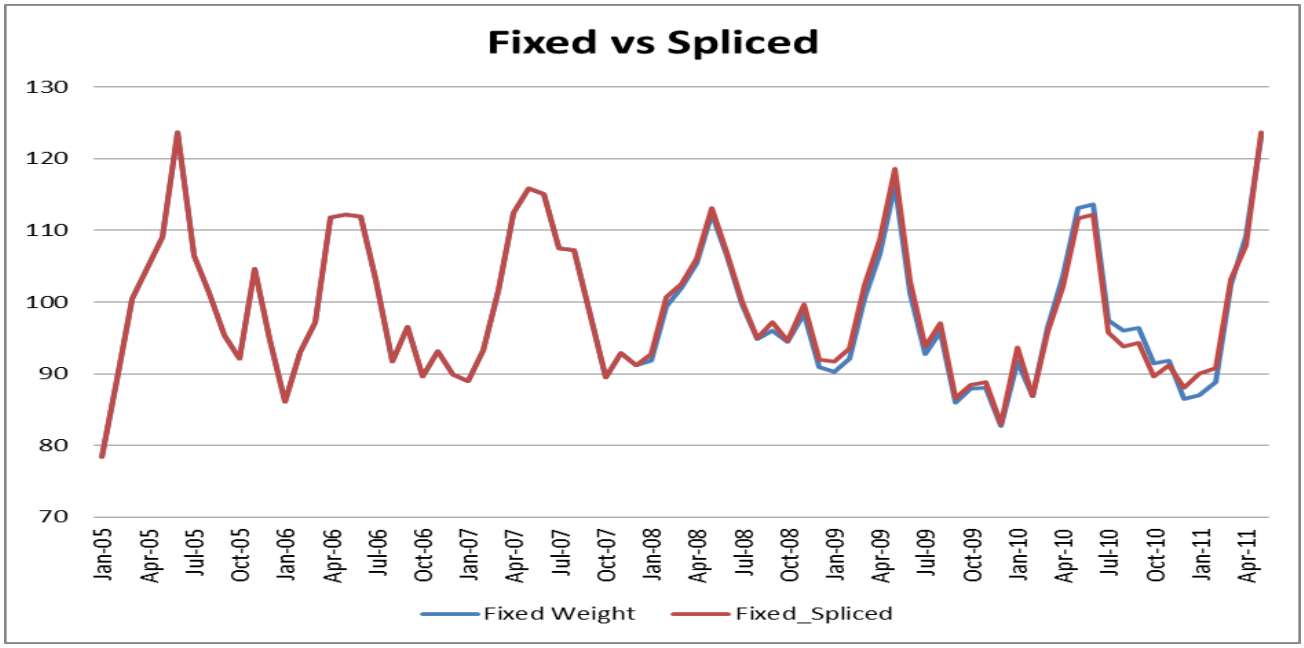
In our example year y-1 is not used but the year whose weight it was decided to apply.

$$I_X^{y,m} = {}_{05}I_X^{y,m} \quad \text{if y in 2005, 2006, 2007}$$

$$I_X^{y,m} = {}_{08}I_X^{y,m} + {}_{05}I_X^{07,12} - {}_{08}I_X^{07,12} \quad \text{if y in 2008, 2009}$$

$$I_X^{y,m} = {}_{08}I_X^{y,m} + {}_{05}I_X^{07,12} - {}_{08}I_X^{07,12} + {}_{08}I_X^{09,12} - {}_{09}I_X^{09,12} \quad \text{if y >= 2010}$$

The outcome is an overview of the change in the production, but the measures will be false due to the splicing. Therefore different methods are used to chain the index below and compared.



3) Monthly change chain linking method

In this method, a temporary index is created that refers for each month to the change since the previous one (the base index, multiply the index of month m by the index of month m-1 and divide by 100).

$T_{X,i}^{05,1} = I_{X,i}^{05,1}$ then $T_{X,i}^{y,m} = (I_{X,i}^{y,m} \div I_{X,i}^{y,m-1}) * 100$ and $T_{X,i}^{y,m} = (I_{X,i}^{y,m} \div I_{X,i}^{y-1,12}) * 100$ if m=1 represents the temporary index for i-eme subsector in year y month m.

Then the more accurate weights (as described earlier) are applied to this temporary index to each index:

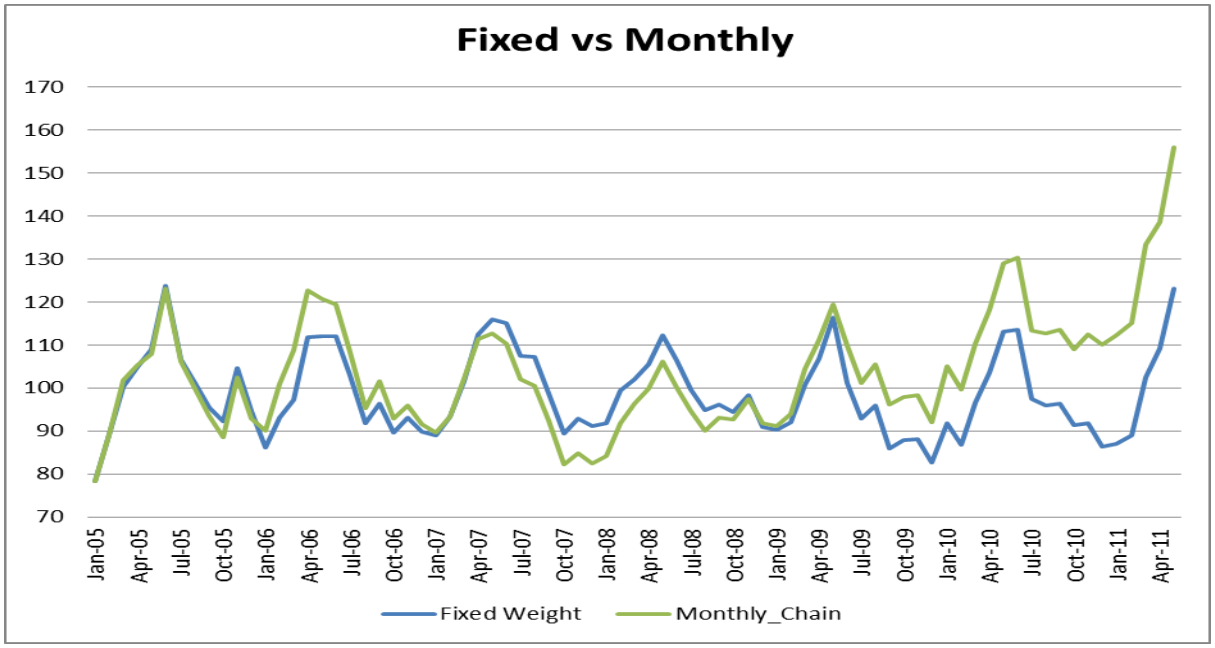
$T_X^{y,m} = \sum_i T_{X,i}^{y,m} * W_{X,i}^{YY}$ (if y in 2005, 2006, 2007: YY=2005, if y in 2008, 2009: YY=2008 and if y>2009: YY = 2009).

Next the temporary index is rebased to the previous month to obtain the final one (keep the first value Jan05 unchanged then multiply temporary Feb05 value by the final Jan05 value, etc..), and this is carried out from the beginning to the end for every month and leads to the final index.

$I_X^{05,1} = T_X^{05,1} = {}_{05}I_X^{05,1}$ then $I_X^{y,m} = (T_X^{y,m} * I_X^{y,m-1}) \div 100$ or $I_X^{y,m} = (T_X^{y,m} * I_X^{y-1,12}) \div 100$ if m=1.

An alternative method was carried out for sector NACE 1081 as there is only a GVA only on 2005 base weights.

An issue with this is annual weights are used for calculating monthly changes and can lead (probably due to extreme values, especially here for NACE 1081, and maybe to the high number of changed calculations) to an abnormal augmentation of the indices.



4) Change on December t-1 chain linking method

So we will chain annually, the first way I did it is with the change on December t-1 chain linking method

Calculate the change since one month on the previous year Instead of calculating the change the previous month for every month. December was chosen as it is the closest month to the actual year. For doing that the index of one month of a year (year t) was multiplied by the index of Dec t-1 and divided by 100. A temporary index is obtained that contains for each year indices referring to the change since previous December (we keep base year 2005 unchanged):

$T_{X,i}^{05,m} = I_{X,i}^{05,m}$ then $T_{X,i}^{y,m} = (I_{X,i}^{y,m} \div I_{X,i}^{y-1,12}) * 100$ represents the temporary index for i-eme subsector in year y month m.

