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Volume measurement of services

Measurement of the volume of general government education and health services and research and development for Slovenia

Note by the Statistical Office of the Republic of Slovenia

Summary

        In the absence of information on prices, the only possibilities for measuring changes in volume are the input or direct output method. This paper the direct output method and its application for computing general government education and health output in Slovenia. The results are presented in detail and in comparison to those obtained using the input method. In addition, the results for research and development using the input method based on the 2008 System of National Accounts and 2010 European System of Accounts.

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I. Introduction

1.   In the economic analysis of measuring economic growth in nominal terms it is necessary to distinguish if the change in growth is an issue of a price change or a volume change. For most economic aggregates, especially for those where prices exist, that is an easy task. For them changes in volume are derived by methods based on price measurement. The problem appears when there is no information on prices. There the only possibilities for measuring changes in volume are the input methods or the direct output methods.

2.   The second chapter of the paper describes the direct output method and its application by volume measurement of the general government education and health output in Slovenian national accounts. All elements of the calculation are presented in detail, including results and their comparison with results by using the input method. In the third chapter the input method is presented and its application, together with results, by measuring the volume of research and development output according to SNA 2008/ESA 2010. Chapter four concludes.

II. Measurement of the volume of general government services in education and health

A. Background

3.   By the direct output method, changes in the volume of output are measured on the basis of quantities produced adjusted for changes in the quality of goods and services concerned. The method has three integral parts:

- stratification: to define output and to choose the quantity indicators;

- quality adjustment: to take account of changes in quality;

- weighting: to calculate the weighting pattern to combine the detailed indicators.

4.   For stratification it is important that:

- all output is totally covered;

- general government output is distinguished from any non-general government output;

- various types of outputs are distinguished and detailed as possible (maximal homogeneity);

- separate types of output are distinguished when costs are substantially different.

5.   For all types of output quantity indicators, depending on the type of goods or services, are produced.

6.   Quality adjustment is made when there are quality changes of goods and services. There are three approaches to adjust quantity indicators for quality:

- direct measurement of the quality of output,

- measuring the quality of inputs and

- measuring the quality of outcomes.

7.   Each approach has its strengths and weaknesses. The information about quality given with the first approach is very subjective (expert opinion) and is therefore not recommended. The second approach presumes that quality change of inputs leads automatically to quality change of outputs, which is questionable. The third approach is the most appropriate way of adjusting for quality as the quality of output lies in its results (in the outcome).

8.   The last part is weighting. The weights used to combine the indicators can be the average cost (expenditure) per unit or other suitable weights.

B.   Stratification

9.   The first field of volume measurement of general government services is education. It is the second largest activity of general government in Slovenia, following public administration and defence, compulsory social security. In 2009 its output is estimated at EUR 2,101 million at current prices and represents 28.5% of total general government output.

10.   General government education services cover all services provided by institutions which are classified as local or central government institutions in education activities according to the NACE Rev. 1.1 classification. Table 1 shows the percentage of general government output in education by type of activity. Annex 1 presents the detailed stratification of output including the information on weighting.

Table 1
General government output of education, by type of activity 2009

Stratification	*Percentage of total*
80.1 Primary education	
80.101 Pre-school education	12.1
80.102 General primary school education	42.2
80.103 Special primary school education for handicapped children	3.0
80.2 Secondary education	18.4
80.3 Higher education	21.2
80.4 Other education	
80.42 Other education and training	3.1

11.   The second field of volume measurement of general government services is health. It is the third largest activity of general government, with output estimated at EUR 1,581 million in 2009 or 21.5% of total general government output in Slovenia.

12.   General government health services cover all services provided by institutions which are classified as local or central government institutions in health activities according to the NACE Rev. 1.1 classification. Table 2 presents the stratification of general government output of health by type of activity.

Table 2
General government output of health by type of activity, 2009

Stratification	Percentage of total
85.1 Human health activities	
85.11 Hospital activities	75.9
85.12 Medical practice activities	
85.121 General medical practice activities	22.5
85.122 Specialised medical practice activities	0.1
85.13 Dental practice activities	0.2
85.14 Other human health activities	1.3

C. Quality adjustments

13.   Adjustment for quality is done on the basis of the quality of inputs and on the basis of the quality of outcomes.

D. Weighting

14.   Weights used to combine detailed indicators are the average cost (expenditure) per unit and sometimes the current price value of output.

