5th Workshop on Efficiency and Productivity Analysis

Book of Abstracts & List of Participants

5th October, 2015
Conference Venue:
Universidade Católica Portuguesa
Américo Amorim Building - Room 3
Rua Diogo Botelho 1327, 4169-005 Porto

Organising Commitee:
Maria Conceição Portela
Ana Camanho
PROGRAMME
## REGISTRATION AND OPENING SESSION (9h00-9h30)

**Invited Session: Challenges in Faculty and University Assessment**

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<td>Laurens Cherchye (Leuven University, Belgium)</td>
<td>Multi-output efficiency analysis: application to higher education</td>
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<td>10h15 - 11h00</td>
<td>José Fernando Oliveira (University of Porto, Portugal)</td>
<td>Faculty evaluation: the experience of the University of Porto</td>
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## COFFEE BREAK (11h00-11h30)

## Invited Session: Costs and Efficiency Analysis in Universities

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<td>12h00 - 12h30</td>
<td>Emmanuel Thanassoulis (Aston University, UK)</td>
<td>Assessing the cost-effectiveness of university academic recruitment and promotion policies</td>
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## LUNCH (12h30-14h00)

## Contributed Session 1 (Chair: Laurens Cherchye)

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<td>The influence of the learning environment on course efficiency. Evidence from Flanders</td>
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<td>14h20 - 14h40</td>
<td>Giannis Karagiannis</td>
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<td>14h40 - 15h00</td>
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<td>15h00 - 15h20</td>
<td>Carla Amado, Sérgio Santos, José de São José</td>
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## COFFEE BREAK (15h40-16h10)

## Contributed Session 2 (Chair: Emmanuel Thanassoulis)

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<td>Is there a prison size dilemma? An empirical analysis of output-specific economies of scale</td>
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<td>17h10 - 17h30</td>
<td>Wasim Sultan, José Crispim</td>
<td>Inefficiency Associated to cross-functionality in hospitals: A DEA approach</td>
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## DINNER AT CASA DA MÚSICA, including guided tour (19h30-22h30)
ABSTRACTS
Multi-output efficiency analysis: application to higher education

Laurens Cherchye
Leuven University, Belgium.

We present a method for multi-output efficiency analysis. The distinguishing feature of the method is that it explicitly accounts for output-specific production technologies, which are characterized by output-specific and jointly used inputs. The method is particularly well-suited for analyzing the efficiency of higher education institutions (with education and research outputs), which we demonstrate through an application to US universities. In our empirical application, we show the use of our method to measure coordination efficiency, which captures the efficiency gains that can be realized by reallocating inputs across outputs.
Faculty evaluation: the experience of the University of Porto

José Fernando Oliveira
Maria Antónia Carravilla

Faculdade de Engenharia da Universidade do Porto, Portugal

In this talk we will present the model for faculty evaluation that has been implemented at the University of Porto. The model incorporates both a quantitative and a qualitative evaluation for the four areas under evaluation: research, teaching, knowledge transfer and university management. The inputs for the model are the curricular items of each faculty member. These inputs are transformed both in qualitative and quantitative indicators, the later based on a scoring system. The quantitative indicators are mapped into criteria, contributing for the quantitative evaluation of an area. The qualitative indicators are used to define a multiplicative factor that affects the initial area quantitative evaluation. Under this general framework, particularly interesting may be the way how, for each criteria, the scoring is transformed in a (normalised) value, where the concept of target, ceiling and value function play an important role. The always challenging aggregation of criteria into areas and areas into a final score, was tackled by means an optimised weighting strategy for each faculty member. This model has been applied in the Faculty of Engineering for already 6 years and is being progressively extended throughout the University, with the natural and required adaptations.
The purpose of this paper is to provide an in-depth study of the cost structure and efficiency of English higher education institutions (HEIs). We are particularly interested, given the change in the composition of the sector, in how costs structures and efficiency vary by mission group. Previous work has focussed on pre-determined mission groups; but that is not necessarily satisfactory as mission groups were often formed historically, and universities which may once have had similar missions may not necessarily have similar outlooks today. To this end we use a panel of data from the English higher education sector from 2002/03 to 2010/11 to estimate a cost function for English HEIs using the latent class variant of the stochastic frontier model. This allows us simultaneously to (i) identify clusters of institutions, based on what the data tell us, (ii) evaluate the parameters of the cost function for each cluster, thence evaluating also measures of economies of scope and of scale within each cluster, and (iii) measure the efficiency of each institution, both relative to other institutions in the same cluster and relative to all other institutions in the analysis.
Assessing the cost-effectiveness of University academic recruitment and promotion policies