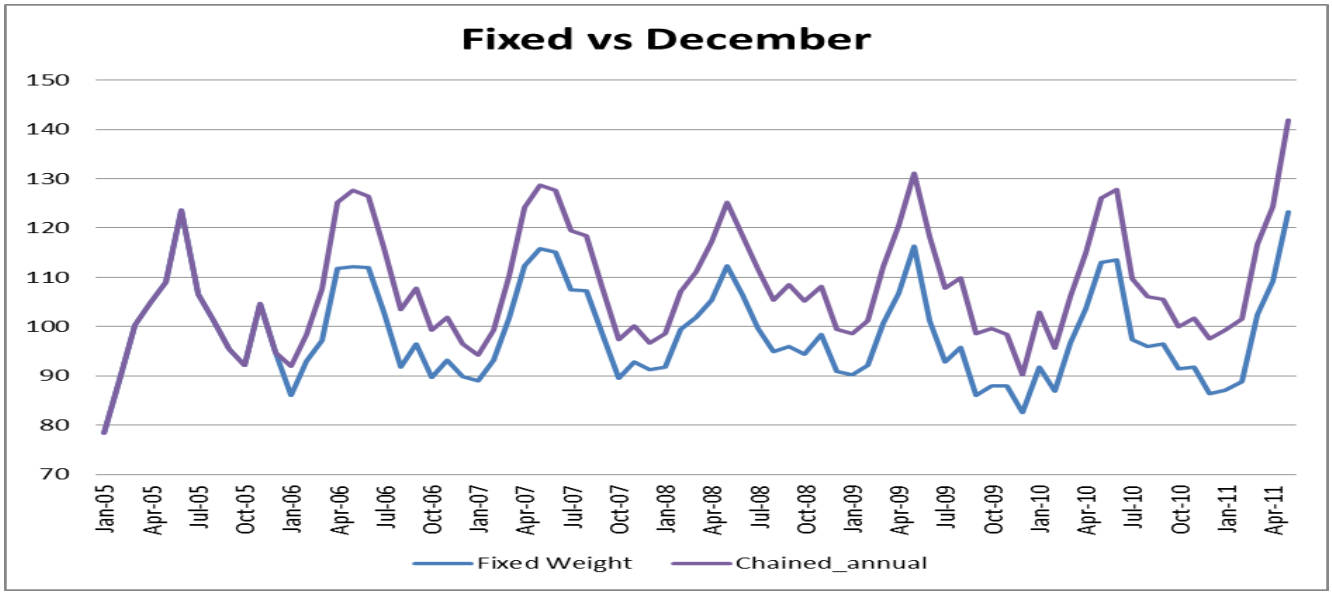
Weights of the previous year for each year are applied (or the more accurate weights as in this case) to this temporary index and a temporary index for NACE 10 is obtained:

$T_X^{y,m} = \sum_i T_{X,i}^{y,m} * W_{X,i}^{YY}$ (if y in 2005, 2006, 2007: YY=2005, if y in 2008, 2009: YY=2008 and if y>2009: YY = 2009)

It is rebased to the year reference: here kept 2005 unchanged, and for each year the monthly indices are multiplied by the final index of previous December and divided by 100.

$$I_X^{05,m} = T_X^{05,m} = {}_{05}I_X^{05,m} \text{ then } I_X^{y,m} = (T_X^{y,m} * I_X^{y-1,12}) \div 100$$

The issue that could have an impact on certain cases is that annual weights are used to compare a change since December; instead weights relative to December should be used. This is the next method.



5) Change on December t-1 with amended weights chain linking method

For this method, the exact same calculation is used as for the previous one (4), except that there is adjustment to the annual weights to give an approximation of December weights.

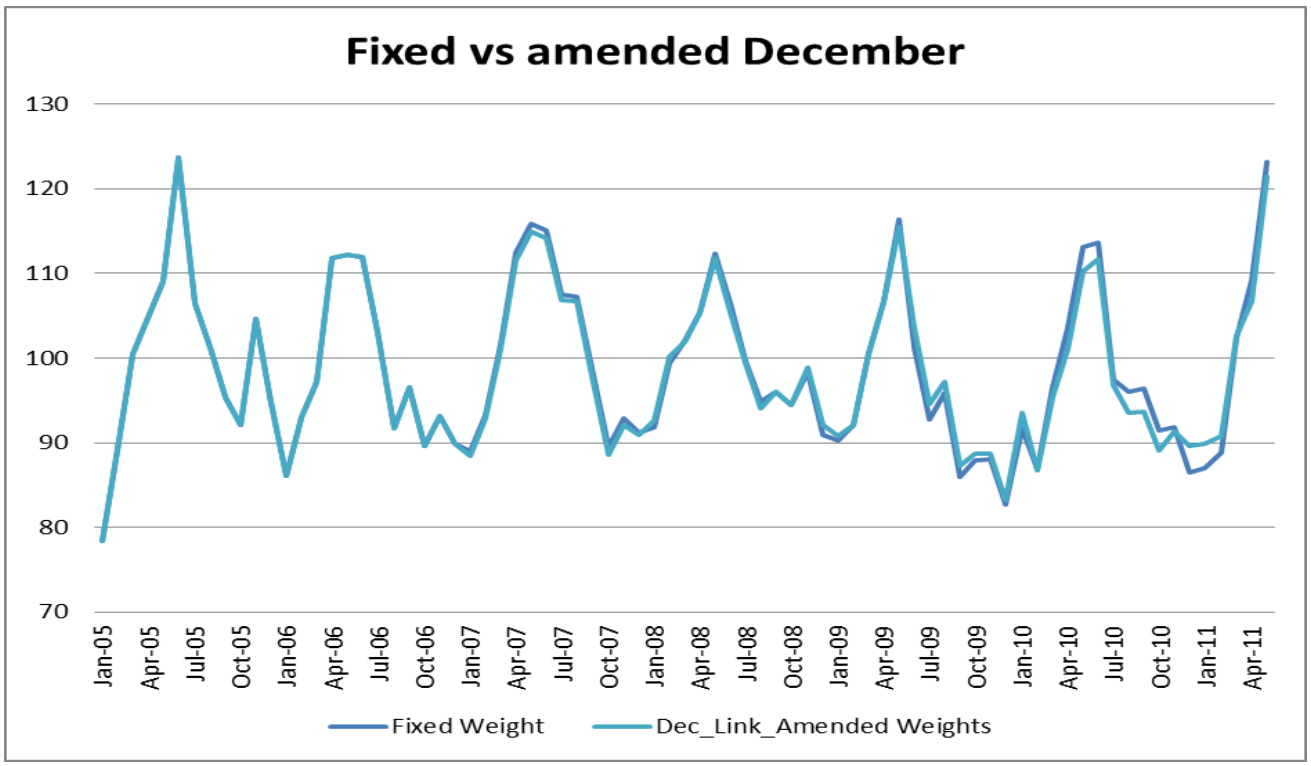
The current GVA is multiplied for one sector by the production of this sector in December in year t-1/Average of production of this sector in year t-1.

$$Wc_{X,i}^{05} = W_{X,i}^{05}$$

$$Wc_{X,i}^{ZZ} = W_{X,i}^{YY} * (I_{X,i}^{ZZ,12} \div mean_m(I_{X,i}^{ZZ,m}))$$

Year ZZ should be equalled to year YY but weights are not available for each year so take for ZZ in 2006, 2007: YY=2005; for ZZ in 2008, 2009: YY = 2008; for ZZ>2009, YY =2010.

In examples from other countries it has lead to good results in our case it seems to be a good correction of the previous December change method.



6) The mean change method

Where there are annual weights it is possible to compare indices to the whole previous year, i.e. the average of the monthly indices in the previous year. A temporary index where we keep 2005 unchanged is created. Then the base indices are divided by the average of the previous year indices for every sector:

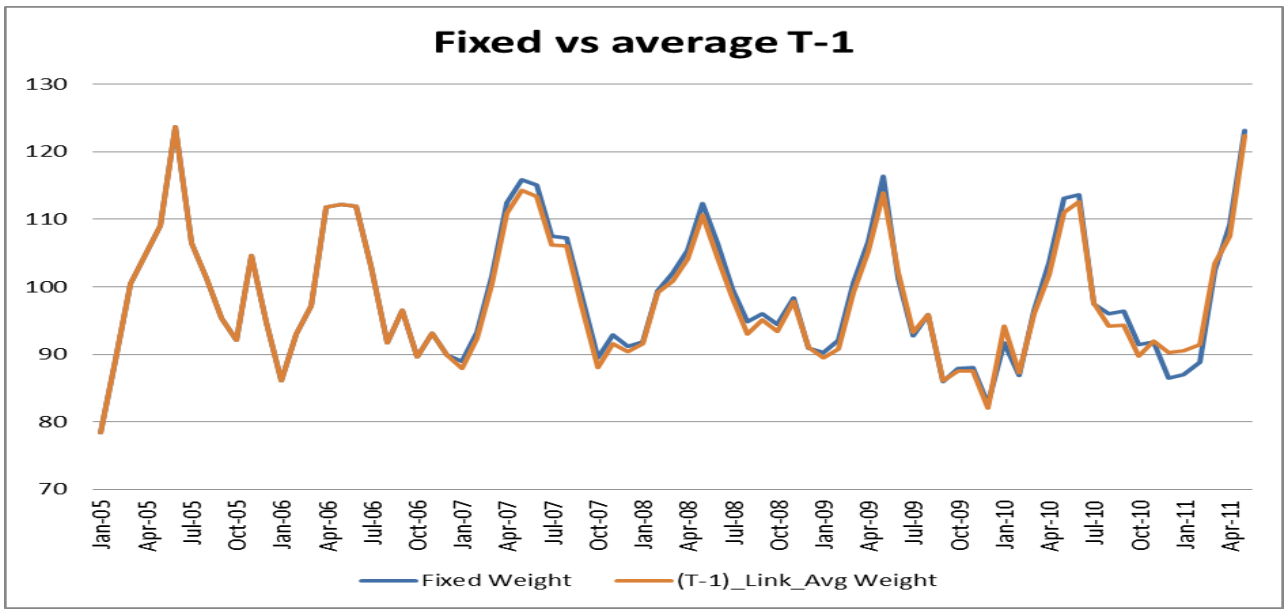
$$T_{X,i}^{05,m} = I_{X,i}^{05,m} \text{ then } T_{X,i}^{y,m} = (I_{X,i}^{y,m} \div mean_m(I_{X,i}^{y-1,m}))*100$$