E. Methods used for volume measurement

15.   Table 3 presents all above described elements of the methods used for volume measurement of general government education and health services in Slovenian national accounts. A column at the very right side of the table brings self-assessment of methods used; the self-assessment is based on the A/B/C classification of methods that could be used for volume measurement according to Commission Decision (98/715/ES)[1] on price and volume measures in national accounts, and according to Eurostat Handbook.[2]

16.   The Commission Decision divides methods into three groups:

- A methods: most appropriate methods;

- B methods: methods which can be used in case an A method cannot be applied (acceptable alternatives);

- C methods: methods which shall not be used.

17.   General criteria for classification of methods into the mentioned groups are:

- the completeness of the coverage of product/activity heading by the indicator

- whether the indicator covers all of the products under the heading or just a selection of them;

- the valuation basis of the indicator – at which prices valuation is done;

- the indicator should take quality changes into account, recording them within the volume estimates rather than the price estimates;

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[1] Commission Decision 98/715 – Official Journal of the European Communities, 16.12.1998, L340, p.33
[2] EC: Handbook on price and volume measures in national accounts, Luxembourg, 2001

• the conceptual consistency between the indicator and the national accounts concept.

18. A method satisfying all four criteria will generally classify as an A method. If one or more criteria are not satisfied, the method will become a B method or a C method according to how far away from an A method the method is. The precise distinction between A, B and C methods depends on the product/activity and its specific circumstances.

Table 3

Data sources and methods for measuring the general government output at constant prices by activities

Stratification	*Quantity indicator*	*Quality adjustment*	*Weighting*	*Data source*	*A/B/C method*
Education					
80.1 Primary education					
80.101 Pre-school education / broken down by type of education program	Number of pupil-hours	On the basis of the quality of inputs (number of pupils per teacher)	Not weighted (assumed that costs per program are equal)	Statistical survey SORS	A/B
80.102 General primary school education / broken down by type of education program	Number of pupil-hours	On the basis of: a) the quality of inputs (number of pupils per teacher) b) the quality of outcomes (average mark by class level)	Not weighted (assumed that costs per program are equal)	Statistical survey SORS	A/B
80.103 Special primary school education for handicapped children / broken down by type of education program	Number of pupil-hours	On the basis of: a) the quality of inputs (number of pupils per teacher) b) the quality of outcomes (average mark by class level)	Not weighted (assumed that costs per program are equal)	Statistical survey SORS	A
80.2 Secondary education / broken down by type of education program	Number of pupils	On the basis of: a) the quality of inputs (number of pupils per teacher) b) the quality of outcomes (advance to higher class)	Weighted with value of output by type of education services	Statistical survey SORS	B
80.3 Higher education / broken down by type of education program, and position in the national degree/qualification structure and field of study for higher professional schools and universities	Number of students	On the basis of the quality of inputs (number of students per teacher)	Weighted with: a) costs per student by type of course b) value of output by type of education program	Statistical survey SORS	A/B
80.42 Other education and training / broken down by type of subject	Number of pupil-hours	On the basis of: a) the quality of inputs (number of pupils per teacher) b) the quality of outcomes (advance to higher class)	Not weighted by type of subject	Statistical survey SORS	B
Health					
85.11 Hospital activities					
- Services to in-patient by general and specialized	Number of treatments grouped into groups	No quality adjustment	Weighting with data on the prices	Institute of Public	A/B

Stratification	Quantity indicator	Quality adjustment	Weighting	Data source	A/B/C method
hospitals	that are medically meaningful and as homogeneous as possible. Groups are based on the DRG[3]-type classifications		of the health services provided – each group in DRG has its own weight	Health of the Republic of Slovenia	
- Hospital psychiatric services	a) number of occupants days by level of care b) number of health services provided by type of treatment	No quality adjustment	Weighting with data on the prices of: a) occupant days by level of care and b) health services provided by type of treatment	The Health Insurance Institute of the Republic of Slovenia	B
- Rehabilitation services	a) number of occupants days b) number of treatments	No quality adjustment	Weighting with data on the prices of: a) occupant days b) treatment	The Health Insurance Institute of the Republic of Slovenia	B
- Nursing services and other health services in hospital	a) number of occupants days by level of care b) number of health services by type of treatment c) number of treatments	No quality adjustment	Weighting with data on the prices of: a) occupants days by level of care b) health services provided by type of treatment c) treatment	The Health Insurance Institute of the Republic of Slovenia	B
85.12 Medical practice activities					
85.121 Services by general medical practitioners	Number of consultations (visits) by type of treatment	No quality adjustment	Weighting with data on costs per patient treated by type of treatment within age groups	Institute of Public Health of the Republic of Slovenia	B
85.122 Services by medical specialists	a) number of occupants days by level of care b) number of health services provided by type of treatment	No quality adjustment	Weighting with data on the prices of: a) occupant days by level of care b) health services	The Health Insurance Institute of the Republic of	B

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[3] Diagnosis Related Groups – system was in Slovenia established in year 2003 – adopted from the Australian AR-DRG system.

