Appendix to Challenges in the Measurement of Public Sector Productivity in OECD Countries:

Table 1: Direct Output Measurement in Education

Country	Source	Quantity Indicator	Weights	Quality adjustment
Canada	a	Research ongoing		
Japan	a	no current project		
Switzerland	a	no current project		
Korea	a	research ongoing		
Luxembourg	a	pupil hours; number of pupils (tertiary)	costs	No
Australia	a	number of pupils	costs	No
Austria	a, b	number of pupils	costs	No
Belgium	a	pupil hours	costs	No
Czech Republic	a	number of pupils	costs	No
Netherlands	a	number of pupils	costs	No
Germany	a, b	pupil hours; number of pupils (tertiary)	costs	No
Greece	b	number of pupils	specific CPI	No
Estonia	a	number of pupils	costs	No
Finland	a	number of pupils; basic degrees (tertiary)	costs	No
New Zealand	a, b	number of pupils	value added	No
Latvia	a, b	number of pupils	number of teachers	class size
Malta	a, b	number of pupils	pupils moving up/graduates	
Norway	a	pupil hours; number of pupils (tertiary)	on the agenda	
United States	b	number of pupils	costs	pupil teacher ratio; high school drop-out rates; test scores
Denmark	a	number of pupils	costs	rates of educated teachers; class size; scoring of pupils
France	a, b	number of pupils	costs	pupils moving up between 1981 and 2001
Hungary	a	number of pupils	costs	class size
Italy	a, b	number of pupils	costs	class size + degrees
Lithuania	b	number of pupils	costs	examination data
Poland	a, b	pupil hours; number of pupils (tertiary)	class size; enrolment in STEM for tertiary	
Slovak Republic	a	number of pupils; pupil hours	costs	scoring of pupils
Slovenia	a, b	number of pupils; pupil hours	costs	scoring of pupils; number of pupils per teacher
Spain	a	number of pupils	costs	class size
Sweden	a, b	pupil hours and number of pupils	costs	school grades; number of pupils with final grade (upper sec)
United Kingdom	a	full time equivalent pre-primary; attendance adjusted FTE primary and up; number of pupils (tertiary)	costs	estimated contribution that each year of schooling makes to performance in school leaving examinations taken at 15-16, applied to both primary and secondary; initial teacher training adjusted by proportion of final year students achieving qualified teacher status

Notes: (a) Administrative data; (b) Survey Data

Table 2: Indicators Used for the Measurement of Output in the Health Sector

Level	Indicators	Source	Study
Outcome	Life expectancy at birth	Eurostat / OECD	NISR
	Infant mortality	Eurostat / OECD	NISR
	Self-perceived health	Eurostat / OECD	NISR
	Hospital Activities		Denmark, 2013
	Health gain as a consequence of hospital treatment		Denmark, 2013
	Reduced mortality rates / increased survival rate		Denmark, 2013
	Preventive arrangements		Denmark, 2013
	Centralisation / specialisation of hospitals		Denmark, 2013
Input	Health expenditure as percentage of GDP	Eurostat / OECD	NISR
	Health expenditure by financing agent	Eurostat / OECD	NISR
	Health expenditure by provider	Eurostat / OECD	NISR
	Private health expenditure as percentage of total health expenditure	Eurostat / OECD	NISR
Output	Number of professionally active physicians per 1,000 population	Eurostat / OECD	NISR
	Number of professionally active nurses per 1,000 population	Eurostat / OECD	NISR
	Number of doctor's consultations per capita	Eurostat / OECD	NISR
	Number of hospital discharges per 100 population	Eurostat / OECD	NISR
	Long-term care recipients as % of the population aged 65 or over	Eurostat / OECD	NISR
	Influenza vaccinations as % of the population aged 65 or over	Eurostat / OECD	NISR
	Hospital activities		Denmark, 2013
Trust	Perceived quality of health services	European Quality of Life Survey	NISR
Price Index	Price index for somatic hospitals		Denmark, 2013
	Price index for public dental services		Denmark, 2013
	Price index for residential and day care places for the elderly		Denmark, 2013
Quality Indicators	AMI 30-day mortality rate		Denmark, 2013
	Hemorrhagic stroke 30-days mortality rate		Denmark, 2013
	Ischemik stroke 30-days mortality rate		Denmark, 2013
	Cervical cancer five-year relative survival rate		Denmark, 2013
	Breast cancer five-year relative survival rate		Denmark, 2013
	Colorectal cancer five-year relative survival rate		Denmark, 2013
	Asthma mortality rate		Denmark, 2013
	In-hospital waiting time for hip fracture surgery		Denmark, 2013
	Surveys of patient experience		Denmark, 2013
	Waiting time		Denmark, 2013

Source: Robano (2016) based on data from the Netherlands Institute for Social Research (NISR; 2015); Statistics Denmark (2013).