The weights are then applied and so a temporary index for NACE 10 is obtained:

$$T_X^{y,m} = \sum_i T_{X,i}^{y,m} * W_{X,i}^{YY}$$ (if y in 2005, 2006, 2007: YY=2005, if y in 2008, 2009: YY=2008 and if y>2009: YY = 2009)

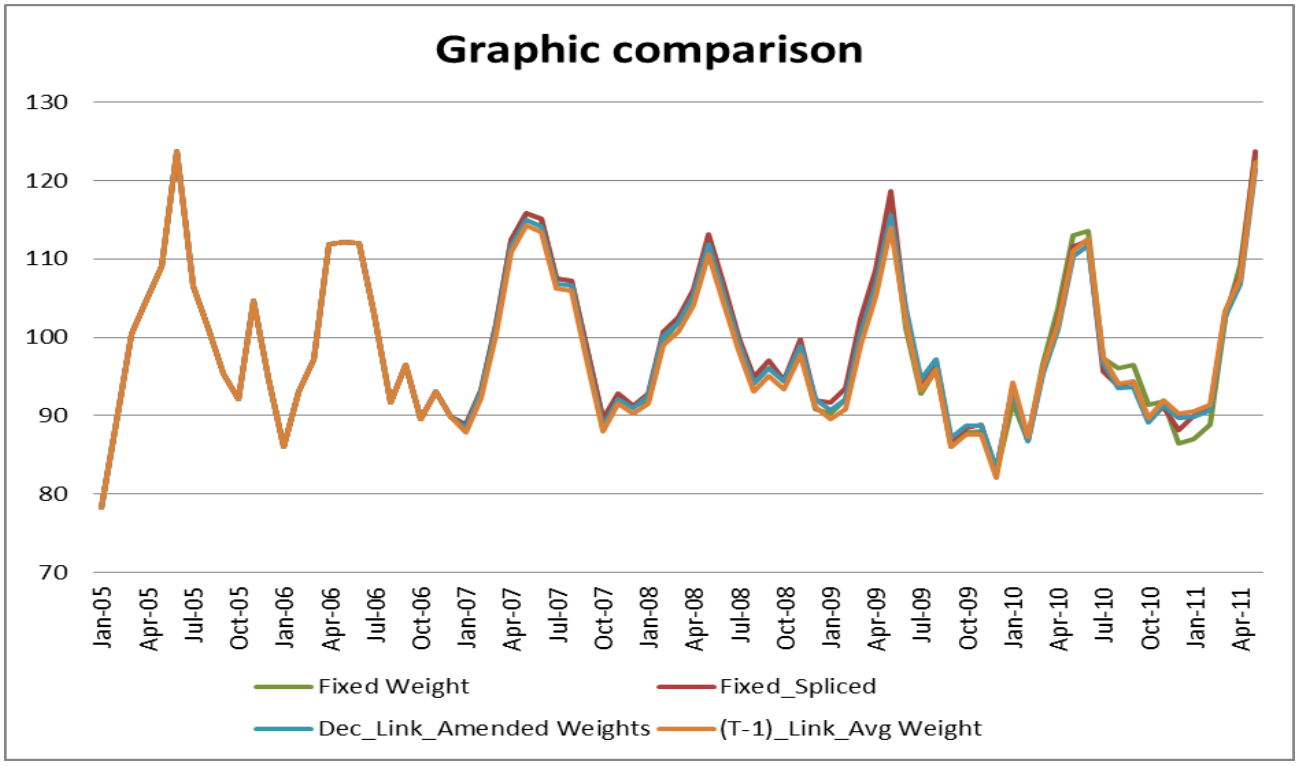
This is rebased to 2005 and the final index is obtained: keeping year 2005 unchanged. The temporary monthly indices of a year are multiplied by the average of the final indices of the previous year and divided by 100, (from Jan2006 to May2011).

$$I_X^{05,m} = T_X^{05,m} = {}_{05}I_X^{05,m} \text{ then } I_X^{y,m} = (T_X^{y,m} * mean_m(I_X^{y-1,m})) \div 100$$



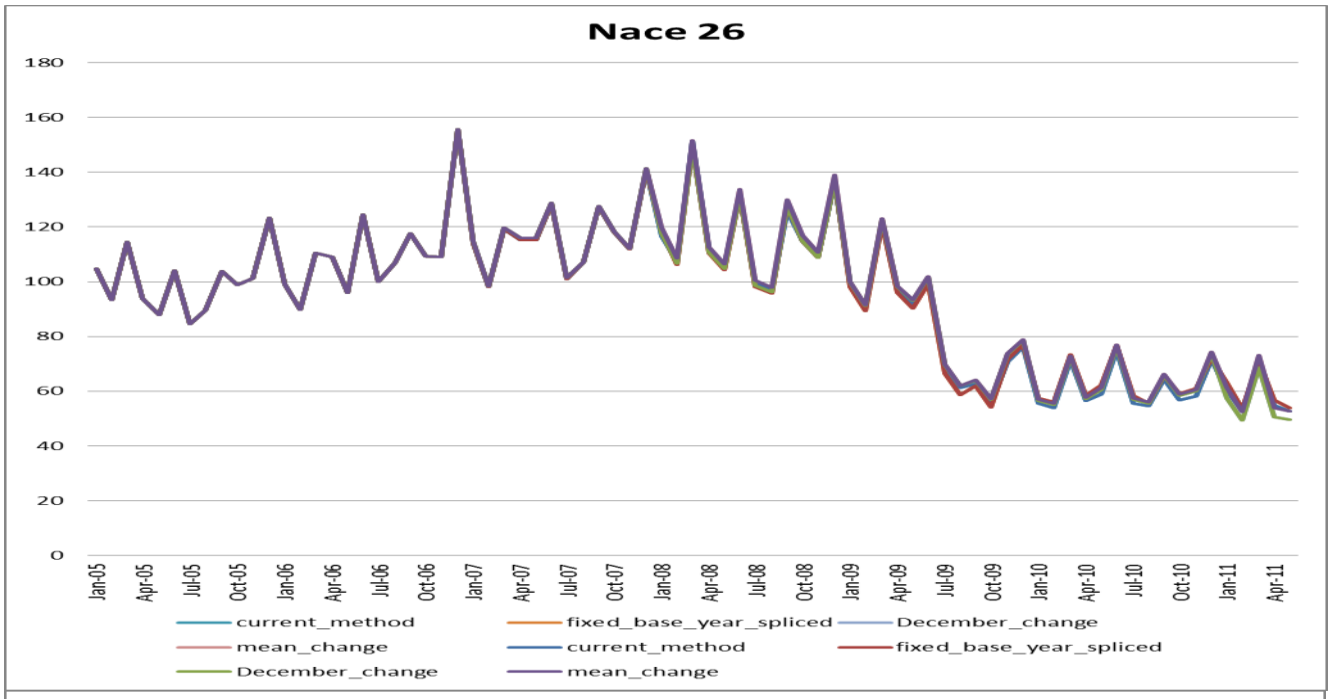
7) **Comparison of different methods**.

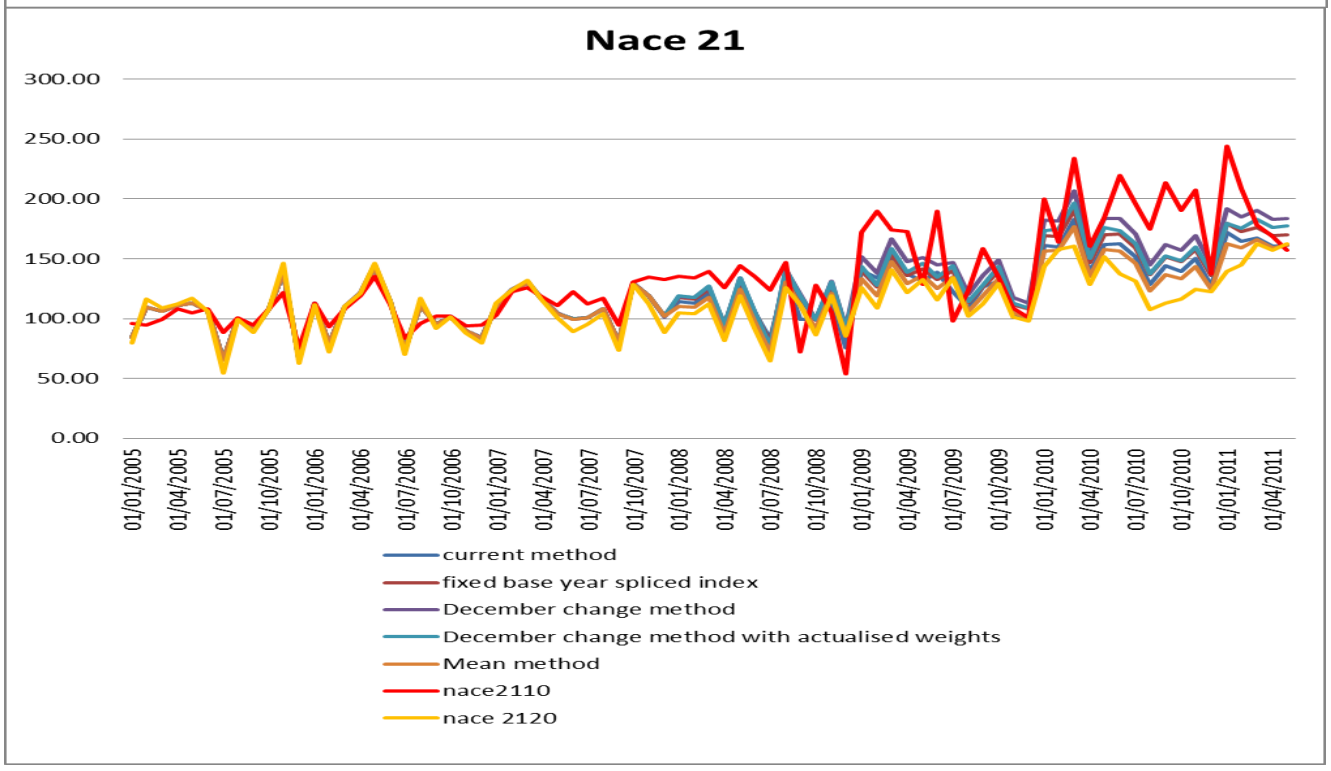
The fixed base year with actualised weights give us a representation of the change in the economy. The monthly change method isn't adapted to our context and looks distorted. The change on December t-1 is also good, but after correction, otherwise it could lead to a wrong time series. The mean change method seems to lead to good results also. Below is a graphic comparison.

