11th International Conference
on Data Envelopment Analysis (DEA2013)

BOOK OF ABSTRACTS

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Emmanuel (UK) Triantis,
Kostas (USA)
Vargas, Francisco (Mexico)
Vincent, Charles (Peru)
# DEA2013: CONFERENCE PROGRAM

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<td>08:30-10:30</td>
<td><strong>Tutorial 1: Health Care Applications in DEA</strong> <em>(Tepe 2)</em>&lt;br&gt;Yasar A. Ozcan, Virginia Commonwealth University, USA</td>
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<td>10:30-12:30</td>
<td><strong>Tutorial 2: Economic Foundation of DEA</strong> <em>(Tepe 3)</em>&lt;br&gt;Subhash Ray, University of Connecticut, USA</td>
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<td><strong>Tutorial 3a: DEA and Banking Sector</strong> <em>(Tepe 2)</em>&lt;br&gt;Rajiv Banker, Temple University, USA&lt;br&gt;Joseph Paradi, University of Toronto, Canada</td>
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<td><strong>Tutorial 3b: DEA Software and Banking</strong> <em>(Tepe 2)</em>&lt;br&gt;Ali Emrouznejad, Aston University, UK</td>
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<td><strong>Tutorial 4: Sensitivity Analysis and Network DEA</strong> <em>(Tepe 3)</em>&lt;br&gt;Necmi Avkiran, The University of Queensland, Australia&lt;br&gt;Kostas Triantis, National Science Foundation, USA</td>
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<td>18:00-20:00</td>
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## SUNDAY (30 June 2013)

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<td>10:30-12:00</td>
<td>Session 7</td>
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<tr>
<td>12:00-13:30</td>
<td>Lunch</td>
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<tr>
<td>13:30-20:00</td>
<td>Social Trip <em>(to Amasya)</em></td>
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1 Detailed Sessions Program is at the back of the book page 75
1 AN INTERTEMPORAL ANALYSIS OF PRODUCTIVITY IN RESIDENTIAL AGED CARE NETWORKS USING DYNAMIC NETWORK DEA

Necmi Avkir, The University of Queensland, Australia
Alan McCrystal, The University of Queensland, Australia

ABSTRACT

With a rapidly ageing population in developed countries there is a rising concern about how this group of people would be looked after, and retirees are increasingly encouraged to remain in their homes for low-level care. The primary purpose of this paper is to develop scenario analysis using simulated data where various criteria can be incorporated into modeling policy targets, and apply a new intertemporal productivity analysis to observe inefficiencies as reform unfolds. The study demonstrates, for the first time, how the efficient frontier technique dynamic network data envelopment analysis (D-NDEA) can be used to evaluate the changing productivity of residential aged care (RAC) over time. Results indicate that it takes 9 years for at least 90% of the RAC networks to have 85% or more of the total beds in high-level care. Based on operating efficiency, an optimal bed capacity is reached by the end of year 7. Closely linked number of beds and registered nurses employed are the main sources of inefficiency among discretionery variables. This insight highlights the added stress on key resources if an RAC sector re-structure were to incorporate a growth in high-level care beds. The common core inefficient cohort identified represents a sub-group of RAC networks more deserving of closer managerial attention because of their constantly inefficient operations over time. In conclusion, the government will need to carefully consider how a re-structure of bed capacity that shifts the emphasis to growth in high care beds can be sustained in a setting where supply of the registered nurses falls short of demand.

2 ECONOMIC EFFICIENCY AND PRODUCTIVITY IN THE MEXICAN METROPOLITAN SYSTEM, 1998-2008

Alejandra Trejo, Center for demographic, urban and environmental studies, El Colegio de Mexico, Mexico
Angelica Maria Vazquez Rojas, Economics Academic Area at Universidad Autonoma del Estado de Hidalgo, Mexico

ABSTRACT

This paper deals with economic efficiency and productivity, and inter-metropolitan disparities by examining technical efficiency and productivity by means of data envelopment analysis and the Malmquist index for the 30 medium sized and big metropolitan zones in Mexico in the years 1998, 2003 and 2008. Metropolises are key territorial units for analysis and action because of their economic, social and political importance. Metropolitan economic efficiency and productivity reveal effective resources allocation, appropriate management, coordinated
development and strong competitiveness. The problem of a heterogeneous metropolitan distribution of productivity and efficiency brings about the challenge of extending economic benefits to all metropolises. Mexico is a Latin American middle-income country that underwent a process of liberalization, deregulation and privatization in the 1980s and 1990s. During this economic transition a two-fold spatial restructuring took place: the emergence of several cities with qualities of metropolitan areas, and the reallocation of some economic activity away from Mexico City. We aim at providing information on the economic performance of metropolises and the spatial heterogeneity in this country in order to guide further analysis as well as private and public policy projects and programs that support an improved performance of individual metropolises and the whole metropolitan system.

3 THE CHARACTERISTICS OF GROWING BANKS DURING THE FINANCIAL CRISIS OF 2007-2012

Shu-Chin Huang, Ming Chuan University, Taiwan

ABSTRACT

The financial crisis has continued for several years since 2007. Each bank may have adjusted its input and output structures in order to keep growing during the recession. This study will apply Data Envelopment Analysis and Metafrontier to estimate technical and scale efficiencies of domestic and foreign banks located in Taiwan, mainland China and Hong Kong in 2007-2012. I will analyze their relative efficiency changes during this period, and point out the characteristics of successful firms during this period. In particular, I will focus on the analysis of risk, entrepreneurship and social responsibility inputs, which were ignored by most previous studies.

4 SELECT BEST LOCATION OF SOLAR PLANTS BY AN INTEGRATED HIERARCHICAL DEA APPROACH IN TURKEY CITIES

Adnan Sozen, Gazi University, Turkey
Amin Mirzapour, Gazi University, Iran, Islamic Republic of

ABSTRACT

Adnan SOZEN*, Amin MIRZAPOUR
Gazi University, Technology Faculty, Energy Systems Engineering, 06500 Teknik okullar, Ankara, TURKEY

The unique Properties of solar energy have caused increasing demands for such resources in various countries. In order to use solar energy as a natural resource, environmental circumstances and geographicallocation related to solar intensity must be considered. Different factors may affect on the selection of a suitable location for solar plants. These factors must be considered concurrently for optimum location identification of solar plants. An ideal location for such centersshould particularly be able to represent the area. To this end, location selection of the solar plants is considered in this article. This article presents an
integrated hierarchical approach for location of solar plants by data envelopment analysis (DEA), an integrated hierarchical DEA approach incorporating the most relevant parameters of solar plants is introduced. Moreover, the Administrated approach is tested for 25 differentcities in different regions in Turkey.

