THE ROLE OF ACCOUNTING IN MEASURING EFFICIENCY IN PUBLIC EDUCATION: A LITERATURE REVIEW

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Abstract

Purpose – During the current financial and economic crisis, public sector efficiency is at the heart of debate. Since education investment can have a lag of 20 years and is faced with lower budgets, many countries invested less in education arguing that they had been so far inefficiently spent. However, academic literature is not unanimous in the type of accounting measures to be used to measure public education's efficiency. Therefore, the aim of this paper is to determine which efficiency measures are most widely used in academic literature, and what influences their design. In addition, we would like to find out if and how efficiency measures of public education changed over time, and which is the role of accounting in its contemporary understanding.

Design/methodology/approach – We performed a comprehensive literature analysis of research papers published in public sector, management and accounting journals since 1990 to answer the following research questions: 1) how is efficiency of education defined in research literature, 2) how is efficiency of education measured in accounting system of education providers, and 3) how these measures changed over time.

Findings - The analysis confirms that most efficiency measures are still oriented towards cost minimization. However, over time due to a growing diversity of accounting data, efficiency measures have become more sophisticated and multidimensional to encourage education providers not only towards cost minimization but also towards increasing of output quality. Furthermore, our survey indicates that the research focus has shifted from measuring efficiency towards the evaluation of implementation measures in terms of social responsibility by application of contemporary accounting methods.

Research limitations/implications – The study reveals that simple efficiency indicators frequently used for allocation of public funds to education providers often leads to undesirable results in terms of lower quality output. However, the literature review is limited to research papers published in English, addressing mostly education providers in developed countries. To get a better understanding of efficiency measures in public education, there should also be analyses of studies conducted in other cultural environments and published in other languages.

Keywords: efficiency, accounting for public education, literature review.

1. INTRODUCTION

Despite the prevailing agreement that the main reason for financial crisis is financial sector's performance, searching for solutions to improve general economic situation soon brought efficiency in the public sector to the heart of the debate. Particularly welfare states are looking for the ways to cut spending without undermining the values on which these countries are based. By comprising the largest share of public spending and with straight impact on citizens' social status, health care, education, and pensions are

areas where eligibility of expenditure levels heats the public discussion. For example, OECD countries spent on average 6% of GDP in 2008 on education, more than three-quarters of it came from public sources (OECD, 2011). Since education investment can have a lag of 20 years (Psacharopoulos & Patrinos, 2004) and they are faced with lower budgets, many countries in financial distress, including Slovenia, invested less in education arguing that funds had been so far inefficiently spent. On the other hand, United States, Britain, Germany, Canada and China education was granted even more funds (Newsweek, 2009) claiming education represents "*a platform of early recovery*" (UNESCO, 2010, p.29). Regardless of whether educational funds were increased or decreased, there is common agreement that public funds should be spent effectively (Gill & Raiser, 2012).

However, academic literature is not unanimous in the type of measures to be used to measure public education's efficiency. For this reason efficiency is measured by comparisons of various quantitative indicators (e.g. literacy rate, student/teacher ratio, enrolment ratio, and graduation rates), with cost indicators (e.g. like educational funds as % of GDP, and public spending per student). Measurement of public education's efficiency is difficult not only due to nonexistence of a generally accepted indicator of (in) efficiency, but it also depends on how developed is public sector's accounting information system.

Therefore, the purpose of this paper is to determine which efficiency measures are most widely used in academic literature and what influences their design. Also, we would like to find out if and how efficiency measures of public education changed over time and which in this context is the role of accounting in its contemporary understanding. Therefore this paper focuses on the following research questions: 1) how is efficiency of education defined in research literature, 2) how is efficiency of education measured in accounting system of education providers, and 3) how these measures changed over time. The main contribution of our paper is that it gives a comprehensive insight into the diversity of education efficiency measures. We employed a narrative literature review method by detailed consideration of papers published in the public sector, management and accounting journals since 1990 to assess current status of education efficiency research area and provide guidance for further research.