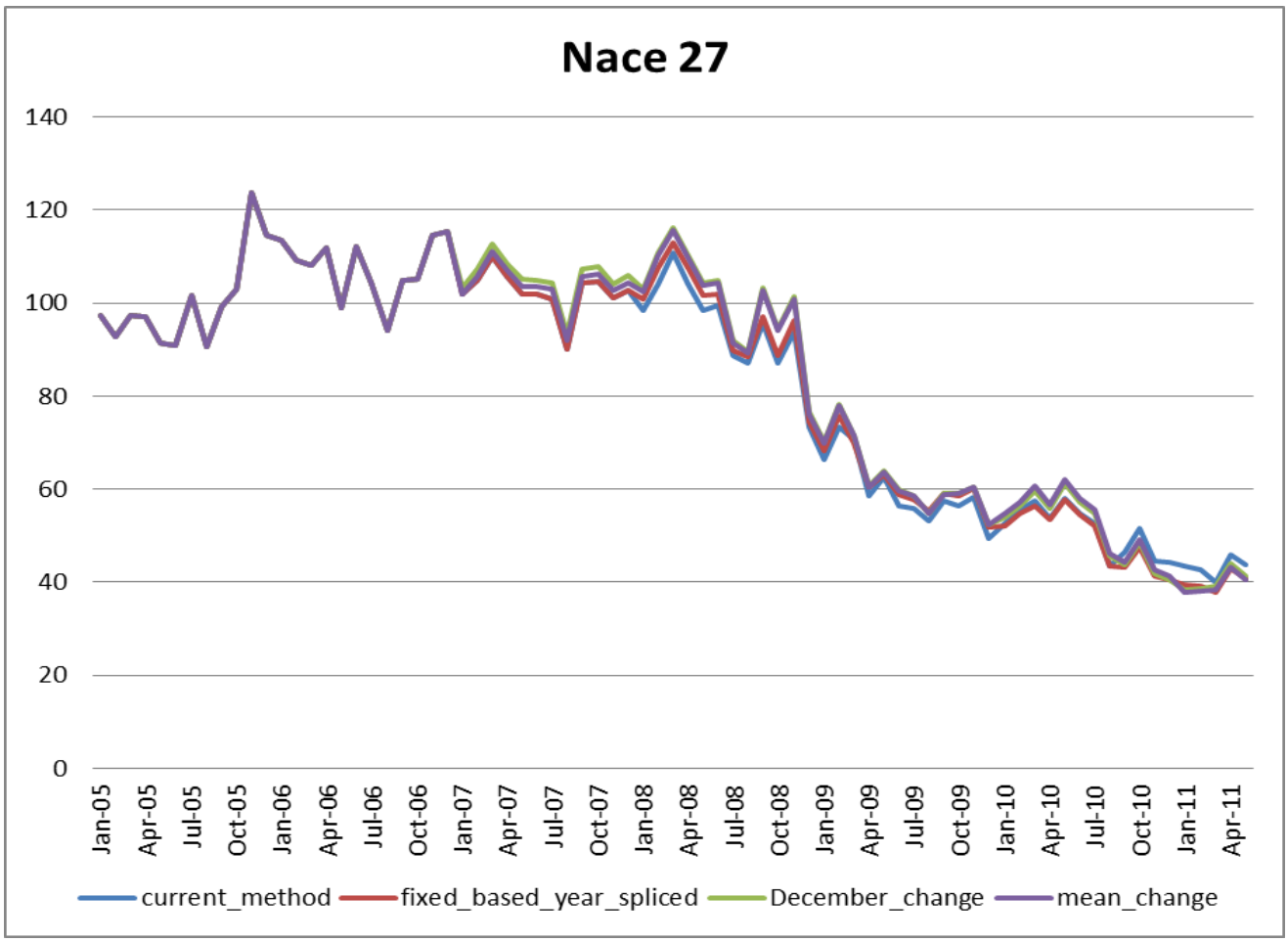


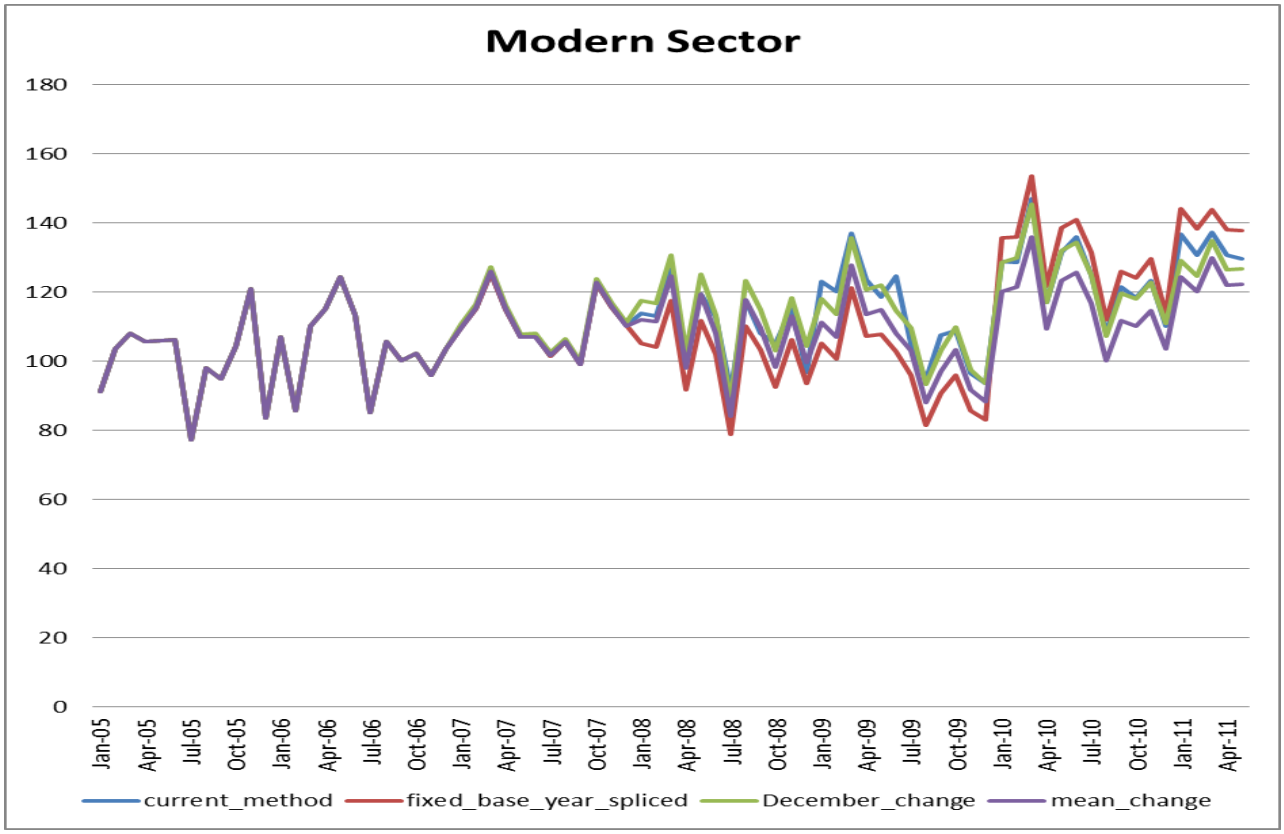
The results for NACE 10 are quite similar with these methods.

The results for NACE 21, NACE 26, NACE 27, and Modern Sector can be viewed in graphical form below. NACE 21 is interesting to see because there are only 2 subsectors in it and we can see also the evolution of these subsectors and look at their weights to appreciate the efficiency of each method; the calculation for NACE 21 is done in Excel it can also be a more practical view of the calculation. In Ireland there was a large change at the enterprise level in NACE 26 since the weights were calculated in 2005. The weight for this sector is now too high but neither method seems to correct for this.