5 INTEGRATED DEA APPROACH FOR LOCATION OPTIMIZATION OF WIND PLANTS

Adnan Sozen, Gazi University, Turkey
Amin Mirzapour, Gazi University, Iran, Islamic Republic of

ABSTRACT

Adnan SOZEN*, Amin MİRZAPOUR
Gazi University, Technology Faculty, Energy Systems Engineering, 06500 Teknik okullar, Ankara, TURKEY

Newly emerging renewable alternative energy resources are expected to take increasing role in the energy scenarios of the future energy consumptions and specially environmental and technical benefits of wind energy have made it as a promising alternative for conventional energy resources. Wind energy is the most ancient source, and it is the root material for almost all fossil and renewable types. Determining the priority of different locations has special importance for utilizing wind systems. Different factors may effect on the selection of a suitable location for wind plants. These factors must be considered concurrently for optimum location identification of wind plants. This article presents an integrated hierarchical approach for location of wind plants by data envelopment analysis (DEA), an integrated hierarchical DEA approach incorporating the most relevant parameters of wind plants is introduced. Moreover, the Administrated approach is tested for 25 different cities in Turkey in different regions. In this study integrated hierarchical DEA approach for geographical location optimization of wind plants.

6 SHADOW PRICE OF NON-PERFORMING LOANS IN CHINESE COMMERCIAL BANKS UNDER DIFFERENT RISK PREFERENCES

Ning Zhu, Jinan University, China
Bing Wang, Jinan University, China
Zhiqian Yu, Copenhagen Business School, Denmark

ABSTRACT

In order to estimate shadow price of NPL, particularly based on different risk preferences, we employ the quadratic directional output distance function through adjusting different direct vectors to evaluate 44 Chinese commercial banks during 2004 to 2011, and bootstrap method is applied to empirically examine macroeconomic environment. We find some interesting results as follows: as the decrease of risk sensitivity, the shadow price of NPL is decreasing as well. SOCB intends to reduce the NPL more actively under risk aversion preference, whereas
CCB and JSCB, owning more rational and flexible operation, prefer to pay more risk premiums than that of SOCB under risk equality and risk invalid preferences. The credit behavior of SOCB has been impacted by some policy power, like government goal and social responsibility. Regarding macroeconomic factors, real GDP and M2 supply decrease shadow prices of NPL, whereas CPI, real lending rate and fixed asset investment to GDP have opposite effect.

7 IMPROVING EFFICIENCY OF ELECTRICITY DISTRIBUTION UNITS THROUGH BENCHMARKING AND MERGER – A CASE STUDY EMPLOYING DATA ENVELOPMENT ANALYSIS

Trishit Bandyopadhyay, XLRI School of Management, India
Fernando Roxas, Asian Institute of Management, Philippines

ABSTRACT

The present study assesses the efficiencies of electricity distribution units, each having multiple inputs and outputs, by DEA, and identifies benchmark units specific to all relatively inefficient units thereby providing guidance to the administrator of power distribution how the inefficient units can improve their efficiencies via their individual emulation paths. The study also provides an assessment of savings (over ten percent) that could be achieved if the inefficient units improve their efficiency; this information could aid the Administrator for setting improvement targets for the inefficient units. Another means of improving efficiency that the Administrator can engage in is first identifying and then influencing the merger of two or more distribution units such that the best that can be offered comes from those multiple units working together – not independently. The study provides identities of various distribution units within regions under the administrator’s control which could merge profitably,-that is, the resources used by the merged unit when it is performing at its best is less than the sum of resources used in the best performances of its constituents when they work independently. An easily accessible software package was used for all calculations thereby increasing the attractiveness of using DEA for the Administrator.

8 DEA SCORES AS A DEBIASING TOOL TO PREVENT THE “DECOY EFFECT”

Heinz Ahn, TU Braunschweig - Institute of Management Control and Business Accounting, Germany
Nadia Vazquez Novoa, TU Braunschweig - Institute of Management Control and Business Accounting, Germany

ABSTRACT

Choice has been shown to be usually made in relative terms, i.e., by comparing easily comparable alternatives and avoiding those that are not easily comparable. Introducing an alternative (A-) which is worse than another one (A) but very similar to it facilitates the comparison among these two alternatives. As a consequence, the non-dominated alternative
(A) appears to be not only better than the dominated one (A-), but also better than any other alternative. This effect is known as the decoy effect.

In a performance evaluation context, the choice of the best performing DMU may be susceptible to the decoy bias. We experimentally evaluate the occurrence of this bias for an evaluation case in which DEA scores are provided/not provided. The results show that the decoy effect occurs in the treatment without DEA scores, but it is neutralized in the treatment including DEA scores, thus suggesting that the presence of DEA scores may serve as an appropriate debiasing tool. This has significant managerial implications, since DEA scores may help evaluators to concentrate their attention on all efficient DMUs, avoiding that some DMUs profit from their similarity to any dominated DMU.

9 SPATIAL RELATIONS BASED ON REGIONAL EFFICIENCY ON NUTS II IN DETERMINING HUNGER AND POVERTY THRESHOLD: TURKEY CASE

Murat Atan, Gazi University, Turkey
Mehmet Özcan, Gazi University, Turkey
Yaşar Arslantürk, Gazi University, Turkey

ABSTRACT

There is no doubt that one of the most important globalized problems of the present day is hunger and poverty. Globalization relates the people and life styles to one another, while it contributes to the enlargement of inequality, which leads to the facts that the life standards of people have increased, but income gaps become widened. There have been numerous studies aiming to define the reasons of poverty as well as who the poor are, with differing points of views. However, it is not an easy task to say which method is “accurate” most to determine poverty. “Hunger Threshold” is defined as the cost of basic dietary minimum requirement to survive. On the other hand, “poverty threshold” is defined as minimum amount of income deemed adequate in a given country.

