Impact of the Implementation of ESA 2010 on Volume Measurement

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Abstract

Volume indices are connected with statistical deflation that means recalculation of macro-aggregates to constant prices. Price calculations have to follow changes in definition or delineation of macro-aggregates. New standards of National Accounts (SNA 2008, ESA 2010 respectively) bring many changes that should be taken into account in volume measures. The aim of this paper is to present new methods of deflation that respect updated definitions and principles. Concept of foreign trade has been changed significantly as globalization is going faster and faster. Re-export and merchanting have become more important especially in small open economies such as the Czech Republic. This phenomenon should be reflected in constant prices calculations. Changes in methodology have also affected volume indices.

Keywords

National accounts, ESA 2010, revision, research and development, foreign trade

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INTRODUCTION

System of National Accounts is macroeconomic statistical model that is designed for the description of economy. National accounts provide data on production, generation of income, its distribution and redistribution as well as accumulation. History of National Accounts started in the 18th century, when François Quesnay published the Economic Table (Tableau économique). National Accounts[3] have been improving since and the first international framework (SNA 1952) was published in 1952 (Hronová et al., 2009). Standards have to be updated regularly as the economy has been changing quickly, especially in recent years. The latest international standard is SNA 2008. European standard ESA 2010, which is derived from SNA 2008, became effective in September 2014. New standards SNA 2008, ESA 2010, respectively, brings significant changes of concept of productive activity and definition of assets

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[3] Balances of National Income (BNI) were used instead of National Accounts in communist regimes including Czechoslovakia. Definition of productive activity is narrower in BNI than in National Accounts. Transformation of data from BNI to National Accounts was carried out by researchers from University of Economic in Prague (Sixta et al., 2014).

(Sixta, 2014). There were many discussions on impacts of revisions on value of macro-aggregates, structure of input-output tables, balance of payment etc. Unfortunately, almost no attention was paid to the impact on volume measures though volume indices are under spot light. Countries have to prepare new deflation procedures independently as there were no international recommendations on volume estimates of newly defined items.

Statistical deflation means transformation of indicators at current prices to constant prices in order to eliminate price changes and estimate volume indices. However, number of indicators that can be revaluated to constant prices is limited as no suitable price indices are defined for many indicators (Nicolardi, 2013). Therefore the paper is focused on impact of changes on transactions in products.

1 PARTIAL CHANGES

The list of changes between current standards of National Accounts and previous standards is long. However, many changes are insignificant and they can be considered as clarification of terminology with negligible impact on indicators. Some changes may be important in a few countries. Nevertheless, selected changes are important in all countries, such as capitalization of military expenditure, small tools, Research and Development, new concept of foreign trade and new concept of output of insurance services.

1.1 Research and Development

Research and Development (R&D) is now identified as a fixed asset in National Accounts. It means that acquisition and disposal of R&D is recorded as gross fixed capital formation. Moreover, Research and Development, as any other fixed assets, is depreciated. R&D is defined in the 'Manual on measuring Research and Development in ESA 2010'[4] as follows: 'Research and Development is a creative work undertaken on systematic basis to increase the stock of knowledge, and use of this stock of knowledge for the purpose of discovering or developing new products, including improved versions or qualities of existing products, or discovering or developing new or more efficient processes of production'.

Deflation techniques should reflect valuation of macro aggregates at current prices. The output of R&D at current prices is measured as follows (EUROSTAT, 2013):

a) R&D by specialized commercial research laboratories or institutes is valued at the revenue from sales, contracts, commissions, fees, etc. in the usual way;
b) The output of R&D for use within the same enterprise is valued on the basis of the estimated basic prices that would be paid if the research was subcontracted. In the absence of a market for subcontracting R&D of a similar nature, it is valued as the sum of production costs plus a mark-up (except for non-market producers) for net operating surplus (NOS) or mixed income;
c) R&D by government units, universities and non-profit research institutes is valued as the sum of costs of production. Revenues from the sale of R&D by non-market producers are to be recorded as revenues from secondary market input.

Expenditure on R&D is distinguished from expenditure on education and training. It does not include the costs of developing software as the main or secondary activity. Basic rule of R&D determination is the presence of novelty, creativity, orderliness, uncertainty and reproducibility in R&D. According to the Frascati Manual (OECD, 2002) the previously mentioned activities are not included.