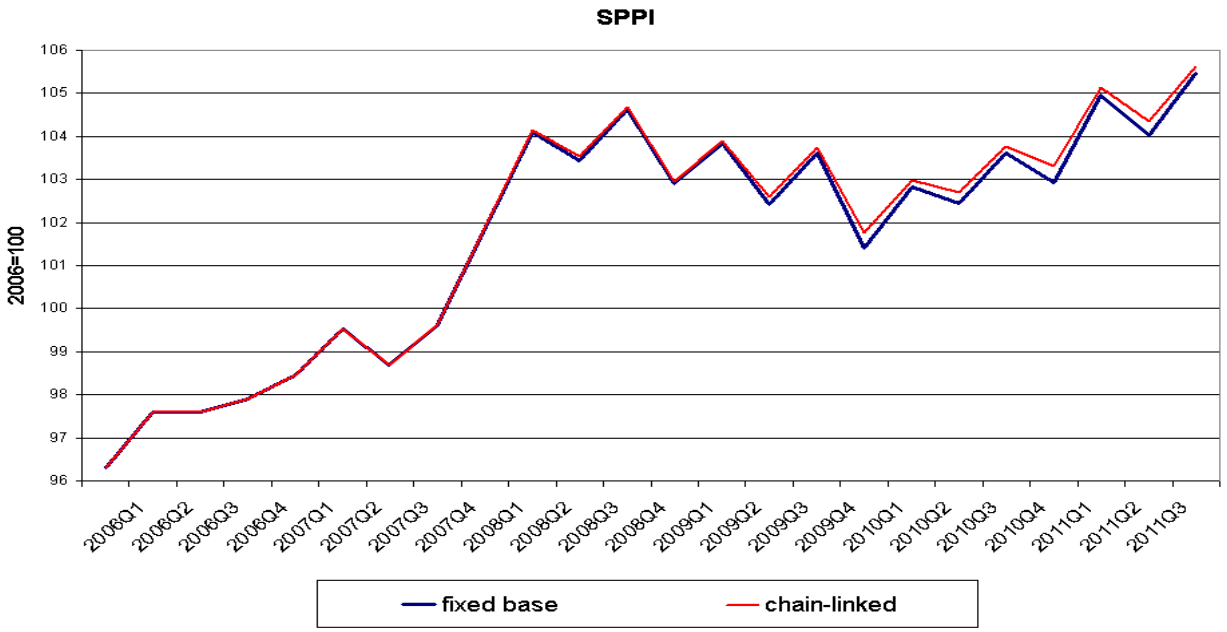



Nace 27
140
120
100
80
60
40
20
0
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Oct-06
Jan-07
Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
current_method
fixed_based_year_spliced
December_change
mean_change

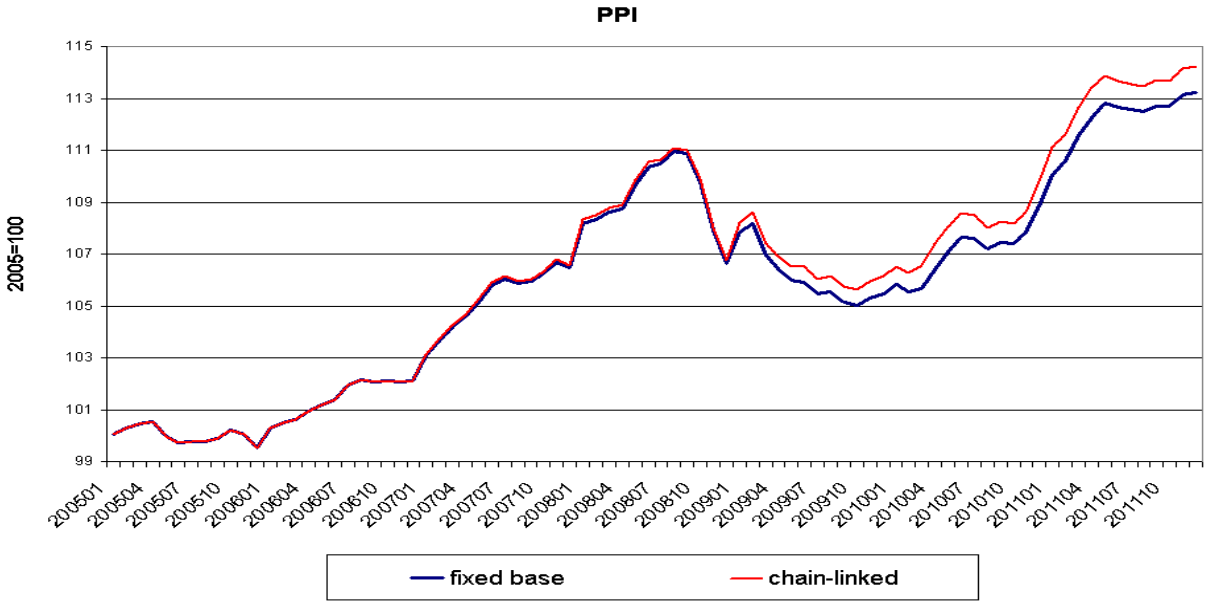

Modern Sector
180
160
140
120
100
80
60
40
20
0
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Oct-06
Jan-07
Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Apr-10
Jul-10
Oct-10
Jan-11
Apr-11
current_method
fixed_base_year_spliced
December_change
mean_change

7.1.3. Czech Republic

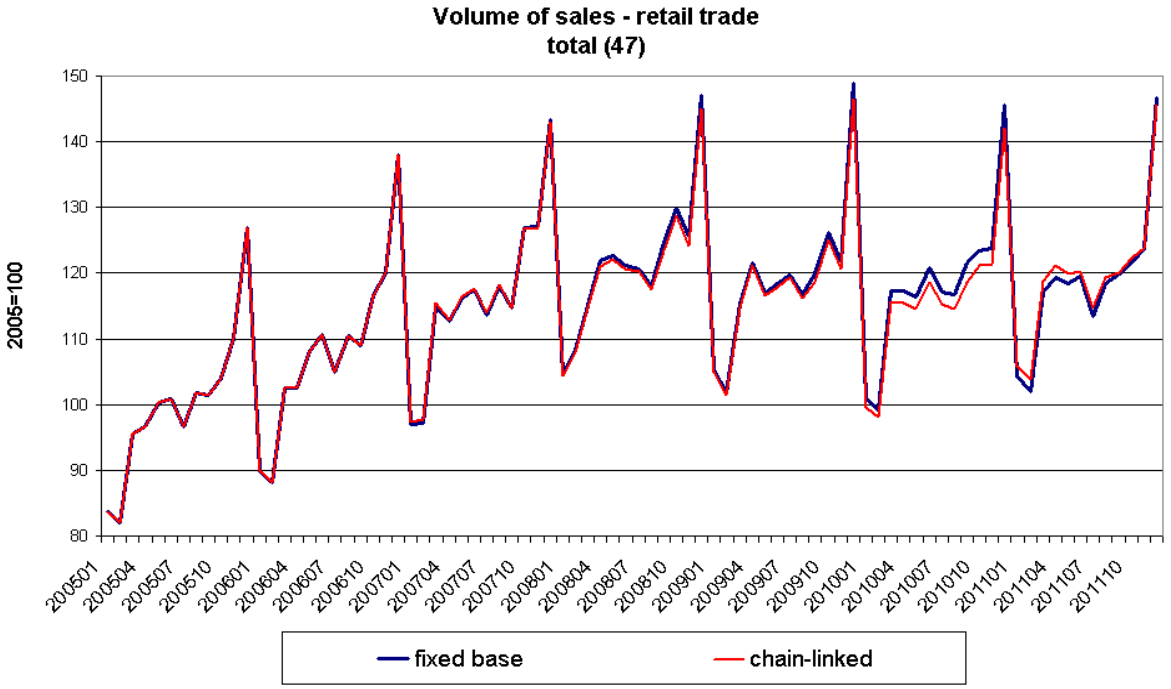
SPPI - comparison of current fixed-base monthly index with theoretical chain-linked index. The technique used is one-quarter overlap, starting in 2008, chain linking is performed on the level of 2-digit NACE.