Emmanuel Thanassoulis
Aston University, UK

We develop a DEA based method so that the recruitment and promotion policies of a tertiary academic institution can be assessed for their cost effectiveness retrospectively. This is done at academic person level. While at person level there could be ad hoc events that could affect the findings of research output, when the results are suitably aggregated at institution level they can be informative about the cost-effectiveness of the policy on recruitment and promotions at institution level. The method is applied to academic staff of a Greek University.
The influence of the learning environment on course efficiency. Evidence from Flanders

Joris Hindryckx
VIVES University College, Kortrijk, Belgium & Maastricht University, Top Institute for Evidence Based Education Research, Maastricht, Netherlands

Kristof De Witte
Katholieke Universiteit Leuven (KU Leuven), Leuven Economics of Education Research, Belgium

Using an unique and rich dataset of a large European higher vocational institute, this paper examines what program, student and didactical characteristics can explain the differences among courses in obtaining high course grades and student success rates, given the student intake. Applying an advanced conditional and robust efficiency model, we examine the role of an elsewhere available textbook, versus (or combined with) a course specific textbook, and learning materials from video or internet. We also test the influence on course efficiency from objectivistic versus constructivist learning activities. Finally, we test for the role of the examination format (i.e., written exam, oral exam, multiple choice, internship, versus continuous assessment). The results suggest that courses with distance learning have a significantly lower efficiency than courses with face-to-face education. We observe that courses with objectivistic characteristics (mainly lectures) have an unfavorable influence on the course efficiency in comparison to courses with only constructivist characteristics (e.g. group work). In comparison to oral examinations, courses with written examinations have lower grades and higher dropout given the student intake. Courses which developed their own course materials have lower efficiency than courses using standard text books and courses that combine own course materials with a general textbook and internet materials.

Keywords: Higher vocational education, Conditional and robust efficiency, Learning environment, Student outcomes, Student success rates
On aggregating programmatic efficiency

Giannis Karagiannis

Department of Economics, University of Macedonia, Greece

The aim of this paper is to derive the aggregation weights that give consistent estimates of aggregate programmatic efficiency. By using the denominator rule we show that the aggregation weights of programmatic efficiency are based on potential rather than actual output (or revenue in the multi-output case), as was the case for technical (managerial) efficiency. Potential output refers to the level of actual output after adjusted for technical inefficiency and here the way efficiency is measured in the output oriented model matters. If we measure efficiency using the Farrell index, potential output would be determined by means of the pooled frontier or meta-frontier while if we measure efficiency using the Färe, Grosskopf and Lovell index, potential output would be determined by means of the group best practice frontier.

Keywords: Programmatic Efficiency; share-weighting aggregation
A Directional Distance Function measure of Eco-efficiency for world-class mining companies

Renata Oliveira
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Ana Camanho
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Andreia Zanella
Faculdade de Engenharia da Universidade do Porto, Portugal

Assessing eco-efficiency of companies is important to ensure the creation of wealth without compromising the needs of future generations. This work aims to extend the eco-efficiency concept by including in the assessment new features related to environmental benefits (e.g., the use of renewable resources and contribution to ecosystem conservation) and environmental burdens (e.g., air emissions). This concept is implemented using a Directional Distance Function model, with an optimization procedure involving two stages. The first stage seeks for performance improvements associated with input and output levels. Different scenarios regarding managerial priorities for adjustments to firm economic and environmental indicators are explored. The second stage explores improvement opportunities in the composition of the resources consumed, in order to become greener by replacing non-renewable inputs with more sustainable alternatives. We present an empirical application to world-class mining companies. The results obtained and their managerial implications are discussed.