The most important part of output of Research and Development is own account produced R&D in the Czech Republic. Valuation of this output is similar to the approach to output of other non-market services. Therefore, deflation technique can be analogical. Other non-market output is deflated using the input method. This approach is based on deflation of each component separately (EUROSTAT, 2001).

[4] EUROSTAT (2014a, p. 6).

However, input method does not enable to carry out analysis of productivity and effectiveness. It means that change in output is equal to changes in inputs (Atkinson, 2005). On the other hand, definition of price representatives for R&D is almost impossible and Research and Development is considered to be collective product for which input method can be used though it is not an ideal solution (EUROSTAT, 2001, p. 113). Market output and output for own final use is deflated by appropriate price indices (PPIs, price indices of export, etc.).

Countries apply different approaches to deflation of capitalised Research and Development. Ritter (2014) has published the paper focused on the approach used in Germany.

1.1.1 Price and Volume Measurement for R&D in German National Accounts[5]

About ¾ of the total R&D output in Germany is produced by nonfinancial corporations. The R&D output of financial corporations is really unimportant (less than 1%). About 20% of the total R&D output is produced by the general government and about 4% by the non-profit institutions serving households.

Input method has been already used for deflation in the government and non-profit institutions sector. The approach is applied on Research and Development in these sectors. However, this method has not been used in other sectors yet. In German national accounts R&D output of nonfinancial and financial corporations is calculated for industries in the following way based on data of the Stifterverband:[6]

Table 1 Estimate of output of Research and Development

	Estimate of R&D output
	Intramural expenditure on R&D
-	Capital expenditure on R&D
=	Current expenditure on R&D
+	Other taxes on production
-	Other subsidies on production
+	Consumption of fixed capital
+	Operating surplus, net
=	R&D output including R&D for software
-	R&D for software
=	R&D output without purchase of R&D for intermediate consumption in the industry A72 (main production R&D)
+	Purchase of R&D from non-financial and financial corporations for intermediate consumption in the industry 72 (NACE Rev. 2)
=	R&D output

Source: Ritter (2014)

[5] This chapter is based on Ritter (2014).

[6] The Stifterverband für die Deutsche Wissenschaft (Association of funders for the German science) is a private non-profit institution. Yearly reports about its R&D survey are published by the Wissenschaftsstatistik GmbH.

The price and volume measurement for intermediate consumption of nonfinancial and financial corporations are based on use tables. Yearly deflators for total intermediate consumption are calculated in a breakdown by industries and product groups. These deflators can be used for deflating intermediate consumption for R&D output as well.

The German use tables distinguish between 64 industries and 88 product groups. For the industry NACE 72 Scientific research and development the input structure of total intermediate consumption – subdivided by product groups – is representative for the input structure of intermediate consumption for R&D output. Only for this industry the input structure can be taken from the published use tables without any modification. Principles to estimate the input structure for other industries are as follows: The structure of intermediate consumption for R&D output can be derived from the structure of total intermediate consumption of the industry which generates the R&D output. The structure of intermediate consumption of the whole industry cannot be applied to R&D output without modifying it. In doing so data about the cost structure of the industry 72 'Scientific research and development' (NACE Rev. 2) can serve as reference figures.

The input method for compensation of employees is based on deflators derived from weighted average for gross hourly earnings of R&D staff by levels of qualification. There are three staff categories defined by the Frascati Manual:[7] Researchers, Technicians and equivalent staff, other support staff. The quarterly earnings survey (performance groups of employees with a similar job qualification profile) identifies these five so called "Performance groups" (PG): PG 1 Managing directors, PG 2 Senior skilled workers, PG 3 Specialised personnel, specialists, skilled staff, PG 4 Semi-skilled workers, PG 5 Unskilled workers.