It is a well-known fact that families with low-income are in no way able to afford adequate dietary needs and basic expenses in Turkey. This study sets out to form indicators which put the dimensions of the economic status of households through the calculated hunger and poverty threshold amounts. The economy of Turkey has been in a trend of important changes on account of the local and global factors.

The changes experienced within the country are closely linked to the levels of income, consumption and welfare of Economic units (households). The main objective is to find out how and to what extent the level of household consumption levels have been affected with specific reference to hunger and poverty threshold.

To serve this purpose, in the first phase, the efficiency of the provinces in NUTS II has been determined through data envelopment analysis. The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory and for the purposes of the collection, development and harmonisation of regional statistics as well as socio-economic analyses of the regions.

The provinces have been defined as NUTS III and neighbouring provinces with similar geographical and social characteristics, including the regional developmental plans and population, too, have been grouped as hierarchical NUTS I and NUTS II, the total of which is 26. In determining the efficiency of the provinces through data envelopment analysis, such
variables as population density, net rate of migration, gender rate, age dependency ratio, unemployment rate and regional gross value added per capita have been used as input and output values.

In the second phase, the effect of hunger and poverty threshold values on efficiency values has been analysed through two separate spatial models. One of them is Spatial Autoregressive Models – SAR and the second one is Spatial Errors Model – SEM. Furthermore, through the calculated spatial models, it will be determined whether there is externality of provinces over one another arising from the neighbouring.

10 EVALUATING RELATIVE EFFECTIVENESS UNDER PREDETERMINED TARGETS

Heinz Ahn, Institute of Management Control & Business Accounting, Germany
Ludmila Neumann, Institute of Management Control & Business Accounting, Germany

ABSTRACT

While efficiency has always been emphasized by business practice, effectiveness has only recently begun to receive considerable attention, especially under the aspect of strategy-focused decision making. Due to the increasing competition, it becomes more important for companies to implement a suitable business strategy which is reflected by a set of harmonized purposes and the respective goals. The degree to which these goals are achieved is a matter of effectiveness.

We provide a management-oriented DEA approach for measuring the relative effectiveness of DMUs in the presence of predetermined targets which are to be achieved simultaneously. As such targets are a core element of common performance management systems, the approach is a desirable complement of these systems. The proposed method classifies the DMUs into subsets according to their ability to meet the targets and provides a complete ranking within each subset. Thereby, the concept of super-effectiveness is introduced to measure the relative effectiveness of those DMUs which over-fulfill all goals. The approach is illustrated by means of a real-world example referring to a European pharmacy chain.

11 EFFICIENCY MEASUREMENT OF PASSENGER PORTS WITH DATA ENVELOPMENT ANALYSIS AND UTILIZING MALMQUIST PRODUCTIVITY INDEX

Samet Güner, Sakarya University, Turkey
Erman Coşkun, Sakarya University, Turkey

ABSTRACT

Efficiency measurement of decision making units (DMUs) is vital for effective management of these units. The aim of this research is to measure the efficiencies of four participating passenger ports’ comparatively and to evaluate the changes occurred in their efficiencies during the period of eight years between 2003 and 2010. To measure the time dependent efficiency levels of each port, Data Envelopment Analysis (DEA) based Malmquist
Productivity Index has utilized in this research. By utilizing the Malmquist Productivity Index, (i) efficiency scores for each port for every year, (ii) average efficiency scores for each year for all the ports, and (iii) average efficiency scores for each port over the time period had been measured. The results show that average efficiency scores by years did not follow a stable trend and fluctuated. Another finding is that during eight year period, only two participating passenger ports performed beyond the efficiency frontier.

12   A BAYESIAN COMPUTATION FOR STOCHASTIC FRONTIER ANALYSIS

Mehmet Ali Cengiz, Ondokuz Mayis University, Turkey
Talat Şenel, Ondokuz Mayis University, Turkey
Yüksel Terzi, Ondokuz Mayis University, Turkey
Naci Murat, Ondokuz Mayis University, Turkey

ABSTRACT

Starting from seminal study by Aigner et all. (1977), theoretical literature on stochastic frontier has grown vastly. The range of applications of the techniques described is huge. The economic meaning of a frontier is to represent the best-practice technology in a production process or in a particular economic sector. Cost frontiers describe the minimum level of cost given a certain output level and certain input prices. Production frontiers represent the maximum amount of output that can be obtained from a given level of inputs. The gap between the actual and the maximum output is a measure of inefficiency and an important issue in many application fields, such as production studies. More recently, a large amount of interest has been devoted to the use of Bayesian methods for making inference in stochastic frontier models. The Bayesian inference in stochastics frontier was first proposed by van den Broeck et al. (1994). Koop et al. (1997) developed Bayesian inferential procedures to be applied to panel data. Griffin and Steel (2004) adopts a semiparametric Bayesian aproach for inference. Huang (2004) and Kumbhakar and Tsionas (2005) introduce the use of MCMC methods in this context. This paper uses MCMC methods for Bayesian analysis of stochastic frontier models using the WinBUGS package for a real data set.

13   THE PERFORMANCE INVESTIGATION TRADE SERVICE, CONSTRUCTION AND MANUFACTURING SECTORS IN TURKEY BY THE DATA ENVELOPMENT ANALYSIS

H.Hasan Örkcü, Gazi University, Turkey
Erson Aktas, Turkish Statistical Institute, Turkey
Sinem Tuğba Şahin Tekin, Gazi University, Turkey

ABSTRACT

We evaluate the efficiency of Trade Service, Construction and Manufacturing industry sectors of Turkey during the period 2005-2012 using a non-parametric approach, Data Envelopment Analysis (DEA) method. DEA is a method for performance evaluation of Decision Making Units (DMUs). Which has an important place in the Turkish economy, Trade Service,
Construction and Manufacturing industry sectors, day by day growing and gaining in value. These sectors account for 55% of total sector in Turkey. In our study, the effect of the outcomes of the three sectors to inflation and unemployment in our country's major economic indicators were examined by Data Envelopment Analysis.

14 Deregulation, Productivity and Profit in Mexican Banking

Francisco Vargas, Universidad de Sonora, Mexico
Luis Rentería, Universidad de Sonora, Mexico
Gang Cheng, University of Beijing, China
Panagiotis Zervopoulos, Panteion University of Social and Political Sciences, Greece
Arnulfo Castellanos, Universidad de Sonora, Mexico

ABSTRACT

In this paper the relationship between productivity and profit variations is considered. The sources of profit variations have been split into three sources. Therefore, an attempt is made to disclose three effects that bring productivity and profit changes about. Such effects are a productivity change, an activity and a price effect. The contribution of each effect on profit variations is measured. To this end, a two periods DEA-Malmquist index model is computed. Finally, decomposition process was applied to the Mexican banking system data in the period 1982-2012.