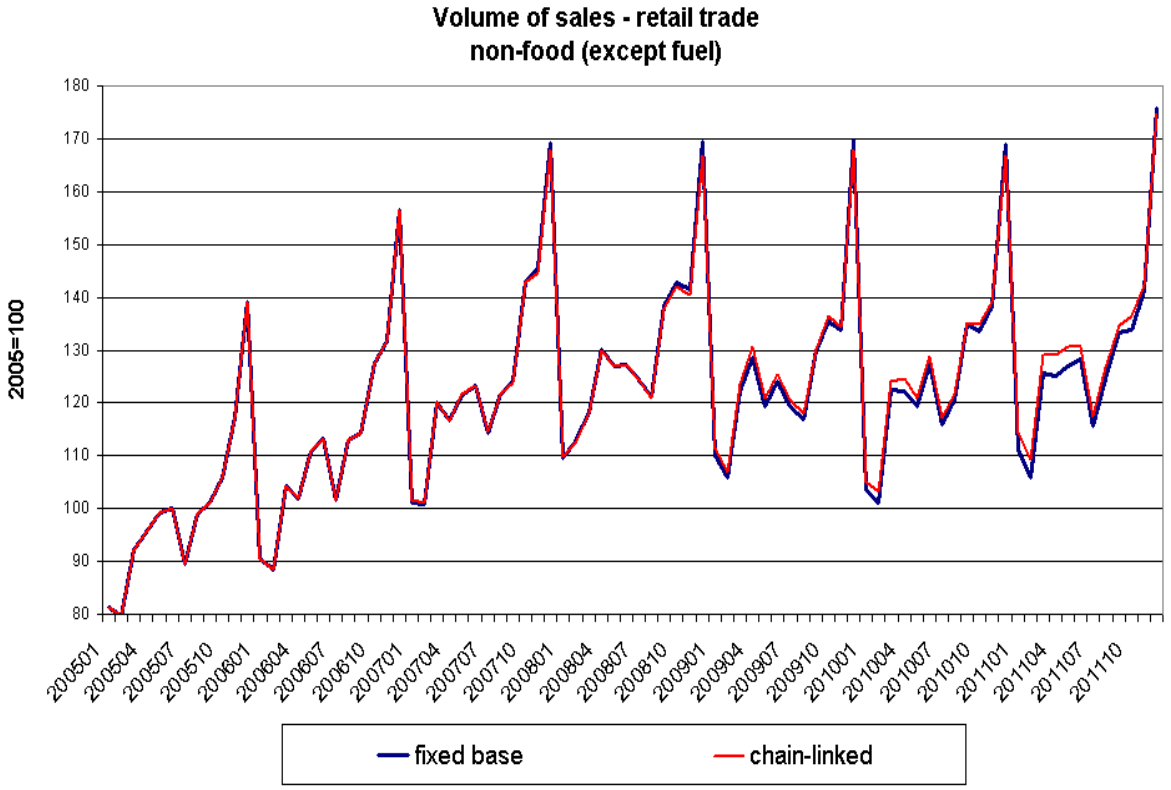


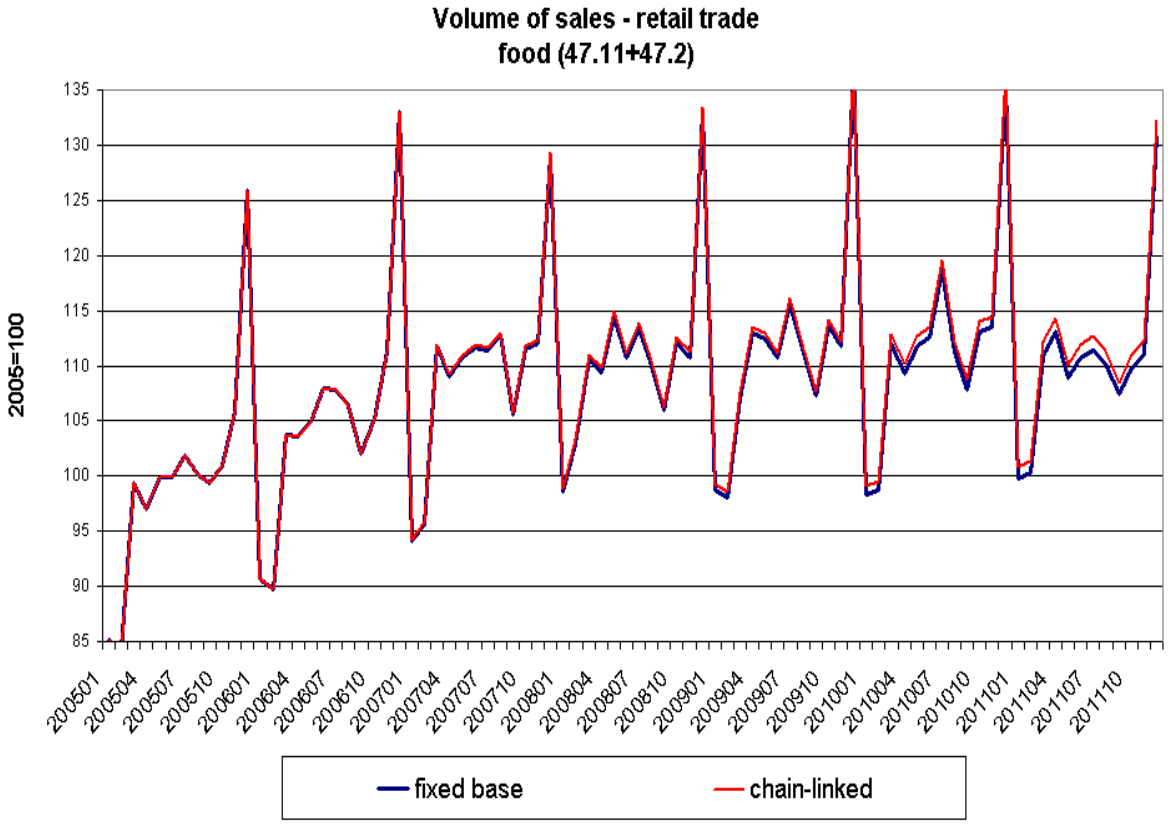
PPI - comparison of current fixed-base monthly index with theoretical chain-linked index. The technique used is one-month overlap, starting in 2007, chain linking is performed on the level of MIG groups. (As with SPPI, it is expected that the differences would be significantly greater were the chaining performed on lower levels.)



Volume of retail sales for food, non-food products (except fuel) and total. Comparison of current fixed-base monthly index with theoretical chain-linked index. The technique used is annual overlap, starting in 2007. There is not yet a concrete plan for chaining this indicator, so this is only a preliminary calculation with provisional weights.