1.1.2 Price and Volume Measurement for R&D in Czech National Accounts

The main data source on Research and Development is statistical survey VTR 5-01, which is based on Frascati Manual. Besides, special questions on subcontracts are included for National Accounts calculations. Estimates at current prices are in line with Eurostat Manual on measuring Research and Development in ESA 2010. Special deflation techniques had to be developed as the concept has changed. Non-market output of R&D is not so important (about CZK 10 mil. in 2013) and it is a part of final government expenditure (not GFCF). Market output is deflated by index of average compensation of employees. There is no price index (e.g. PPI) because it is almost impossible to define a price representative. Therefore this method is considered to be suitable (EUROSTAT, 2001, p. 105) and it was used in the past as well (CZSO, 2008). However, new deflation method for own account produced R&D has to be developed. Czech approach is similar to (and inspired by) German method, which means that each type component is deflated separately. Compensation of employees is deflated by index of average compensation of employees in related industry. Currently, we do not do any stratification by staff categories, but we are investigating whether data in both dimensions (staff category, industry) is possible to gather. Intermediate consumption (IC) is recalculated by implicit deflator of IC in NACE 72. As supply and use tables are compiled for each version of annual National Accounts, possible changes in structure IC is included in the deflator. Another option would be to use symmetric input-output tables SIOT) because the main part of output of R&D is produced in other industries (e.g. production of industrial products, education services). Symmetric input-output tables offer product structure of costs related R&D product (not industry). Nevertheless, data is in basic prices and has to be transformed to basic prices and SIOT is not compiled annually. Consumption of fixed capital is estimated directly at constant prices within PIM.[8] Currently, other components are deflated by implicit deflator of output. We plan to improve this approach and use price index for market R&D.

[7] Ritter (2014).

[8] Perpetual Inventory Method. Consumption of fixed capital is estimated using actual service life of assets, for detail see Sixta (2007).

1.2 Small tools

Fixed assets used to be defined in ESA 1995 as items used in production for more than one year with value higher than 500 ECU. Purchase of items below this threshold was classified as intermediate consumption. Now, in ESA 2010, no such threshold is given, the only criterion is the use in production process for more than one year. The change in value added is opposite to the change in intermediate consumption (production approach) and equal to the change in gross fixed capital formation (expenditure approach) and in gross operating surplus (income approach). This change has no impact on deflation techniques, as intermediate consumption and gross fixed capital formation are deflated in the same way. On the other hand, GDP was affected significantly, about 1.9% in 2013.

1.3 Foreign Trade

Concept of foreign trade has been altered significantly though the main principle (a change in ownership) remains unchanged. The main reason is that globalization is going on quickly and economic statistics has to follow it.

1.3.1 Processing

Between ESA 1995 and ESA 2010, there is a fundamental change in the treatment of goods sent abroad for processing. According to the previous standard (ESA 1995), such goods were shown as exports because of the fact they were sent abroad, and then recorded as imports on return from abroad, at a higher value as a result of the processing. This was known as the gross recording method where international merchandise trade figures represent an estimate of the value of the goods being traded.

According to the ESA 2010 a change of ownership is not imputed but the processing service is recognized. Processing service is a part of export of services for the country where the processing takes place. This recording is more consistent with business accounting and associated financial transactions. However, it does cause an inconsistency with the international merchandise trade statistics (IMTS). This statistics will continue to record gross value of exports for processing and returning imported processed goods, as it is based on the physical movement of goods, rather than the change of the economic ownership of the goods.

This change results in one main consequence: a new processing service is recognized. It means that value of goods sent for (after) processing is not included in export and import. Deflation methods have to follow changes in current prices. In the past, inward processing (export and import) was deflated by price indices of import. The same type of price indices was used on both sides (export, import) in order not to influence a balance of foreign trade and also gross value added. Similarly, outward processing was deflated by PPIs. Currently, just processing service is deflated. Used price indices remain the same, however, the interpretation is different. It can be argued that price development of services and goods may vary. On the other hand, no better method[9] has been introduced yet.

1.3.2 Merchanting

Standard ESA 2010 defines export of merchanting as follows: The purchase of a good by a resident from a non-resident and the subsequent resale of the good to another non-resident, without the good entering the merchant's economy. Import of merchanting is not defined explicitly, but as analogous case in import. Export of merchanting is recorded on 'net' principle, i.e. export of margin (sales minus cost

[9] Eurostat established task force on price and volume measures that started in 2015. This method will be accepted in updated Manual on Price and Volume Measures as suitable method. Other possible approaches are: deflation by index of wages or input method. However, cost structure of processing service is not available in most countries.

on sold products). Theoretically, it can be negative if costs are higher than sales. Unfortunately, import of merchanting, which is a mirror case in partner country, has not been covered by international manuals. The Czech Statistical Office has promoted that at many international meetings. It is called inverse or negative merchanting.