15 Determining the Efficiencies of European Football Leagues by Data Envelopment Analysis.

Cenk İçöz, Anadolu University, Turkey
Harun Sönmez, Anadolu University, Turkey

ABSTRACT

Data envelopment analysis (DEA) is a mathematical programming based approach to determine relative efficiencies of decision making units (DMUs) by using multiple inputs and outputs. These DMUs can be both non-profit organizations and profit organizations which consume same kind of inputs and produce similar outputs. Some examples of them are schools, hospitals, universities, factories, hotels, sportsmen, sports clubs etc. Football is one of the most popular sports in the world with an estimated fan base over billions. It is not only a game but also an economical sector when you look at the revenues that clubs gather and the amount of money they spend for success on the pitch. In this study, we aim to examine the efficiencies of European football leagues according to some inputs and outputs especially stadium capacity utilization. Furthermore, the relation between the success and the performance indicators are investigated. Finally, we also propose some improvements in inputs and outputs to inefficient leagues.
16 THE PERFORMANCE INVESTIGATION OF A PUBLIC BANK BRANCHES IN TURKEY BY THE DATA ENVELOPMENT ANALYSIS

H.Hasan Örkcü, Gazi University, Turkey
Sercan Karatas, Republic of Turkish Ziraat Bank, Turkey

ABSTRACT

Banks play a vital role in the economy for two reasons: they provide a major source of financial intermediation and their checkable deposit liabilities represent the bulk of the nation’s money stock. Evaluating their overall performance and monitoring their financial condition is important to depositors, owners, potential investors, managers and, of course, regulators.

Data envelopment analysis (DEA) is a linear based programming model which was first proposed by Charnes et al. in 1978 twenty years after Farrell’s seminal work for evaluating activities of not-for-profit entities participating in public programs. Recent years a variety of DEA applications have been seen for evaluating the performances of different kinds of entities engaged in many different activities in many different contexts in many different countries (Cooper et al. 2004). DEA assess the comparative efficiency of homogeneous organizational units, such as bank branches, schools, tax offices, and hospitals (Thanassoulis 1999).

Banking sector of Turkey is flourishing and contributing to its economy. This study examines the productivity of the a big public bank in Adana Region in Turkey for the period from 2007 to 2012 by DEA.

17 PRODUCTIVITY CHANGE OVER TIME AND THE DYNAMICS OF COST COMPETITIVENESS: A NONPARAMETRIC ANALYSIS OF U.S. MANUFACTURING DATA

Subhash Ray, UCONN, United States

ABSTRACT

Firms within a state, states within a country, and countries across the world are continuously striving to enhance their competitiveness in the present age of globalizaton. This paper defines competitiveness of a production unit as the relative cost of production per unit of output. Basic concepts from neoclassical production economics are used to provide a detailed decomposition of cost competitiveness of a firm relative to a rival. It is also shown how changes in efficiency and relative input prices along with technical change affect the evolution of cost competitiveness of a firm over time. State level data from the U.S. Census of Manufacturers from the years 1992, 1997, 2002, and 2007 are used in a empirical application of the proposed methodology using Data Envelopment Analysis.
18 A COMPLEX ADAPTIVE SYSTEMS APPROACH FOR PRODUCTIVE EFFICIENCY ANALYSIS

Kostas Triantis, Virginia Tech, United States
Fran Dougherty, Virginia Tech, United States
Nathan Ambler, Virginia Tech, United States

ABSTRACT

We explore the conceptual associations of the basic building blocks of the complex adaptive systems (CAS) “flocking” metaphor (environments, agents, goals, rules, percepts, actions, etc.) with those of Data Envelopment Analysis (DEA) (production possibility space, decision-making units, efficient frontier, inputs, outputs, etc.). Within the framework proposed in this paper, DEA “decision-making units” (DMUs) are represented as agents in the agent-based modeling (ABM) paradigm. Guided by simple rules, agent DMUs representing business units of a larger management system, “align” with one another to achieve mutual protection/risk reduction and “cohere” with the most efficient DMUs among them to achieve the greatest possible efficiency. Analysis of the emerging patterns of behavior can provide policy insights. For this research, management systems include any enterprise in which humans using efficiency concepts actively guide the key decisions of the enterprise. By treating management systems as ecosystems, CAS recognizes the autonomous, goal-oriented, dynamic, non-linear nature of decision-making and accounts for the importance of the interactions among decision-makers in the evolution of a management system.

19 EXPLORING THE POTENTIAL OF DATA ENVLEOPMENT ANALYSIS FOR PERFORMANCE-RELATED-PAY IN HEALTH CARE PROVISION

Olena Kalinichenko, Faculty of Economics, University of Algarve and CEFAGE-UE, Portugal
Carla A Amado, Faculty of Economics, University of Algarve and CEFAGE-UE, Portugal
Sérgio P Santos, Faculty of Economics, University of Algarve and CEFAGE-UE, Portugal

ABSTRACT

The implementation of incentive regimes is currently considered to be one of the primary tools to improve the quality of health care delivery. However, the current popularity and diversity of pay-for-performance programs in the health care sector is not supported by conclusive evidence regarding their impact in practice. Our research, in this context, explores one of the fundamental aspects underlying contemporary incentive schemes, that is the methodology used to set performance targets. In particular, we aim to compare different methodologies for target setting and discuss their implications in practice. Furthermore, we aim to explore the potential of Data Envelopment Analysis to design an appropriate performance-related-pay regime in health care provision. We provide an empirical application using data from primary health care provision in Portugal.
20 ESTIMATING DIRECTIONAL RETURNS TO SCALE OF BASIC RESEARCH INSTITUTES IN CHINESE ACADEMY OF SCIENCES

Guo-Liang Yang, Chinese Academy, China
Lu Zhao, Kent Business School, University of Kent, United Kingdom
Wen-Bin Liu, Kent Business School, University of Kent, United Kingdom

ABSTRACT

This paper investigates the directional returns to scale and congestion for 16 basic research institutes in Chinese Academy of Sciences (CAS) using the methods proposed by Yang (2012). In comparison with the classic returns to scale analysis, which only provides information of input-output change along the diagonal direction, our methods have the following advantages: (1) we can identify the regions of increasing (constant, decreasing respectively) directional returns to scale for each of the basic research institutes, which is useful for these institutes future planning; (2) we find that the directional congestion occurs in some directions other than the diagonal direction. On this occasion, the outputs of the institutes will decrease with increase of the inputs along these directions. This indicates that CAS should make further studies on the possible reasons of the occurrence of the congestions, so that its science and technology (S&T) resources can be more effectively used.