The rest of the paper is organized as follows. Section 2 provides a brief overview of various efficiency definitions. Section 3 explains the input and output selection problems in the process of educational efficiency calculation. The overview of the functional forms used to measure efficiency is presented in Section 4. Section 5 summarises the overall findings and provides possible directions for future research on this subject.

2. DEFINING EFFICIENCY

Even though efficiency of extremely diverse industries is calculated daily, and comparisons across highly different countries are made, economic and business academic literature is unanimous in the spirit of its calculation: when estimating efficiency, you need to make a comparison of outcome to the resources. Farrell (1957) emphasized the need to get a better output with the given set of inputs, and this is particularly important for public sector operations. Further attempts to use Farrell's methodology of valuating performance of the public sector to estimate production or technical efficiency helped to develop the Data envelop analysis (DEA). Namely, the first application of now widely used methodology was based precisely on the evaluation of efficiency in publicly financed education.

In their seminal papers considered as the foundation of the DEA methodology, Charnes, Cooper & Rhodes (1978, 1981) set out to evaluate the efficiency of various public education programs. They introduced the idea that in order to determine true program efficiency, management efficiency has to be identified first and disentangled from program efficiency (1981, p.668). Their goal was to identify programs that appear to be better off than they truly are (i.e. they actually have low program efficiency) due to good management (i.e. high management efficiency). They claim that such "contamination" (1981, p.678) should be eliminated first in order to avoid "imputing the results of good management to bad programs and vice versa" (1981, p.668). Since this distinction is based on reliable determination of production technology (1978, p. 430), such separation is particularly difficult in the public sector and consequently only "relative efficiency" based on ranks can be estimated (1978, p.430): program's efficiency is determined by the reference to other competitive programs. Charnes, Cooper & Rhodes (1981, p.669) define program as inefficient if it is possible to improve any output without increasing any input and/or without decreasing any other output (i.e. output orientated determination of program's efficiency), and/or if it is possible to reduce

any input without increasing any other input, and/or without decreasing any output (input orientated determination of program's efficiency).

Definition of (in)efficiency that was provided by Charnes, Cooper & Rhodes (1981) doesn't require input and/ or output prices, as efficiency is determined by quantitative parameters only. On one hand, elimination of parameters affected by market fluctuations purifies program's efficiency calculation, since it can expose the source of production's inefficiency (Green, 2007) without requiring assumptions about functional form of production function (Mandl, Dierx & Ilzkovits, 2008). On the other hand the elimination of prices artificially sets up a presumption that technically efficient programs are also allocatively efficient. Nonetheless, Charnes, Cooper & Rhodes's definition of efficiency (1981) allows the identification of either efficiency frontier or production possibility frontier, which is: highest achievable level of outcome for a specified level of input or/and lowest possible level of input required to get a given amount of output (Afonso, Schuknecht & Tanzi, 2003).

However, Green (2007, p.92) notes that an ideally efficient program produces not only a maximum output possible given a set of inputs (is technically efficient), but also at "*the minimum cost of producing that output given the prices of the inputs, or the maximum profit attainable given the inputs, outputs, and prices of the inputs and outputs*" (i.e. economically or cost efficient). Since private goods are sold on a market, prices of private sector's outputs are available. On the other hand, public sector's outputs are frequently not sold on the market; as a result their price of is unknown or is barely assessed. Related to education, questions like "How much should we pay for Harvard graduate?" frequently arise. The answer can only be estimated, since it doesn't only depend on the educational program completed, but also on individual's abilities. On top of it, public spending has multiple economic and social objectives. Mandl, Dierx & Ilzkovits, (2008) point out that public spending should be effective: outputs should not only be cost effectively produced, but also have to be judged against the economic and/or social goals to be achieved. As shown in education, it is not sufficient to compare public educational spending to graduation rates or test scores, but also to the increased competitiveness of workforce.

Even though input prices are easier to obtain, scholars disagree about the definition and measurement of costs of education or *"the value of the resources a community must consume in the production of a given level of student achievement"* (Duncombe, Ruggiero & Yinger ,1996). Specifically, many researchers point out that identical annual expenditure per student across different programs doesn't guarantee that all students will have an equal opportunity to get quality education, since prices of inputs vary across programs among other reasons due to varying ability to attract teaching personnel of given quality (Wentzler, 1981). The use of the cost of education index developed by Chambers (1981) and now applied as an adjustment factor in several US states, should eliminate price affecting factors that lie beyond control of program's managers from cost efficiency estimation. If such adjustment is not made, we can come across programs that are technically efficient by quantitative variables but cost inefficient because of expensive resources on certain geographic locations.