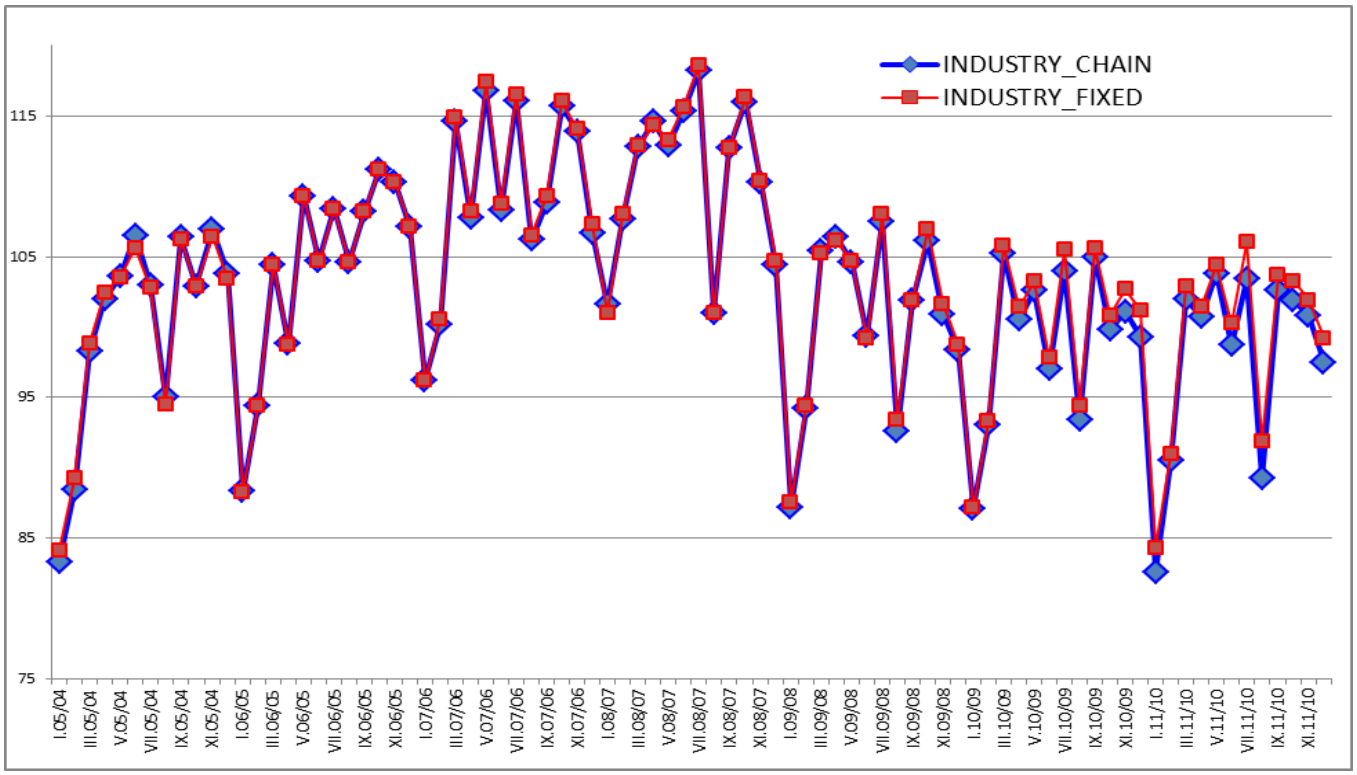






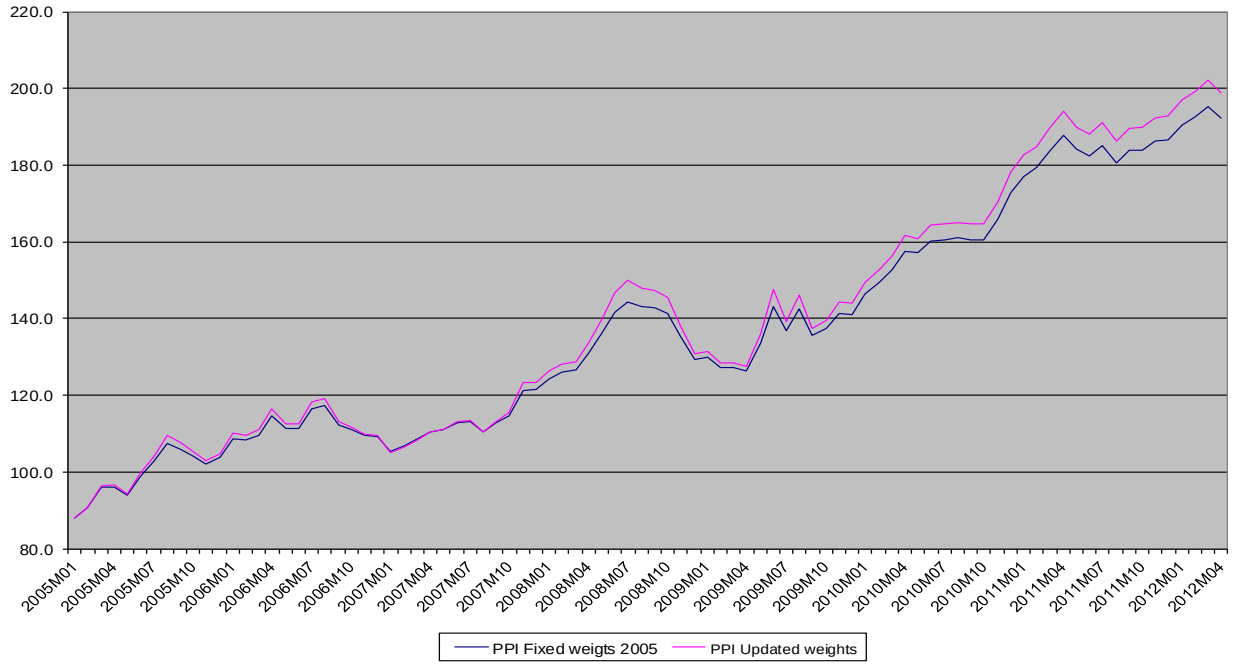
7.1.4. Croatia

The graphic shows the comparison between the annual chain-linked and fixe base year Croatian IPI.

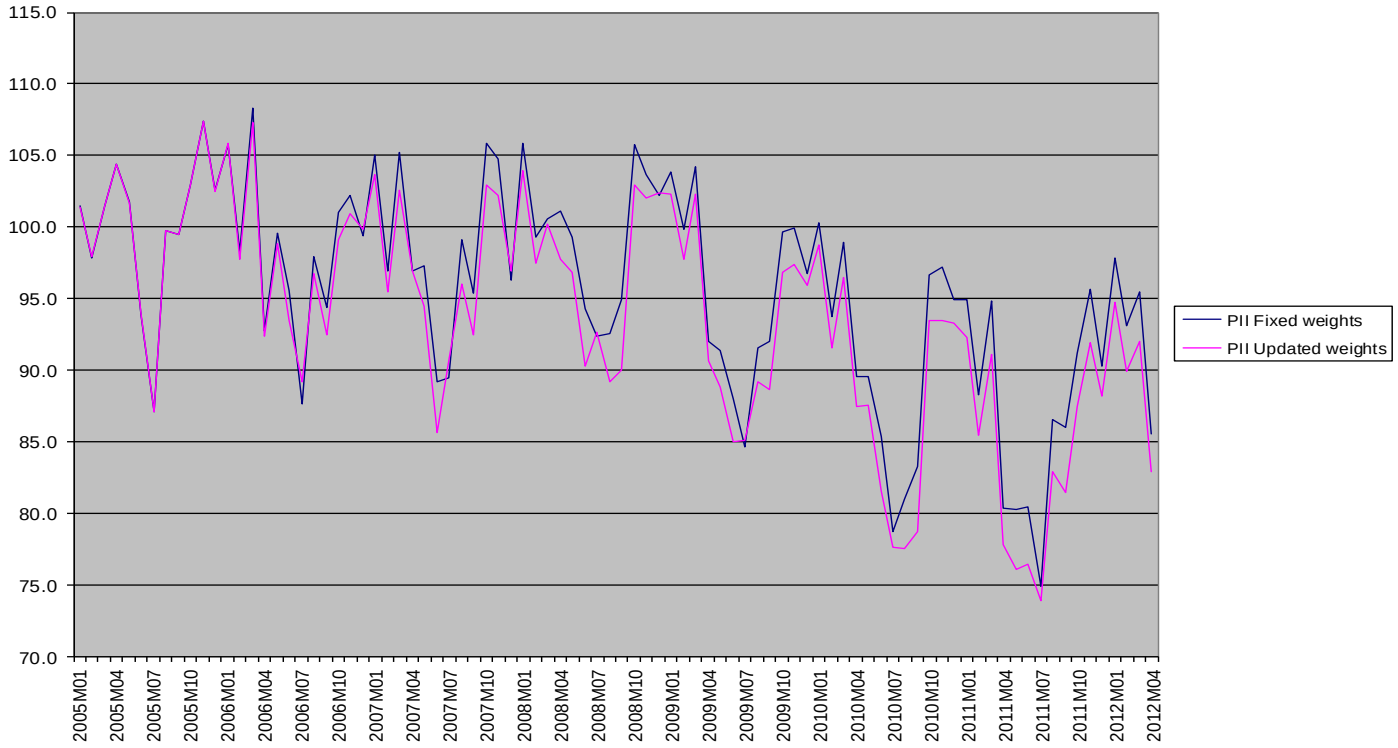


7.1.5. Norway

The graphic shows the comparison between the annual chain-linked and fixe base year Norwegian PPI.

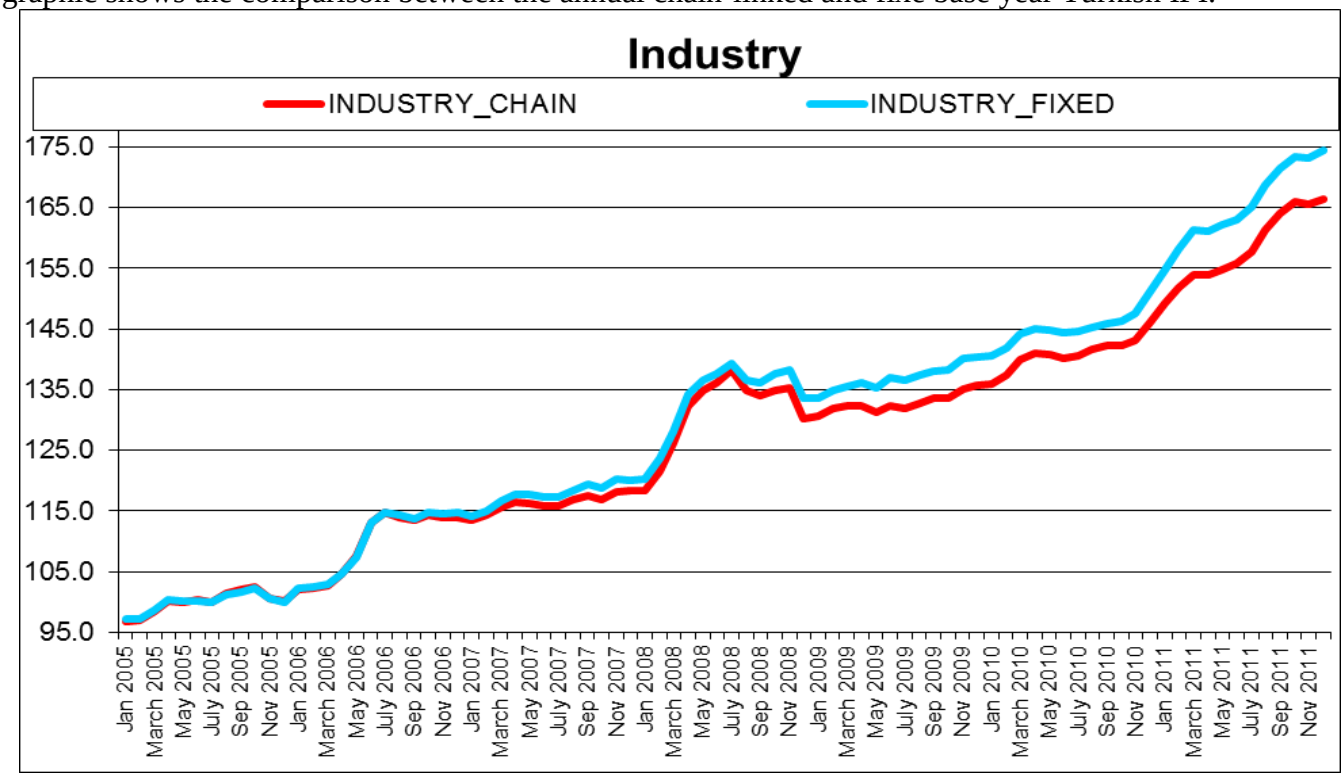


The comparison between the annual chain-linked and fixe base year Norwegian IPI is presented in the following graph.