Keywords: Eco-efficiency, Directional Distance Function, Mining Companies
Using Data Envelopment Analysis to measure the gender pay gap

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Research Center for Spatial and Organizational Dynamics

The gender pay gap attempts to measure the differences in the wages earned by female workers when compared to male workers. Despite specific legislation in the European countries, on average, women continue to be paid considerably less than men. Even after adjusting for productivity related factors, a significant part of the gender pay gap remains. Despite extensive research in this area, there is still no undisputed method to measure the gender pay gap. Accurately measuring the gender pay gap is an important exercise in order to measure how far we are from the ideal of equal pay for work of equal value. In this article, we contribute to the development of an enhanced method to measure the gender pay gap. This method is based on the Data Envelopment Analysis (DEA) technique, which presents several advantages when compared with other techniques that have been used to measure the gender pay gap. We propose the use of DEA to construct an index reflecting an adjusted measure of the gender pay gap, which takes into account the multiple factors that may influence compensation as well as the multiple types of compensation. The enhanced method is illustrated with data regarding the compensation of Technicians and Associate professionals working in Financial and Insurance activities in European countries. The policy implications of the results are also discussed.

Keywords: Data Envelopment Analysis; Gender Pay Gap; Compensation frontier
Malmquist and Hicks-Moorsteen productivity indexes for clusters performance evaluation

Diogo Cunha Ferreira
Rui Cunha Marques
Pedro Simões

Civil Engineering Research and Innovation for Sustainability (CERis), DECivil-IST, University of Lisbon, Portugal.

Background: Measuring the performance of clusters characterized by the unbalance-deneness and units with no correspondence in other clusters (“uncorrespondencedeness”) has not achieved the desired attention in the literature. In particular, the operational research has been almost exclusively focused on performance evolution over time, where clusters are generally balanced and the units are repeated over these groups. Furthermore, such analysis has been based on the Malmquist and (in the past few years) the Hicks-Moorsteen indexes. However, these ones are solely based on Shephard’s radial distance functions, which do not account for all inefficiency sources.

Objectives and Materials: Making use of the so-called Geometric Distance Functions (GDF) and the GDF-based Malmquist index, we propose a generalization of the Hicks-Moorsteen index (HMI), based on targets instead of distances to the efficient frontier. This generalization allows the use of any frontier-based model to assess cluster productivity. Moreover, we propose a four-step Monte-Carlo-based framework to achieve the pseudo-corresponding units for general cluster performance analysis. This framework is then a generalization of the conventional performance evolution over time, allowing an individual performance interpretation along each cluster.

Results: Due to the proposed generalization of the HMI, we have shown that (1) the HMI can be decomposed into economically meaningful indexes (efficiency spread, productivity gap and RTS-based effects) and can be rewritten as the geometric mean of the input- and the output-oriented Malmquist indexes (plus a residual term), (2) constant returns to scale is a sufficient condition to collapse both the Malmquist index and the HMI, (3) the HMI is a true, multiplicatively complete and circular/transitive TFP measure if prices are competitive, and (4) the HMI is always feasible. Given these conclusions and our proposed framework, the employment of the HMI to the general clusters analysis is straightforward.
Measuring Electric Energy Efficiency in the Portuguese Economy

Thomas Weyman-Jones
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The aim of this paper is to measure the progress in electric energy efficiency in the production of goods and services in Portugal - total electricity consumption excluding residential uses.

There is a great interest in measuring the efficiency of electrical energy uses, and this is an area where EDP has done research, in both data collection and methodology. It is relatively common to model energy efficiency in terms of an energy intensity or electricity intensity relationship with aggregate income. A new approach to this problem was suggested by Filippini and Hunt (2011, 2012) in which an econometric energy demand model was estimated to control for the exogenous variables determining the energy demand. The variation in energy efficiency over time could then be estimated by applying econometric efficiency analysis to determine the variation in energy efficiency.

Following the recent applications of this new approach to electricity consumption in the Portuguese households, developed by Weyman-Jones et al. (2012, 2013), this paper now focus on the application of econometric efficiency analysis to electricity consumption in the Portuguese productive activities.