Stratification	Quantity indicator	Quality adjustment	Weighting	Data source	A/B/C method
			provided by type of treatment	Slovenia	
85.13 Dental practice activities	Number of health services provided by type of treatment	No quality adjustment	Weighting with data on the prices of health services provided by type of treatment	The Health Insurance Institute of the Republic of Slovenia	B
85.14 Other human health activities	Number of health services provided by type of treatment	No quality adjustment	Weighting with data on the prices of health services provided by type of treatment	The Health Insurance Institute of the Republic of Slovenia	B

B. Results

19.   In Slovenian national accounts the direct output method for measuring the volume of general government education services was used for the first time in 2003. It is based on above described weighted and quality adjusted quantity indicators. Table 4 presents estimates of general government output of education in volume measured by the direct output method. For comparison also estimates measured by the input method are shown.

Table 4
General government education output, 2001-2009

	2001	2002	2003	2004	2005	2006	2007	2008	2009
Output at current prices, mio EUR	1,179	1,330	1,459	1,585	1,677	1,780	1,860	2,016	2,102
Output at constant previous year prices, mio EUR									
Input method	-	1,228	1,352	1,486	1,598	1,719	1,811	1,916	2,064
Output method	-	1,224	1,379	1,504	1,622	1,711	1,812	1,901	2,072
Output volume index (2001=100)									
Input method	100.0	104.1	105.8	107.8	108.7	111.4	113.4	116.8	119.6
Output method	100.0	103.8	107.6	110.9	113.5	115.8	117.8	120.4	123.8

Output annual volume growth rate (%)									
Input method	-	4.1	1.7	1.9	0.8	2.5	1.7	3.0	2.4
Output method	-	3.8	3.7	3.1	2.3	2.0	1.8	2.2	2.8

20.   Results show:

•   the difference in volume growth rate between the two methods in the 2001–2009 period is 4.2 percentage points (input method 19.6%, output method 23.8%);

•   the annual volume growth rate measured by the output method of the primary and secondary school education activities has been progressively declining after 2002. On the other hand, the annual volume growth rate of pre-primary and higher education activities has been increasing after 2003;

•   annual volume growth rates by the output method are mostly higher than growth rates by the input method, especially in the 2003–2005 period.

21.   For measuring the volume of general government health services direct output methods are still not used in official GDP estimates of Slovenia. The calculations by them are done in parallel with the currently used input method. The main reason for that is the late introduction of the DRG system in Slovenia and its usage in health statistics. It is planed that results of output methods will be used for compiling official GDP figures at the end of 2012. New volume measures of general government hospital services and services by general medical practitioners, which represent 98.4% of total general government health services, will be included for the 2008–2010 period.

22.   Table 5 shows general government health output at current and at constant prices and growth rates using the input method and the output method for the 2003–2009 period.

Table 5
General government health output, 2003-2009

	2003	2004	2005	2006	2007	2008	2009
Output at current prices, mio EUR	1,054	1,116	1,169	1,219	1,290	1,455	1,581
Output at constant previous year prices, mio EUR							
Input method	-	1,071	1,142	1,203	1,267	1,348	1,496
Output method	-	1,119	1,215	1,206	1,249	1,344	1,451
Output volume index (2003=100)							
Input method	100.0	101.6	104.0	107.0	111.2	116.2	119.5
Output method	100.0	106.2	115.6	119.3	122.2	127.3	126.9
Output annual volume growth rate (%)							

Input method	-	1.6	2.3	2.9	3.9	4.5	2.9
Output method	-	6.2	8.9	3.2	2.4	4.2	-0.3

23.   Results show:

•   the difference between annual volume growth rate measured by the input method and annual volume growth rate measured by the output method for 2004 and 2005 is significant and is increasing (in 2004 it was 4.6 percentage points and in 2005 6.6 percentage points);

•   the difference in volume growth rate in the 2003–2009 period is 7.4 percentage points (input method 19.5%, output method 26.9%);

•   annual volume growth rates by the output method are up to 2006 higher and after this year lower than growth rates by the input method;

•   the volume of general government hospital services was increasing in the whole period, except in 2009 when it decreased by 0.3%. The decrease in volume in this year is present also in health services provided by general medical practitioners and in other human health services.