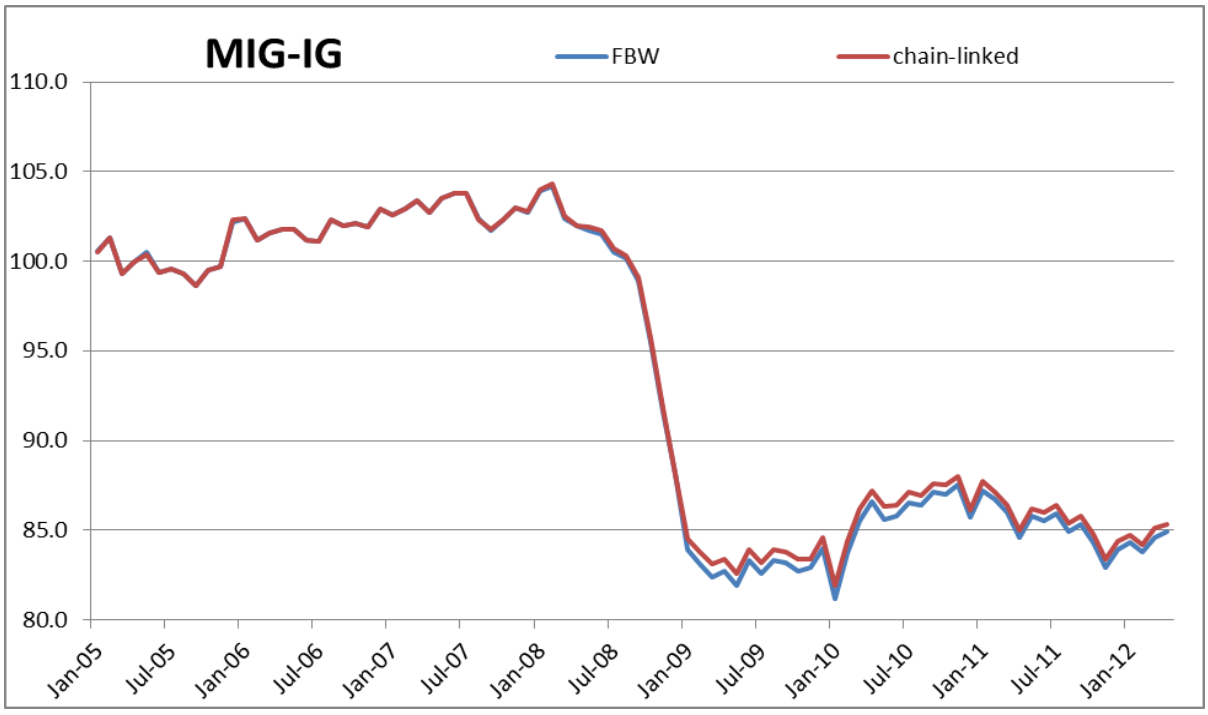
7.1.6. Turkey

The graphic shows the comparison between the annual chain-linked and fixe base year Turkish IPI.



7.1.7. United Kingdom

The comparison between the annual chain-linked and fixe base year IPI is presented in the following graph.



7.2. Task Force conclusions on theoretical aspects and costs

7.2.1. Theoretical aspects pros and cons

The arguments in favour of annual chain-linking can be summarized as follows:

(1) The use of weights close to the reporting period is more representative.

(2) Updating weights baskets gives more flexibility in terms of sampling.

(3) The history of the index is not changed when the weights are updated.

(4) The consistency with other statistical domains is enhanced.

(5) It ensures routine competence on chaining, whereas a fixed base year routine performed every five years may incur some insecurity and maybe quite high routine costs.

(6) Empirically, chain-linked indices correct partly the phenomenon that fixed-base indices over-estimate price changes.

(7) Changes in index reference years are easy.

The arguments against annual chain-linking can be summarized as follows:

(1) Problems arise when comparing results calculated by different chain-linking techniques.

(2) Problems arise when aggregating results calculated by different chain-linking techniques.

(3) Some growth rates for certain periods may not only reflect pure price or volume changes.

(4) Additivity of industries is lost.

(5) Higher routine costs are associated with updating the weights and chain-linking every year.

(6) Risk may arise by performing routine activities in short time.

(7) Timely availability of weights is a problem.

7.2.2. Costs

The initial and routine costs for annual chain-linking are listed in the following table:

Country	initial costs	routine costs
France	3 man x months	annual update of weights: 2 man x months
Austria	12 man x months	annual update of weights: 0.75-1 man x month
Slovakia	9 man x months	change of base year for the fixed base year index: 12 man x months every 5 years (meaning 2.4 man x months every year)
Norway	3-6 man x months	annual update of weights: 0.5-0.75 man x month
Lithuania	6 man x months	likely the same for the fixed base index and chain-linking
Croatia		PPI: annual update of weights: 4 man x months + 0.5 man x month for IT + 3 man x month for sample updating SPPI: annual update of weights: 8 man x months + 0.5 man x month for IT + 5 man x month for sample updating

8. TASK FORCE RECOMMENDATIONS REGARDING THE IMPLEMENTATION OF CHAIN-LINKING IN STS

The Task Force recommendations for the STS coordinators focus on addressing 2 questions:

1. For which indicators and under which conditions is annual chain-linking recommended?

- In a situation where the economic structure is developing fast the annual chain-linking of volume and price indices is recommended in STS.
- For volume indices where relative prices do not change significantly, a chained five year index is still appropriate for the current period.
- For price indices where relative quantities do not change significantly, a chained five year index is still appropriate for the current period.
- It is more relevant to have one common target method for the chain-linking of a specific STS indicator than having all Member States changing from the five-yearly rebasing to the annual update of weights and chain-linking
- Annual chain-linking is not relevant for nominal indices.

2. Should STS aim at making the annual update of weights a recommendation?

- It is recommended to implement chain-linking, but only for price and volume indices in STS.
- It is recommended to switch before or with the implementation of the base year 2015 (by 2018).
- If costs are a problem, chain-linking could be limited to the levels from the class or group level (i.e. 4 or 3-digit level), and not necessarily at the elementary level.

Under which conditions?

- Changes in structure are significant over years – but this can only be said retrospectively (one would not have been able to forecast the 2008-2009 developments).
- Impact on indices and growth rates is significant.
- There is one common target methodology for a given indicator.

9. TASK FORCE CONCLUSIONS REGARDING THE COMMON TARGET METHODOLOGY FOR CHAIN-LINKING IN STS

The following are the Task Force's conclusions regarding the common target methodological framework intended to serve as guidelines for countries planning to implement the annual update of weights in combination with chain-linking in STS.

– **Target method for annual chain-linking of the price indices:**

- For monthly STS price indices, e.g. PPI, the A method (target method) is the one-month overlap chained Laspeyres index.
  The chaining period is December of the previous year. Weights have to be price-updated up to December of the previous year.
- For quarterly STS price indices, e.g. SPPI, the A method (target method) is the one-quarter overlap chained Laspeyres index.
  The chaining period is the fourth quarter of the previous year. Weights have to be price-updated up to the fourth quarter of the previous year.
- For monthly and quarterly STS price indices the B method is the five-yearly rebasing of a Laspeyres index.

– **Target method for annual chain-linking volume indices:**

- For STS volume indices, e.g. IPI, the A method (target method) is the annual overlap.

  The chaining period is the average month of the previous year.

  From Eurostat's point of view, the use of one common method (the annual overlap method) by all Member States would be preferred.

  The SNA 2008 & UN "Internal Recommendations for the Index of Industrial Production 2010" state that for Laspeyres-type volume measures, the annual overlap technique may be more practical. For Quarterly National Accounts, the SNA 2008 and the IMF QNA manual recommends the one-quarter overlap with benchmarking.

  The method chosen for chaining STS volume indices should be agreed with National Accounts.

- The B method is the five-yearly rebasing of a Laspeyres index.

– **Nominal indices:**

For nominal indices (i.e. for STS indicators other than price and volume indices) annual chain-linking is theoretically not relevant.

– **Benchmarking to the annual series:**

- Annual chain-linked price indices using the one-month overlap or one-quarter overlap technique should not be benchmarked.

- For volume indices, the annual overlap method is usually done without benchmarking.

- Using the one-quarter overlap technique for volume indices the series may be benchmarked to national accounts data.

– **Calculation of elementary indices:**

- For annual chain-linked price indices:

  The geometric average of price changes for products should be used if no weights are available.

  The harmonic mean (in the case of average prices) or weighted arithmetic mean (in the case of elementary price indices) should be used if weights are available.

- For annual chain-linked volume indices, the production groups' weights, i.e. below 4-digit level, should be updated at least every 5 years.

– **Calculation of higher level indices (4-digit level or higher):**

The monthly changes of higher level indices should be calculated as price updated weighted (t-1) averages of monthly changes of lower level indices. If the one-month overlap method is used for price indices the weight has to be price-updated to December of year t-1, and for the one-quarter overlap method the weight has to be price-updated to the fourth quarter of year t-1.

– **Source of weights:**

SBS is the preferred source of weights for STS.

For volume indices there can be reasons to seek consistency with National accounts, at the top level.

– **Seasonal adjustment:**

Seasonal adjustment should be applied to the index level, i.e. after chain-linking, and not just to the numerator.

10. MEMBERS OF THE TASK FORCE

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DEUTSCHLAND	Mr Norbert Herbel (1st meeting)
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Eurostat	Mr Sven Kaumanns (1st meeting)
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Eurostat	Ms Carmen Lipp-Lingua (2nd meeting)
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Eurostat	Mr Stefan Schipper (2nd meeting)