3. INPUTS AND OUTPUTS OF EDUCATION

What is the true cost of education and what are true results of money spent has been a key issue ever since the question of education investment's eligibility was raised. Because theoretically ideal variables which should be used in education efficiency calculation (e.g. teaching quality as in input and market competitiveness of a graduate as an output) cannot be reliably measured, various proxies are used. This increases the likelihood of specification error that occurs due to the wrong choice of inputs and outputs which in turn induces systematic errors in efficiency measurement (Green, 2007). Consequently, some programs may appear more efficient than they truly are and vice versa. Additionally, model over-identification (i.e. model with more inputs and outputs than necessarily) will also boost efficiency (Chalos, 1997). Recent developments of accounting information systems' enhanced the measurement accuracy within educational institution, and consequently improved program efficiency estimation within specific education institution, however efficiency estimations of various educational institutions as a whole remain a challenge. Table 1 shows most frequently used proxies for inputs of education process. This is followed by Table 2 showing proxies for educational outputs.

The basic premise is that quality of education is reflected in the labour performance of graduates shown by their higher income and/or higher employability (Barro & Lee, 2001). However, increase in income resulting from education is not easily estimated. Usually, conclusions are based on income by educational

attainment distribution obtained by population census (see for example US Census Bureau, 2011). However, income fluctuates from year to year depending on general economic conditions and on current situation on the labour market. One should also take into account, that not all programs offered at certain educational institution are of equal interest to potential employers. Kempkes & Pohl (2007) tried to investigate the efficiency of German universities as a whole and concluded they "*are too heterogeneous to be compared*". Based on their research, Mandl, Dierx & Ilzkovits (2008, p.24) concluded that cross-country comparisons of efficiency of tertiary education are "*hardly possible*" for the time being.

Table 1

Key inputs used in education efficiency estimation

Financial variables	**Reference**
Annual education expenditure per student	Hanushek, Rivkin & Taylor (1996) Barro & Lee (2001) Afonso & Aubyn (2004) Sequeira & Robalo (2008)
Annual education expenditure per student (as % of GDP pre capita)	Aristovnik (2011)
Total education expenditure (as % of GDP)	Jafarov & Gunnarsson (2008) Ahmed (2012) Aristovnik (2011)
Average teacher salary	Heckman, Layne-Farrar & Todd (1996) Hanushek, Rivkin & Taylor (1996) Barro & Lee (2001) Sequeira & Robalo (2008)
Quantitative variables	**Reference**
Length of school year (in hours)	Afonso & Aubyn (2004)
Length of school year (in days)	Heckman, Layne-Farrar & Todd (1996) Barro & Lee (2001) Sequeira & Robalo (2008)
Teacher to student ratio	Hanushek, Rivkin & Taylor (1996) Heckman, Layne-Farrar & Todd (1996) Barro & Lee (2001) Afonso & Aubyn (2004) Jafarov & Gunnarsson (2008) Sequeira & Robalo (2008)
Number of teachers at certain program	Charnes, Cooper & Rhodes (1981)
Share of teachers in total employment	Gonand (2007)
Parents' education	Charnes, Cooper & Rhodes (1981) Bevc, Dolenc, Ložar, Novak, Perič-Mulac & Smrekar (2001)
Parental school visits	Charnes, Cooper & Rhodes (1981)
Parent counseling index (i.e. hours spent with child on school-related topics)	Charnes, Cooper & Rhodes (1978) Charnes, Cooper & Rhodes (1981)
Employment rate	Gonand (2007)

Indicators used in efficiency analysis aim to measure schooling (service) quality while controlling for students' quality. Typical indicators of student quality are family factors like parent's education (Charnes, Cooper & Rhodes, 1981; Barro & Lee, 2001; Bevc et al., 2001), parental school visits and parent counseling index (Charnes, Cooper & Rhodes, 1978 and 1981). As a proxy for parent's income, Barro & Lee (2001) use GDP per capita, while there is no uniform agreement whether dropout rates and repetition rates are an indicator of student or schooling quality. Some inputs are fairly easy to measure and record (e.g. length of school year, teacher to student ratio and teacher salary) while others are based on less reliable survey data (e.g. time parents spent with child on school-related topics).