Table 3: Overview of Country Approaches in Estimating Health Services

Country	Direct volume approach (DRG)	Output-based deflation approach	Input-based deflation approach
Australia	yes		
Austria	yes		
Belgium	yes		
Denmark	yes		
Finland	yes		
France	yes (non-market output)	yes (market output)	
Greece (2009)	number of days		
Hungary	yes		
Ireland	yes		
Italy	yes		
Netherlands	yes		
New Zealand (2009)	yes (non-market output)	yes (market output)	
Norway	yes	yes (out of pocket payments of hospital-based services)	
Slovenia	yes		
Sweden	yes		
United Kingdom	yes		
Israel	number of days		
Lithuania	number of days		
Chile		yes	
Germany		yes	
Iceland		yes	
Japan		yes	
Luxembourg (2009)		yes	
Korea		yes	
Portugal		yes	
Switzerland		yes	
Slovak Republic		yes	
Bulgaria		yes (market output)	yes (non-market output)
Latvia		yes (market output)	yes (non-market output)
Poland		yes (market output)	yes (non-market output)
United States		yes (market output)	yes (non-market output)
Canada		yes (market output)	yes (non-market output)
Estonia		yes (market output)	yes (non-market output)
Turkey	n/a	n/a	n/a

Source: Robano (2016) based on data from Lorenzoni (2015).

Box 1: Meso-level Productivity Measurement in Education and Health Care Services

In the education sector, the delivery of services can be accomplished either by a market (provision for a price) or a non-market activity (public provision for free or for an economically insignificant price). Information on the output indicators used for education services by OECD countries was last reviewed in 2010 (Schreyer, 2010). Output indicators include (i) the number of pupils; and (2) the number of pupil-hours. The output for education services suggested by the OECD (Schreyer, 2010) and the European Commission (EC, 2016) is "the amount of teaching received by students for each type of education." In addition, the OECD suggests the use of quality adjustment. The measurement of the output should be performed at the individual level and focus on individual benefits for the students. Recommended output indicators are stratified by different levels of education (Table 1).

Table 1: Output Indicators for Education

Stratification	Method / quantity indicator
Pre-primary education	Number of pupil-hours
Primary education	Number of pupil-hours
General secondary education	Number of pupil-hours
Technical and vocational secondary education	Number of pupils
Post-secondary non-tertiary education	Number of students
Tertiary education	Number of students
Other education	Number of students
Educational support services	Input methods can be used

Source: European Commission (2016: 127).

Health care services can also be organized either as a market or a non-market activity. For the measurement of outputs the OECD identifies "the quality adjusted numbers of completed treatments of particular diseases or of activities to prevent a disease" (Schreyer, 2010). ESA 2010 suggests using the output method whenever possible, although it recognizes that due to the potential heterogeneity of products and services, input methods can be used for some items. The definition of health output suggested by the European Commission is "the quantity of health care received by patients, for each type of health care provided" (EC, 2016:128). For practical reasons, it is measured in terms of complete treatments delivered by a single provider.[1] Outputs are defined separately for different health care providers, such as hospitals, specialists, general practitioners, etc. Diagnostic Related Groupings (DRGs) — a statistical system for classifying hospital cases for the purposes of payment — provides activity-based measures like "the number of hospitalizations by DGRs", "the number of bed days" or "the number of consultations or visits" (see Appendix Table 2 for output measures of health care services).

According to the latest data (OECD, 2015f), the majority of OECD countries use direct volume measures for non-market health care services output, most of them in the form of DRGs, together with DRG cost measures, while a few of them use "days of hospital care". The input-based approach is used by six countries, among them Canada and the United States (Appendix Table 3) (Lorenzoni, 2015), although this

1 Preferably, measures should take into account complete treatments for diseases independent of the provider to better capture technological developments, e.g. developments away from operations towards the use of pharmaceuticals. In practice, however, this is quite difficult to implement (Schreyer, 2010).

may be due to the fact that in some countries such as the United States, health care is largely provided by market services, and, as a consequence, there is less need for the development of an output-based method of government services.

Further measurement initiatives in health care are planned, among them new and recurring price collection for health purchasing power parities (PPPs) and the construction of temporal price indices with the same information. These will be essential for measuring health care productivity across countries.

Box 2: Approaches to Quality Adjustment to Output Measures

Quality changes can be achieved by (i) direct measurement of output quality (e.g. reports of school inspections, user experience); (ii) measuring the quality of inputs (assuming implicitly that they are fully translated to the output); and (iii) using outcomes, although this latter method faces the major problem that the outcomes can be influenced by other external variables beyond output changes.

Another method applied by the majority of OECD countries is stratification, meaning that different qualities of the same product (or service) are treated as different products (Schreyer, 2010; EC, 2016). By stratifying, outputs, are rendered homogenous and therefore quality is kept constant in each stratum for better comparison.

In their output measurement in the education sector, some countries adjust for quality by class size, the pupil-teacher ratio, and the educational scores of pupils. The United Kingdom uses the estimated contribution made by each year of schooling to the performance in school leaving examinations taken at the age of 15-16 for both primary and secondary education, as well as the initial teacher training adjusted by the proportion of final year students achieving the qualified teacher status (see Appendix Table 1 for details in country practices).

For health care services, only three countries reported using quality adjustment. Hungary uses survival indices, Norway the number of readmissions, and the United Kingdom relies on patient experience and quality-adjusted life years, albeit only for productivity analysis. Methodological advancement can occur on the area of quality adjustment by using post-treatment survival, life expectancy, waiting times (Castelli *et al*., 2007, Deveci, 2011) and patient reported measures (NHS Information Centre, 2011; Gutacker *et al*. 2011).