21 COMPUTING ECONOMIES OF VERTICAL INTEGRATION, ECONOMIES OF SCOPE AND ECONOMIES OF SCALE USING PARTIAL FRONTIER NONPARAMETRIC METHODS

Pedro Carvalho, Center for Management Studies (CEG-IST), Technical University of Lisbon, Portugal
Rui Marques, Center for Management Studies (CEG-IST), Technical University of Lisbon, Portugal

ABSTRACT

Economies of scope and economies of scale have been searched for in the literature primarily by using full frontier nonparametric methods, particularly the data envelopment analysis method (DEA). However, it is known that these methods present some features that might lead to biased results, as is the case the high sensitivity to extreme data and to outliers. In this work we applied a methodology based on the most robust partial frontier nonparametric methods with the purpose to look for economies of scope and of scale. The applied methodology allows for assessing the robustness of these economies, the influence of outliers and extreme data on them and the influence of the imposition of convexity on the production set of firms. This methodology was applied to a sample of Portuguese water utilities that operated in the 2002-2008 period. The results demonstrate the existence of economies of vertical integration and economies of scale in the retail segment. In the wholesale segment economies of scale were also found while diseconomies of scope were found in the joint supply of water and wastewater.
22 MEASURING THE CONGESTION OF PORTUGUESE INTERNMENT SERVICES

Diogo Ferreira, Instituto Superior Técnico, Portugal
Rui Marques, Instituto Superior Técnico, Portugal

ABSTRACT

It is usual to think that more money means better health system. It is not always like this. If the hospitals suffer from congestion more inputs can mean fewer outputs. In this paper several non-parametric models were used to evaluate the congestion of hospitals in Portugal. Using capital inputs for internment service (inpatients and hospital days as outputs) and input-oriented variable returns to scale (VRS) models, 49 hospitals were evaluated between 2002 and 2009. Under the different models adopted and developed we found important and standardized levels of congestion inefficiencies over time.

23 ON THE USE OF MODIFIED DATA ENVELOPMENT ANALYSIS MODELS FOR PRODUCT LINE SELECTION

Majid Hashemipour, Eastern Mediterranean University, Turkey
Sahand Daneshvar, Eastern Mediterranean University, Turkey
Mohammad Hashem Davoodi Semiromi, Eastern Mediterranean University, Turkey

ABSTRACT

Product line selection problem is defined as selecting a subset of potential product variants that can simultaneously minimize product proliferation and maintain market coverage. Selecting the most efficient product mix is a complex problem, which requires analyses of multi-criteria. This paper proposes a method based on Data Envelopment Analysis (DEA) for product line selection. Data Envelopment Analysis (DEA) is a linear programming based technique, used for measuring the relative performance of a group of decision making units with multiple inputs and outputs. Although DEA has been proved as an effective project evaluation tool, it has not been applied to solve the product line selection problem. In this study, Modified Data Envelopment Analysis method that systematically adopts DEA to solve a product line selection problem, is used. Afterward the proposed method is applied to an existing line of staplers to provide quantitative evidence for managers to generate desirable decisions to maximize the company profits while fulfilling market demands.
24 SENSITIVITY AND STABILITY IN STOCHASTIC DATA ENVELOPMENT ANALYSIS

Rajiv D. Banker, Fox School of Business and Management, Temple University, Philadelphia, United States
Karlo Kotarac, Faculty of Economics and Business, University of Zagreb, Croatia
Luka Neralic, Faculty of Economics and Business, University of Zagreb, Croatia

ABSTRACT

Sensitivity and stability for Banker’s model of Stochastic Data Envelopment Analysis (SDEA) is studied in this paper. In the case of the DEA model, necessary and sufficient conditions to preserve the efficiency of efficient Decision Making Units (DMUs) and the inefficiency of inefficient DMUs are obtained for different perturbations of data in the model. The cases of perturbations of all inputs, of perturbations of output and of the simultaneous perturbations of output and of all inputs are considered. An illustrative example is provided.

25 INTEGER DEA MODELS AND AN APPLICATION

Talat Şenel, Ondokuz Mayıs University, Turkey
Serpil Gümüştekin, Ondokuz Mayıs University, Turkey
Erol Terzi, Ondokuz Mayıs University, Turkey
Nurettin Savas, Erzincan University, Turkey

ABSTRACT

Since the pioneering work of Charnes et al. (1978), data envelopment analysis (DEA) has been widely studied from both the theoretical and practical points of view. Different models have been developed to measure the efficiency of a group of decision making units (DMUs) which utilize the same inputs to produce the same outputs under different conditions. Conventional Data Envelopment Analysis models consider that inputs and outputs are continuous (i.e. real-valued) amounts. However, there are many applications in which one or more inputs and/or outputs are necessarily integer quantities. Commonly, in these situations, the non-integer targets are rounded off. However, rounding off may easily lead to an infeasible target (i.e. out of the Production Possibility Set) or to a dominated operation point. In this study, we illustrate the working of the proposed approach with on a problem from real data set.
26 TECHNICAL EFFICIENCY DETERMINANTS WITHIN A DUAL BANKING SYSTEM

Hamdani Hanen, FSEG Sfax Tunisia, Tunisia
Emrouznejad Ali, Aston school, United Kingdom
Louhichi Awatef, faculty of economics and management of Sfax, Tunisia
Ouertani Mohamed Nejib, FSEG Sfax Tunisia, Tunisia