While there is no apparent market for education output, universally accepted proxies for quality of primary and secondary schooling are student scores on various tests (most frequently OECD program for International Student Assessment PISA), completion rates, and school length. PISA is a common choice among researchers since it is the largest available data set on students' performance collected by same criteria. Some researchers classify teacher salary as an input indicator (see for example Sequeira & Robalo,

2008; Barro & Lee, 2001), whereas others believe that teacher salary depends on the level of education expenditure and is therefore classified as an output (see Aristovnik, 2011). This dilemma can be avoided by the use of regression analysis, which contrary to the more popular DEA model doesn't require input-output classification of efficiency indicators. Additionally, contemporary accounting methods based on "*lean enterprise*" management tools help identify value added processes and consequently detect true value adding input parameters with higher reliability.

A few decades ago teacher to student ratio and annual education expenditure per student were key indicators for education policy making (Hanushek, Rivkin, & Taylor, 1996). Today public policy focuses on highly educated unemployed workforce. Consequently, measures like unemployment with tertiary education, measured as a % of total unemployment are coming to the forefront of education efficiency analysis (see for example Gonand, 2007; Aristovnik, 2011).

Table 2

Key outputs used in education efficiency estimation

Outputs	Reference
Performance of students (assessed by various national or international evaluation programs like PISA[38], IEA[39] or IAEP[40])	Charnes, Cooper & Rhodes (1981) Barro & Lee (2001). Afonso, Schuknecht & Tanzi (2003) Afonso & Aubyn (2004) Jafarov & Gunnarsson (2008) Sequeira & Robalo (2008) Aristovnik (2011)
Self-esteem measures	Charnes, Cooper & Rhodes (1981)
Completion rate	Hanushek, Rivkin & Taylor (1996) Tajnikar & Debevec (2007) Jafarov & Gunnarsson (2008) Aristovnik (2011)
Years of schooling completed	Hanushek, Rivkin & Taylor (1996).
Repetition rates	Barro & Lee (2001) Sequeira & Robalo (2008)
Dropout rates	Barro & Lee (2001) Tajnikar & Debevec (2007) Sequeira & Robalo (2008)
School enrolment	Afonso, Schuknecht & Tanzi (2003) Jafarov & Gunnarsson (2008) Aristovnik (2011) Ahmed (2012)
Teacher to student ratio	Aristovnik (2011)
Employment rate	Gonand (2007)
Unemployment with tertiary education (% of total unemployment)	Gonand (2007) Aristovnik (2011)
Labor force with tertiary education (% of total labor force)	Aristovnik (2011)
Adult literacy rate	Ahmed (2012)
GDP growth	Gonand (2007)
Productivity gains	Gonand (2007)

3. EVALUATING EFFICIENCY AND THE ROLE OF CONTEMPORARY ACCOUNTING METHODS

In addition to variable selection, the selection of statistical methods applied to evaluate educational efficiency and assumptions required that the chosen method can again induce systematic errors in the efficiency measurement. According to Green (2007, p.98), function itself is "*a relationship between inputs and outputs*": function selection should therefore follow a careful consideration about relationships among

[38] OECD program for International Student Assessment.
[39] The International Association for the Evaluation of Educational Achievement.
[40] International Assessment of Educational Progress.

variables of interest and not vice versa. As multiple factors can affect quality of output, cost functions are often used in efficiency analysis since they allow the inclusion of multiple inputs (Green, 2007). On the other hand, Duncombe, Ruggiero & Yinger (1996) point out that production functions typically assume separability between outputs. Therefore main advantage of production function is that it enables production efficiency estimation separately for each output. Estimation of production or cost function in education is commonly done by one of the statistical methods presented in Table 3.