As merchanting is in fact trade margin it can be deflated similarly. However, it can be merchandised products that have normally no trade margin, e.g. electricity. Moreover, basic prices of merchanting of a particular product (e.g. electricity) are zero that does not enable to apply standard method of deflation of trade margin used by the Czech Statistical Office.[10] Several approaches were broadly discussed at the CZSO but also with colleagues from other countries. Finally, the Czech Statistical Office has introduced own method that has been promoted at international meetings.[11] It takes into account product structure of goods that are merchandised and also territorial structure of transactions. Sales and costs are deflated separately and export of merchanting is calculated as a difference between sales at previous year's prices and costs at previous year's prices. It is similar to the double deflation of gross value added. Sales are deflated by price indices of countries where specific products are sold. Price indices are also adjusted to changes in exchange rate of given countries. Similar approach is applied to deflation of costs. Inverse (negative) merchanting is deflated by price indices of import. 'Double deflation' method is not used as the structure of countries is not available directly from data sources. However, a model approach to preparation of the structure of countries is planned to be used in the future. It should enable to apply 'double deflation' method for inverse merchanting as well.

1.3.3 Re-export

Re-export is defined as goods, that are produced abroad and imported into the domestic territory by residents (so a change in ownership from non-resident to resident occurs) and that are subsequently without significant transformation exported abroad (so again a change of ownership from resident to non-resident occurs). The goods cross the border of domestic territory and are therefore recorded in the foreign trade statistics. Re-export is mentioned as a globalisation phenomenon in ESA 2010. According to change of ownership principle the re-export is considered as export and import of goods in the National Accounts (CZSO, 2014). Although the principle is similar to merchanting, the recording in National Accounts is different (gross principle). The difference between merchanting and re-export can be found in territory (domestic for re-export, foreign for merchanting) but the nature of the activity is the same. Value of re-export in export and import varies, the difference makes the trade margin. Value of good itself is deflated by price indices of export, margin is deflated separately. A rate of margin from the previous year is applied to good itself at previous year's prices. It is fully consistent with deflation of margin related to other types of uses.

1.4 Other changes

Standard ESA 2010 brings many other changes but they no or negligible impact on volume measures. Delineation of government sector may have an impact on method of calculation of output (market or non-market). Subsequently deflation method is changed. Weapon systems are recognized as an asset therefore government expenditure on them is considered as gross fixed capital formation. It has also an impact on other non-market output and government consumption that are deflated by input method. Other changes do not have an impact on transaction in products or do not require changing deflation methods.

[10] For more details about deflation of trade margin see CZSO (2008).

[11] This method was presented at above mentioned task force. Now it is being discussed and it will be probably accepted as an appropriate deflation method (method A).

2 IMPACT OF CHANGES ON VALUE AND VOLUME INDICES

Changes in methodology and deflation techniques cause changes in value and volume indices. Implicit deflators were also affected as product structure of indicators changed. The impact of the most important changes was separated for gross value added and gross fixed capital formation that were mainly affected. Changes that occurred within the revision are quantified in GNI Questionnaire.[12] However, all changes had to be also estimated at previous year's prices. Developed deflation techniques were applied to merchanting, Research and Development and re-export. Other items were deflated by appropriate price index related to the item (e.g. small tools by deflators of gross fixed capital formation in product breakdown). Consumption of fixed capital related to the capitalisation of R&D was estimated at previous year's prices directly within PIM method. Contributions to growth method was employed, see the following formula:

$$c = \frac{I_q}{w}, \tag{1}$$

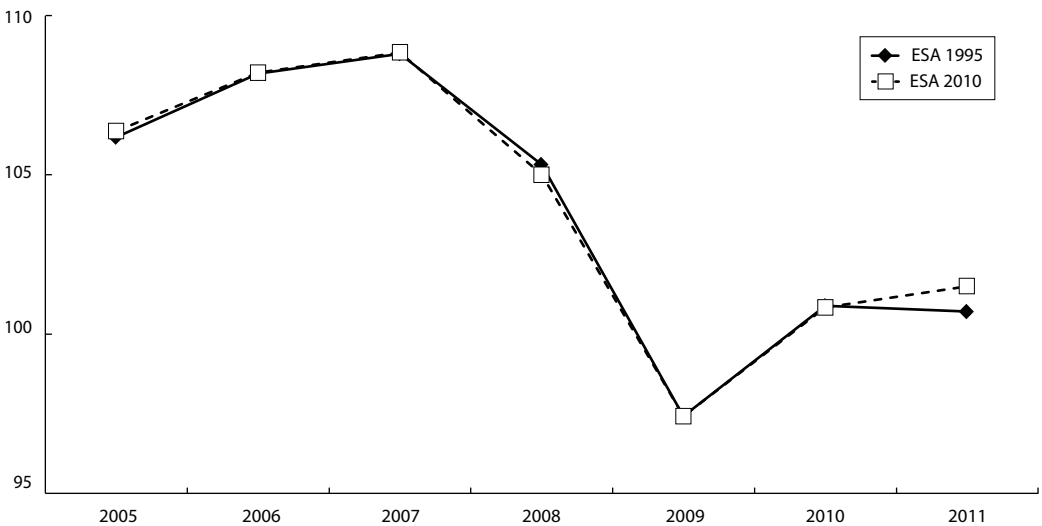
where c denotes the contribution of particular macro-aggregate, I_q denotes to volume index of particular macro-aggregate expressed in percentage and w denotes to a share of particular macro-aggregate on GDP in previous year.

However, a reconciliation of particular results with overall results had to be done. A share of ESA 2010 changes on GDP differs year by year (from 3.0% to 6.5%).[13] Shares of particular ESA 2010 changes (e.g. R&D) on total changes depends on a share of R&D on ESA 2010 changes but also on ESA 2010 changes on total changes.

2.1 Changes in indices of Gross Value Added

The differences in value indices of gross value added are negligible, see Figure 1.

Figure 1 Value indices of Gross Value Added



Source: CZSO; authors' computation

[12] Member states of EU are obliged to report GNI Questionnaire annually. Moreover, they have to quantify changes between ESA 2010 methodology and ESA 1995 methodology.

[13] See: <https://apl.czso.cz/nufile/Uvodni_poznamky_01_10_2014.pdf>.

The revision did not cause significant changes in volume indices of gross value added (GVA). The difference in volume index is less than 0.5 p.p. in all years. Research and Development and small tools increase volume index in most years, on the other hand changes in foreign trade have negative impact on volume index.

Table 2 Changes in volume indices of Gross Value Added

Gross Value Added	2005	2006	2007	2008	2009	2010	2011
ESA 2010	6.60	7.50	5.20	3.59	–5.49	2.87	1.97
ESA 1995	6.99	7.70	5.49	4.06	–5.16	3.12	1.81
Difference (p.p.)	–0.39	–0.20	–0.29	–0.47	–0.34	–0.25	0.16
Infl. of changes ESA 2010	0.11	–0.16	0.11	–0.48	-0.11	–0.03	0.06
R&D	0.06	0.00	0.07	0.00	0.07	–0.03	0.07
Small tools	0.23	0.42	0.12	–0.08	–0.05	0.04	0.24
Weapon systems	0.02	–0.03	–0.02	–0.02	–0.01	–0.01	0.00
Changes in foreign trade	–0.07	–0.04	–0.05	–0.12	0.04	–0.05	0.00
Insurance services	0.23	–0.35	0.08	–0.10	–0.02	0.19	–0.26
Other changes by ESA 2010	–0.34	–0.16	–0.10	–0.16	–0.14	–0.18	0.01
Infl. of other changes	–0.50	–0.04	–0.40	0.00	–0.22	–0.22	0.10
Improvement/Other	–0.54	–0.02	–0.41	0.08	–0.13	–0.43	0.07
Balancing adjustments	0.04	–0.02	0.01	–0.07	–0.09	0.21	0.04

Source: CZSO; authors' computation

2.2 Changes in indices of Gross Fixed Capital Formation

Table 2 shows impact of revision on value indices of gross fixed capital formation. The highest difference (1.45 p.p.) is observed in 2009. The decrease is now smaller than it was according to ESA 1995. The difference is caused mainly by Research and Development and Weapon systems which are acquired at least partly by government institutions. It is known that government investment is more stable than investments of companies. As a consequence a decline of gross fixed capital formation is less deep than it was.