ABSTRACT

The purpose of this study is to provide a comparative analysis of the efficiency of the Islamic banking sector in five Gulf Cooperation Council (GCC) countries. To this end, we employ a semi-parametric two-stage methodology, where we derive technical efficiency scores via a DEA-VRS technique in the first stage and then the scores obtained are regressed on a series of determinants of bank efficiency using a double bootstrapping procedure. Our findings indicate that during the eight years of study, conventional banks largely outperform Islamic banks with an average technical efficiency score of 81% compared to 95.57%. However, it’s clear that since 2008 conventional banks efficiency was in a downward trend while the efficiency of their Islamic counterparts were in an upward trend since 2009. This indicates that Islamic banks have succeeded to maintain a level of effectiveness during the dark period of the subprime crisis after certainly, coming under their secondary effects during 2008-2009. An investigation of the determinants of banks' efficiency show that bank size have a significant positive impact on, only Islamic bank’s efficiency, while z-score is related negatively to efficiency of both departments showing that a higher (lower) distance from insolvency reduces (increases) banks’ efficiency. In other words, a stable and reliable system is crucial to foster the efficiency of GCC banks. Finally, for the whole sample, the analysis demonstrates the strong link of macroeconomic indicators with efficiency for GCC banks. But, surprisingly, there is no significant relationship in the case of Islamic banks.

27 MODIFIED CROSS EFFICIENCY AND ITS APPLICATION IN STOCK EXCHANGE

Mozhgan Mansouri Kaleibar, Young Researchers and Elite Club, Tabriz Branch, Islamic Azad University, Tabriz, Iran, Iran, Islamic Republic of
Sahand Daneshvar, Tabriz Branch, Islamic Azad University, Tabriz, Iran, Iran, Islamic Republic of

ABSTRACT

This paper firstly revisits the cross efficiency evaluation method which is an extension tool of data envelopment analysis. In this paper, we consider the DMUs as the players (institutions) in a cooperative game, where the characteristic function values of institutions are defined to compute the Shapley value of each DMU (institution), and the common weights associate with the imputation of the Shapley values are used to determine the ultimate cross efficiency scores for institution of Stock Exchange of Tehran. In models some weight may happen to be zero for all optimal solutions. This means that the corresponding criterion is not accounted for in the solution of the game at all. The zero weight issue can thus be solved in this way. This
This paper introduces the models for computing benefit for each institution. Using shapely value we obtain the effect of each institution, and through determining common weight for each company we find out the ultimate weight which shows how much the existence or not existence of that institution affects the interesting competence.

28 COMPUTING THE BIENNIAL MALMQUIST INDEX USING MODIFIED VARIABLE RETURNS TO SCALE DEA MODEL

Sahand Daneshvar, Department of Industrial Engineering, Eastern Mediterranean University, Turkey
Gokhan Izbirak, Department of Industrial Engineering, Eastern Mediterranean University, Turkey

ABSTRACT

In this paper malmquist productivity index is introduced which is used for comparing two group’s performance at the same period of time or measuring the productivity change of decision making units between two different periods of time. The biennial malmquist index and its decomposition into technical, efficiency and scale changes is illustrated. Then modification on production possibility set of BCC model is proposed by using facet analysis. This modification contains some changes in BCC model. Finally, the biennial malmquist index will be computed using modified BCC model and advantages of this approach will be illustrated by an example.

29 NON-PARAMETRIC MEASURES OF CAPACITY UTILIZATION IN TUNISIA: A DUAL APPROACH

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Helali Kalai Maha, FSEG SFAX, Tunisia

ABSTRACT

This paper develops a non-parametric method to determine the minimum of the long run average total cost curve of an industry to define its capacity production. This provides a benchmark for measuring the capacity utilization rate of the industry in question. In the long run when returns to scale are constant, the minimum of the short run average total cost curve is determined to estimate the short run capacity utilization. At the empirical application, we measure the annual capacity utilization of Tunisian manufacturing and its six sectors during the period 1961-2010. In addition, we develop in this document a non-parametric analysis, based on the DEA methodology for quasi-fixed capital factor, of the short run average cost curve under variable returns to scale, using an iterative search procedure.
30 A MODIFIED DATA ENVELOPMENT ANALYSIS METHOD FOR PRIORITY DETERMINATION AND GROUP DECISION MAKING IN THE ANALYTIC HIERARCHY PROCESS

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Gökhan Izbirak, Eastern Mediterranean University, Turkey
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ABSTRACT

The DEAHP method for weight deviation and aggregation in the analytic hierarchy process (AHP) has been found suffering from considerable weaknesses. Recently, revised DEAHP for AHP weight derivation proposed by Mirhedayatian and Saen (2011) [10] [S.M. Mirhedayatian, R.F.Saen, A new approach for weight derivation using data envelopment analysis in the analytic hierarchy process, Journal of the Operational Research Society 62 (2011) 1585–1595], which has been suffering from vital drawbacks. Ying-Ming Wang and Ying Luo add several useful notes to Revised DEAHP for AHP weight derivation and brought out its defects [13] [Ying-Ming Wang, Ying Luo, A note on “A new approach for weight derivation using data envelopment analysis in the analytic hierarchy process” Mathematical and Computer Modeling 56 (2012) 49–55]. This paper provides a modified constant return to scale data envelopment analysis model for priority determination in the AHP, which modified by facet analysis and cover all previous proposed models weaknesses.

31 CUSTOMER EFFICIENCY VERSUS FIRM EFFICIENCY: A BANKING EXAMPLE

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Hasan Bal, Gazi University, Turkey

ABSTRACT

Customer focus is a key issue in firm management for success and the most important pillar of customer focus is to ensure customer satisfaction. However there are many firms in market and all of them are trying to attract customer for being efficient. In the same manner demand side of the market also wants to be efficient. It is evident that one side is efficient whereas the other side is inefficient under this circumstance. In this study the interaction between customer and firm efficiencies will be examined by the means of DEA. Therefore, banking sector data will be used to demonstrate the importance and interaction between two efficiency measures.
32  ASSESSING CONVERGENCE OF MCMC ALGORITHMS FOR STOCHASTIC FRONTIER ANALYSIS

Mehmet Cengiz, OMU, Turkey

ABSTRACT

Markov chain Monte Carlo (MCMC) methods have become an important tool in Bayesian analysis. While MCMC algorithms allow an enormous expansion of the class of candidate models for a given dataset, they also suffer from a well-known and potentially serious drawback: it is often difficult to decide when it is safe to terminate them and conclude their "convergence." Although there are many studies on the problem of determining MCMC algorithm convergence for many statistical models, there has not been any study on the convergence problem for stochastic frontier analysis. In this study, we introduce the MCMC convergence diagnostics in stochastic frontier analysis for our dataset.