III.   Measurement of the volume of research and development

A.   Introduction

24.   According to SNA 2008/ESA 2010, research and development expenditure has the nature of investments. In order to prepare for the introduction of new statistical standards into national accounts, first preliminary estimates were prepared in Slovenian national accounts covering years 2005, 2006 and 2007. The integral part of the experimental calculation was the compilation of research and development output at constant prices. The estimates were prepared according to the Eurostat Task Force on R&D recommendation,[4] namely by the input method – by the cost approach as the sum of costs (inputs) of production: intermediate consumption, compensation of employees, other taxes on production and consumption of fixed capital. The same approach was applied for the volume of market output as well as for the volume of non-market output.

B.   Methods used for volume measurement

25.   By the input method the used inputs of production are observed. The intermediate consumption is stratified into six components which are deflated by the consumer price index or the implicit output deflator of the activity 73 Scientific research and development (NACE Rev. 1.1 classification). The compensation of employees in volume is estimated on the basis of the quantity indicator (number of employees), the consumption of fixed capital is deflated by the implicit deflator for gross fixed capital formation, and other taxes on production are mainly extrapolated with the quantity indicator (number of employees).

26.   Table 6 presents a more detailed procedure of application of the input method for volume measurement of research and development, and the whole structure and methods.

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[4] Final minutes, 1st meeting of the Eurostat Task Force on R&D in March 2011, Recommendation 3.

C. Results

27. Estimates of research and development output at current prices and at constant prices, measured by the input method, are currently compiled as satellite accounts and are not used in compiling official GDP figures. It is expected that these new estimates will be included in official GDP estimate with the introduction of ESA 2010 scheduled to take place in 2014. Table 7 presents results of experimental calculation for the 2005–2007 period. The inclusion of research and development according to SNA 2008/ESA 2010 into Slovenian national accounts will increase the nominal level of GDP by around 1–1.5%.

Table 6

Methods for measuring output of research and development at constant prices

Stratification	*Method*
Intermediate consumption	
Material	Deflation by the consumer price index
Services	Deflation by the consumer price index
Temporary and occasional contract work, honoraria payments	Deflation by the consumer price index
Allowances and other travel costs	Deflation by the consumer price index
Other material and services	Deflation by the consumer price index
Extramural purchases of research and development	Deflation by the implicit output deflator of the activity 73 Scientific research and development
Value added	
Compensation of employees	
Gross wages and salaries	Extrapolation by the number of employees (broken down by sector)
Other labour costs	Extrapolation by the number of employees (broken down by sector)
Employer's social security contributions	The same volume growth rate as of gross wages and salaries
Consumption of fixed capital	Deflation by the implicit deflator for gross fixed capital formation in activity 73 Scientific research and development
Other taxes on production	
Payroll tax	Extrapolation by the number of employees (broken down by sector)
Other taxes on production	The same ratio to the volume of output as in the previous year's current price ratio
Subsidies	The same ratio to the volume of output as in the previous year's current price ratio
Net operating surplus	The same ratio to the volume of output as in the previous year's current price ratio
Expenditure on own-account production of software and other adjustments	Deflation by the service producer price index

Table 7
Research and development output, 2005–2007

	2005	2006	2007
Output at current prices, mio EUR	398	459	469
Output at constant previous year prices, mio EUR	-	440	474
Output volume index (2005=100)	100.0	110.3	113.9
Output annual volume growth rate (%)	-	10.3	3.2

D. Further Steps

28.   According to ESA 2010, Chapter 10: Price and volume measures, paragraph 10.30, considering the conceptual difficulties and the absence of consensus on output methods adjusted for quality, these methods are no longer recommended in order to preserve the comparability of the results between the countries. These methods are reserved for supplementary tables, while continuing research. Thus, in the field of general government education and health, volume measures of output have to be calculated on the basis of direct output measures – not adjusted for quality – by weighting up the quantities produced by the previous year unit weights, without applying any correction to take account of quality. Therefore, with the introduction of ESA 2010 in Slovenian national accounts quality adjustments applied on quantity indicators for measuring general government education services as described above will be removed.