Keywords: Electric Energy Efficiency, Econometric Efficiency Analysis
Is there a prison size dilemma? An empirical analysis of output-specific economies of scale

Veerle Hennebel
Center for Economic Studies, KU Leuven, Belgium.

Richard Simper
Centre for Risk, Banking and Financial Services, University of Nottingham, UK

Marijn Verschelde
Center for Economic Studies, KU Leuven, Belgium

We advocate a nonparametric multi-output framework to estimate output-specific economies of scale and we apply this model to male prisons in England and Wales over the sample period 2009-2012. To estimate output-specific returns to scale in prisons, we consider not only operational tasks, but also qualitative outputs such as successful reintegration, purposeful activity and safety within-prison. Furthermore, we introduce environmental heterogeneity using the characteristics of the prisoners. England and Wales offers a unique example to study prison scale economies as the UK has started to build new super-size prisons in order to replace the most old-fashioned prisons.
Efficiency in Primary Health Care: a longitudinal analysis

Rita Bastião
Nuno de Sousa Pereira
CEF.UP, Faculdade de Economia da Universidade do Porto, Portugal.

Primary Health Care (PHC) is often considered the cornerstone of an efficient health care system. Still, it has been less studied than other levels of care. In Portugal, several reforms have been implemented to increase the efficiency and the role of primary health care, but the outcomes are dubious. Our aim is to evaluate the determinants of efficiency across PHC units and to measure how they are affected by the different reforms, including the type of adopted organizational structure.

Using data between 2009 and 2014 from all PHC units in Portugal, we conduct a two-stage analysis where the approach of Simar and Wilson (2007) follows Data Envelopment Analysis to measure technical efficiency. We also study the determinants of the transition across Family Health Units Type A (FHU-A) and Type B (FHU-B) estimating duration models and random-effects panel probit models.

Preliminary results reveal that the average input-oriented efficiency score of Portuguese PHC units ranges from 0.2 to 0.4. PHCUs and FHUs significantly differ in their efficiency levels, with the latter being more efficient. FHUs-B are consistently more efficient, while units within Local Health Units (LHU) are less efficient. We also observe significant geographical heterogeneity. FHUs-A take nearly 3 years to transition to FHU-B and the ones that do it are the most efficient and mature ones. On the other hand, units that belong to LHUs persist longer as FHU-A.

In conclusion, it seems that reforms should continue to foster a transition towards FHUs-B.

Keywords: Primary Health Care, efficiency analysis, organizational structure
Inefficiency Associated to Cross - Functionality in Hospitals: 
A DEA Approach

Wasim I. M. Sultan 
José Crispim 

University of Minho, School of Economics and Management, Braga, Portugal.

To accomplish their medical and social goals hospitals in Palestine are set up in a functional organizational structure. For most hospitals, the main operating departments are medical, paramedical and administrative ones. To draw constructive plans for future improvements, it is important for management to capture the sources of inefficiency in the hospitals. This study aims at measuring the relative operational efficiency of hospitals, and explores the departmental setback “deficiencies” among inefficient hospitals. We will examine data from the 50 hospitals located in West Bank using Data Envelopment Analysis (DEA) to assess the relative efficiency of the Palestinian hospitals.

DEA is a method for measuring the efficiency of peer decision making units (DMUs) and proved excellent approach in the literature of performance evaluation. A standard DEA model will be used in order to capture the sources of inefficiency. This approach avoids the pitfalls of using Network DEA in the hospital operating context. In Palestine, health sector development is occurring in a unique political and socioeconomic context. Therefore, contextual and social indicators (e.g., per-capita GDP fluctuation, women unemployment rates, education) will be incorporated in the analysis. Time, hospital size, and public versus NGO sector efficiency comparisons will be made.

This study adds to previous literature by providing: a) an extension of the DEA method by incorporating frontier based performance analysis, b) reflecting specific contextual and demographic characteristics (e.g., median age 21 years, unemployment rate 28%, occupied region with restrictions to the movement of patients) and c) describing a new case study (empirical study) which applies DEA to a developing country with few existing studies.

Keywords: DEA, Hospitals, cross functionality, inefficiency, Palestine.
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