33  A NEW CONSTRAINED DATA ENVELOPMENT ANALYSIS APPROACH WITH CORRELATION COEFFICIENTS FOR BALANCED WEIGHT DISTRIBUTION

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ABSTRACT

Data Envelopment Analysis (DEA) which is applied to evaluate the relative efficiency of decision making units (DMU), is a mathematical programming approach. The efficiency in the classical DEA is "the ratio of the sum of the weighted outputs to the sum of weighted inputs". In order to obtain the maximum efficiency score for each DMU under evaluation, different weights are assigned to the inputs and outputs of the DMU. Classical DEA models allow weight flexibility. Thus, zero weights can be assigned to some important inputs and outputs of the DMU. In this case, such inputs and outputs will be ignored in the evaluation and will be found unrealistic results. Weight restrictions are utilized to eliminate the problem. Input and output variables in the production process are associated with the degree of correlations between these variables. Previous papers didn’t consider the relationship between inputs and outputs. In this study, the weights are defined by correlations between input and output variables. So, the new DEA models constrained with correlation coefficients (CCRCOR and BCCCOR) are developed. The CCRCOR and BCCCOR models and other known DEA models were applied on some datasets in the literature. The results were compared with the Spearman rank test. According to the results, the CCRCOR and BCCCOR models provided a more balanced weight distribution than the other models.
IDENTIFYING SUSPICIOUS EFFICIENT UNITS IN DEA MODELS

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Andrey Lychev, National University of Science and Technology, Russian Federation

ABSTRACT

In this paper, we propose tools for discovering units which may cause inadequate results in the DEA models. It is shown that terminal units constitute “suspicious” points in the first place. We also propose how to deal with inadequacies in the DEA models with the help of incorporating artificial units and rays interactively on the screen of the computer by experts into some BCC model. It is shown by establishing theorems how terminal units can be identified and how different definitions of suspicious units, which were introduced by some other authors, are related. Our theoretical results are based on some theorems and illustrated by a number of graphical examples. Our computational experiments document theoretical results.

PERFORMANCE MEASUREMENT FOR RADIOLOGY PROVIDERS: A NATIONAL STUDY

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ABSTRACT

Hospitals and medical center’s radiology departments, and free standing radiology centers employ a variety of capital-intensive technologies for patient diagnosis, treatment, and management. Although there is an abundant evaluation of performance for larger entities such as hospitals or health care systems, performance evaluation for radiology departments or free standing radiology centers is very limited. Moreover, the existing evaluations do not use state of the art optimization techniques which differentiate best performers in normative way is lacking. In this paper we report the performance of these entities and illustrate how performance can be improved for the underachievers. Data were acquired through an annual Radiologic Workplace survey conducted by the American Society of Radiologic Technologists. In conjunction with author’s request, the survey included additional items to conduct the present research. Using data envelopment analysis (DEA)—input oriented VRS model, we determined that the majority of departments featuring basic diagnostic radiology are technically efficient. However, as the complexity of technologies increase (e.g., computed tomography, magnetic resonance, etc.), a smaller percentage of departments are efficient. Attention to the best blend of inputs to maximize outputs is critical for maintain efficient radiology department in difficult economic times. However, the unique nature of radiology technologies and the referral nature of the profession may impact manager’s ability to influence significantly these efficiency parameters.
EVALUATION OF EFFICIENCIES OF SOCCER CLUBS IN TURKISH SUPER LEAGUE BY DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Turkish professional soccer league has been dubbed "super league" since 2005. Since then, it turned out to be a large scale economic power. In this study, the active soccer clubs in the super league between 2005 and 2010 have been evaluated by data envelopment analysis. The success level of each team in the league is considered with respect to their spending and the steps that they need to take are discussed according to their performance levels.

EVALUATING THE PERFORMANCE OF PUBLIC HEALTH CARE SERVICES PROVISION: AN ANALYSIS OF THE MUNICIPALITIES OF MATO GROSSO STATE, BRAZIL

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Adriano Provezano, Federal University of Viçosa, Brazil, Brazil
Marcelo Braga, Federal University of Viçosa, Brazil, Brazil

ABSTRACT

The public health care system in Brazil is designed to be universal and equitable. To cover almost 200 million people, it demands a great amount of public resources. To improve the resource application on health care, we propose a framework to assess performance of this system. In addition, we verify whether contextual variables affect the level of efficiency and test the hypothesis of constant returns to scale, by using non-parametric tests in an outlier corrected environment. The methodological approach is based on two-stage data envelopment analysis (DEA). The sample comprises the municipalities of Mato Grosso state, Brazil, in 2011. The results indicate that the municipalities of Mato Grosso have an average 76.8% of technical efficiency in the resources application. An average, the adoption of best management practices observed in the state would allow the expansion of 30.2% on provision, access and quality of services. Finally, we confirm the hypothesis of the presence of scale economies. Thus, the adoption of best management practices, the scale adequacy (by managerial centralization), and the alignment of public health preventive policies can be emphasized to increase efficiency.
38 NATIONAL INNOVATION SYSTEMS EFFICIENCY ANALYSIS WITH DEA: ISSUES OF SAMPLE CONTENT AND THE SET OF VARIABLES

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ABSTRACT

The paper analyses the efficiency of national innovation systems using data envelopment analysis (DEA) method for 54 countries. The samples contains highly developed countries (such as the USA, Canada, Japan), developing countries (such as Bolivia, Colombia, Ecuador), and countries with economies in transition (including Russia, Ukraine, Armenia). The calculations were performed using the program MaxDEA (version 6.0, free version). Since data on innovation activity for the vast majority of sample are not available, the analysis was focused on the research and development sector of national innovation system. The main objective of this analysis is to show that the choice of data format, set of variables as well as set of studied objects (countries in our case) can seriously influence the result of DEA analysis. In many cases taking the data without its preliminary preparation leads to misleading and controversial results. Hence the information database preparation should be the integral part of DEA analysis especially in the case of national innovation systems efficiency analysis. Some basic approaches to information database preparation will be proposed in this paper.