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Annex 1

Complete stratification of general government education output

Stratification	Weighting
80.1 Primary education	
80.101 Pre-school education	
- all-day program	not weighted – assumed that costs are equal
- half-day program	not weighted – assumed that costs are equal
- shorter program	not weighted – assumed that costs are equal
80.102 General primary school education	
- 8-year program	not weighted – assumed that costs are equal
- 9-year program	not weighted – assumed that costs are equal
80.103 Special primary school education for handicapped children	
- 8-year program	not weighted – assumed that costs are equal
- 9-year program	not weighted – assumed that costs are equal
80.2 Secondary education	
- general secondary education	weighted with value of output
- general gymnasium programmes	not weighted – assumed that costs are equal
- professional gymnasium programmes	not weighted – assumed that costs are equal
- matura courses	not weighted – assumed that costs are equal
- technical and vocational secondary education	weighted with value of output
- lower vocational programmes	not weighted
- middle vocational programmes	not weighted
- technical and other professional programmes and vocational technical programmes and courses	not weighted
80.3 Higher education	
- colleges (2-3 year programme)	weighted with value of output
- higher professional schools	weighted with value of output
1 Education	
14 Teacher training	weighted with costs
2 Humanities and Arts	
21 Arts	weighted with costs
22 Humanities	weighted with costs
3 Social sciences, Business and Law	
31 Social sciences	weighted with costs
32 Journalism and information	weighted with costs
34 Business and administration	weighted with costs

Stratification	Weighting
38 Law	weighted with costs
4 Science, Mathematics and Computing	
42 Life science	weighted with costs
44 Physical science	weighted with costs
46 Mathematics and statistics	weighted with costs
48 Computing	weighted with costs
5 Engineering, Manufacturing and Construction	
52 Engineering	weighted with costs
54 Manufacturing and processing	weighted with costs
58 Architecture and building	weighted with costs
6 Agriculture and Veterinary	
62 Agriculture and forestry	weighted with costs
64 Veterinary	weighted with costs
7 Health and Welfare	
72 Health	weighted with costs
76 Social services	weighted with costs
8 Services	
81 Personal services	weighted with costs
84 Transport services	weighted with costs
85 Environmental protection	weighted with costs
86 Security services	weighted with costs
- universities	weighted with value of output
1 Education	
14 Teacher training	weighted with costs
2 Humanities and Arts	
21 Arts	weighted with costs
22 Humanities	weighted with costs
3 Social sciences, Business and Law	
31 Social sciences	weighted with costs
32 Journalism and information	weighted with costs
34 Business and administration	weighted with costs
38 Law	weighted with costs
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62 Agriculture and forestry	weighted with costs
64 Veterinary	weighted with costs
7 Health and Welfare	
72 Health	weighted with costs
76 Social services	weighted with costs
8 Services	
81 Personal services	weighted with costs

Stratification	Weighting
84 Transport services	weighted with costs
85 Environmental protection	weighted with costs
86 Security services	weighted with costs
80.42 Other education and training	
Music schools and other artistic schools	
Bowed string instruments	
- Violin	not weighted
- Viola	not weighted
- Violoncello	not weighted
- Contrabass	not weighted
Woodwind instruments	
- Flute	not weighted
- Oboe	not weighted
- Clarinet	not weighted
- Bassoon	not weighted
- Saxophone	not weighted
Brass instruments	
- Horn	not weighted
- Trumpet	not weighted
- Trombone	not weighted
- Tuba	not weighted
- Other brass instruments	not weighted
Keyboard instruments	
- Piano	not weighted
- Organ	not weighted
- Accordion	not weighted
Plucked string instruments	
- Harp	not weighted
- Guitar	not weighted
Blockflute	not weighted
Percussion instrument	not weighted
Folk instruments	
- Diatonic accordion	not weighted
- Cither	not weighted
- Tambura	not weighted
Dance	
- Ballet	not weighted
- Contemporary dance	not weighted
Singing	not weighted
80.1 Primary education	
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Stratification	Weighting
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- Contrabass	not weighted
Woodwind instruments	
- Flute	not weighted
- Oboe	not weighted
- Clarinet	not weighted
- Bassoon	not weighted
- Saxophone	not weighted
Brass instruments	
- Horn	not weighted

Stratification	*Weighting*
- Trumpet	not weighted
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- Diatonic accordion	not weighted
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- Ballet	not weighted
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