Most common method for education efficiency estimation is the Data Envelopment Analysis, widely known as the DEA method. The main advantage of nonparametric methods (including DEA) compared to parametric ones is that they don't make assumptions regarding the underlying distribution. For this reason, non-parametric tests are more stringent than parametric methods: if an education program is efficient under non-parametric method, it is also efficient under the parametric one. Nevertheless, non-parametric tests have less power than parametric ones: using non-parametric tests usually requires larger sample sizes to get a reliable estimation.

Table 3

Methods used in education efficiency estimation

Nonparametric methods	**References**
Data Envelopment Analysis (DEA) developed by Charnes, Cooper & Rhodes (1978)	Afonso & Aubyn (2004) Gonand (2007) Kempkes & Pohl (2007) Jafarov & Gunnarsson (2008) Aristovnik (2011)
Free Disposal Hull Analysis (FDH)	Afonso & Aubyn (2004) Afonso, Schuknecht & Tanzi (2003)
Parametric methods	**References**
Seemingly unrelated regression method	Sequeira & Robalo (2008) Barro & Lee (2001)
Fixed effects regression	Barro & Lee (2001)
Two stage regression	Heckman, Layne-Farrar & Todd (1996)
Generalized least squares regression	Hanushek, Rivkin & Taylor (1996)
Tobit regression	Kempkes & Pohl (2007)

Both DEA and Free Disposal Hull Analysis (FDH) are used to estimate production frontier using most efficient education programs. However, unlike DEA, FDH doesn't assume that production frontier is convex and is therefore less stringent (Afonso & Aubyn, 2004). Similarly to DEA, the rarely used FDH method helps estimate "*wastefulness of public spending"* (Afonso, Schuknecht & Tanzi, 2003) by quantifying inefficiency.

Unlike the DEA method and the FDH analysis, regression analysis is not sensitive to classification of variables as inputs and outputs. Additionally, regression analysis allows for testing the quality of the model (Berg, 2010). Consequently, DEA as well as regression analysis are increasingly used to simultaneously test the robustness of results (see for example Kempkes & Pohl, 2007). In addition, contemporary management accounting tools like *Balanced Score Card,* popularized by Robert S. Kaplan and David P. Norton, provides a reliable identification of value added inputs by clarifying education institution's "*strategic objective with coherent set of performance measures*" (Kaplan & Norton, 1993) connected to socially responsible behaviour, social and economic goals.

4. CONCLUDING REMARKS

Our analysis of education efficiency estimation literature confirms there is no unanimous agreement regarding either education efficiency parameters or estimation methods. Since education efficiency researches diverge in the definition of efficiency of education, and its measurement, these two research questions cannot be answered straightforwardly. Due to difficulties in assessing the value of learning outcomes (i.e. outputs) most financial measures of (in)efficiency are still oriented towards cost minimization. On the other hand, while investigating our third research question, we discovered that accounting data efficiency measures have become more sophisticated and multidimensional to encourage education providers not only towards cost minimization but also to increase output quality. Furthermore, our survey indicates that

the research focus started to shift from measuring pure education efficiency with traditional accounting performance measures towards the evaluation of social impact of education using contemporary statistical and management accounting methods: increasingly education programs are judged against the economic and/or social goals to be achieved. Financial crisis combined with growing unemployment among young well-educated adults has forced policy makers to opt for firmly justifying education spending. For this reason we believe it is essential that further research should focus on education spending effectiveness, not only on efficiency.

This study also reveals that simple efficiency indicators frequently used for allocation of public funds to education providers often lead to undesirable results in terms of lower quality output. However, the lack of research in this area as well as not fully comparable data sets and various methods employed, led to the fact that we were not able to statistically quantify the results (by using meta-analysis) to reliably determine the parameters that increase and those parameters that reduce education efficiency. Additionally, technical advancement is ongoing and so production function is not static (Green, 2007): yesterday's highly efficient combination of inputs is already outdated today. Finally, with the exception of one study, our literature review is limited to research papers published in English, which mostly address education providers in developed countries. To get a better understanding of efficiency measures in public education, there should also be analyses of studies conducted in other cultural environments and published in other languages.

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