Table 3 Changes in value indices of Gross Fixed Capital Formation

GFCF	2005	2006	2007	2008	2009	2010	2011
ESA 2010	7.07	6.63	15.20	2.91	–8.74	0.24	0.28
ESA 1995	5.97	6.91	15.05	4.20	–10.19	0.48	–0.85
Difference (p.p.)	1.11	–0.27	0.15	–1.29	1.45	–0.24	1.13
Infl. of changes ESA 2010	1.22	–0.26	0.06	–0.44	1.30	0.07	1.44
R&D	–0.09	–0.41	0.27	0.04	0.76	–0.07	0.40
Small tools	0.59	1.47	–0.07	–0.44	0.08	–0.03	0.93
Weapon system	0.73	–1.32	–0.14	–0.05	0.46	0.17	0.10
Infl. of other changes	–0.12	–0.01	0.09	–0.85	0.15	–0.32	–0.30
Improvement/Other	0.71	–0.05	–0.58	–0.89	0.20	–0.08	–2.07
Balancing adjustments	–0.82	0.04	0.68	0.04	–0.05	–0.23	1.77

Source: CZSO; authors' computation

Changes in volume indices may differ from changes in value indices as new deflation techniques have been introduced. Research and Development contributed to the growth of GFCF at current prices by 0.27 p.p. in 2009. However, the effect in volume index is negative as the increase in current prices was caused by a change in price level. Contributions of capitalisation of small tools are positive in all monitored years with exception of 2008. It is probably caused by changes in production process that is being modernized and requires more ICT.

Table 4 Changes in volume indices of Gross Fixed Capital Formation

GFCF	2005	2006	2007	2008	2009	2010	2011
ESA 2010	6.41	5.87	13.54	2.54	–10.09	1.32	1.07
ESA 1995	6.03	5.80	13.24	4.10	–11.05	1.02	0.36
Difference (p.p.)	0.38	0.07	0.30	–1.57	0.96	0.30	0.72
Infl. of changes ESA 2010	1.39	0.03	0.11	–0.05	1.12	–0.09	1.18
R&D	–0.08	–0.25	–0.02	0.02	0.84	–0.27	0.20
Small tools	0.72	1.45	0.18	–0.04	0.02	0.02	0.91
Weapon system	0.74	–1.17	–0.05	–0.03	0.27	0.15	0.07
Infl. of other changes	–1.01	0.05	0.19	–1.52	–0.16	0.39	–0.46
Improvement/Other	0.18	–0.02	–0.52	–0.98	0.24	0.27	–2.00
Balancing adjustments	–1.19	0.06	0.71	–0.54	–0.41	0.12	1.54

Source: CZSO; authors' computation

CONCLUSION

The paper is focused on changes that have been brought by new standard ESA 2010 and subsequent changes in deflation techniques. Although new standard should have been fully implemented by September 2014, international discussion on price and volume measurements started in the following years. It was obvious that deflation techniques should be changed in order to follow the new concept of indicators. Main changes are described in this paper as well as newly developed deflation techniques. They have been implemented the time series (1990 onwards). Nevertheless, some simplifications had to be done for the beginning of the time series due to insignificance of changes or lack of data.

The impact of changes was estimated. It was a difficult task as some changes have also indirect impact. Research and Development, small tools or weapon system cause changes in non-market output via consumption of fixed capital. The impact of some changes in volume index of GVA (e.g. capitalization of small tools) is cyclic. It is negative in the years of crisis (2008 and 2009) and positive in other years. The impact of capitalization of R&D is almost always positive because it considered crucial factor for the economy and it is supported by various economical tools (subsidies, taxation etc.) However, the impact of some items is accidental and depends on factors outside the economy, e.g. changes in insurance services are brought by natural disasters. We can conclude that the development of economy is similar but not the same.

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