39 OVERCOMING THE SHORTCOMINGS OF THE PARTIAL PRODUCTIVITY MEASURE: A DIRECTIONAL DISTANCE TECHNOLOGY FUNCTION APPROACH

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ABSTRACT

In multilateral comparisons of productivity over time, partial productivity measures especially partial labor productivity is one of the most commonly used measure. While its intuitiveness and computational ease make this index an attractive one, partial productivity measures that do not take into consideration compositional differences between outputs and inputs of the units being compared (which are also subject to change over time) and that ignore the type of substitution among inputs make it a measure that disguises rather than illuminates.

The theoretical part of this paper shows how one can overcome the shortcomings of the partial productivity measure by constructing a new partial productivity index using directional distance technology functions. The new index constructed in this study not only overcomes the shortcomings of the partial factor productivity measures but also satisfies the axiomatic properties of index numbers that are laid down by Fisher. The empirical part by using various panel data sets (i.e., EU KLEMS, state level manufacturing data of US) demonstrates the bias associated with the traditional partial productivity measures by comparing it with the one proposed in this paper.
40 MARGINAL PRODUCTION COST OF GENERAL DENTAL PRACTICES IN COLORADO: AN APPLICATION OF DATA ENVELOPMENT ANALYSIS

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ABSTRACT

This paper contributes to the literature on the production prospect of the U.S. dental care industry at practice level. We apply the non-parametric Data Envelopment Analysis (DEA) method on a sample of practice level data collected by the American Dental Association (ADA) through a 2005-2006 survey of general dental practices in Colorado. The multi-output DEA cost efficiency model allows us to investigate the marginal production cost for each of the four categories of dental care procedures: (i) diagnostic procedures; (ii) restorative procedures; (iii) prosthodontic procedures; (iv) and all other procedures. Our finding shows that the overall multi-output DEA cost efficiency score for each practice in the sample varies from 0.465 to 1, with the mean at 0.877. It also demonstrates that, to generate one more dollar of revenue at average output levels, prosthodontics is most costly while diagnostics is least costly among the four categories of dental care procedures.

41 DATA ENVELOPMENT ANALYSIS DATABASE (DEABASE)

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ABSTRACT

DEA is an extensively used efficiency measurement tool. Since 1978, it was studied over 7000 times in a wide variety of areas by about 7000 researcher and DEA is still very popular. Therefore, it is really a hard work to select most relevant studies for our purposes. Data Envelopment Analysis Database (DEABASE) is a DEA special database application not only the collection of DEA studies separated among different academic databases, but also a guide to DEA colleagues in their DEA studies. Instead of stable survey application of DEA, it is a dynamic open web source and updated periodically. Thus, for all researchers who are interested in data envelopment analysis, it provides an actual collection of DEA. Besides that, it also made a self-classification of DEA studies with the help of extended search fields according to the interest area of researcher.
42 ECO-EFFICIENCY CHANGE AND TECHNOLOGICAL GAP IN POWER PLANTS: USING A SLACK-BASED MEASURE FOR THE MALMQUIST LUENBERGER META-FRONTIER PRODUCTIVITY INDEX

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ABSTRACT

Malmquist Luenberger index is a popular index deployed for evaluating eco-efficiency and productivity change over time when both desirable and undesirable factors are jointly produced in the production process. However, conventional DEA models used for computing this index are unable to distinguish the various technologies employed by DMUs. When heterogeneity exists in the technology, the Malmquist Luenberger meta-frontier approach is adopted to evaluate eco-efficiency and productivity change when undesirable outputs are present. This paper develops a new slack-based DEA measure to compute the Malmquist Luenberger meta-frontier index and deploys it to evaluate 48 Iranian thermal power plants productivity change in three different categories -steam, gas, and combined cycle, over an eight years period of restructuring in the power industry. This technique enables the calculation of eco-efficiency for thermal power plants operating under different technologies as well as the technology gap ratios, measuring the extent to which the efficiency frontiers of individual categories of power plants deviate from the meta-frontier. The results reveal that the last years of the restructuring period saw a greater rate of productivity growth compared to the initial years; and evidence of significant eco-efficiency improvement over the period in all the three types of thermal power plants.

43 INTERNATIONAL DATA ENVELOPMENT ANALYSIS IN HIGHER EDUCATION: HOW DO INSTITUTIONAL FACTORS INFLUENCE UNIVERSITY EFFICIENCY?

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ABSTRACT

Institutional factors in higher education like for example being a private or a public higher education institution are major differences in the concept of higher education. Therefore many research and practical discussions are evolving around question like e.g. “Are private universities more efficient than public ones?” or: “Are large universities with all kinds of study programs more efficient than small universities with specialized fields like business and engineering?”

In this research international university data will be analysed and compared in order to find a first answer towards these questions. As a research method the data envelopment analysis (DEA) with a strong research application background in higher education research is used. A BCC model assuming variable returns to scale is implemented due to existing research results regarding the RTS situation in universities. As input and output indicators the following data sources are used: Budget (input), staff (input), graduates (output) and third party funds (output).
44 CANDIDATE COUNTRIES AND THE EUROPEAN UNION COUNTRIES OF THE EUROPEAN UNION ENVIRONMENTAL PERFORMANCE MEASUREMENT

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ABSTRACT

Among the techniques used in modeling of energy and the environment non-parametric data envelopment analysis approach to measuring performance evaluation of an activity often emerges as one of the techniques used. In this study, primarily related to the implementation of Environmental Performance Measurement Data Envelopment Analysis literature is presented, then the 28 European Union countries and the European Union, the candidate countries, using data for the year 2010 Environmental Performance Measurement, are evaluated using Data Envelopment Analysis.

45 THE EFFECTS OF THE SUPPORT POLICIES ON THE AGRICULTURAL EFFICIENCY AND TOTAL FACTOR PRODUCTIVITY IN TURKEY

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ABSTRACT

Productive and efficient use of the production factors in the agricultural sector is very essential in order to meet the food demand of increasing population, to raise life standards of farmers and to realize agricultural development. The aim of this research is to explore the effects of support policies on the efficiency and the total factor productivity of Turkish agriculture during the period of 1980-2009. Data Envelopment Analysis and Malmquist Index were used to analyze the efficiency of resource utilization and total factor productivity. After the period of 2000 in which the support policies mainly compatible with market mechanism, the resources were used more efficient than the previous period. Although total factor productivity of agricultural sector in 2000’s decreased by 3.6% compared to 1980’s, it increased by 27% with respect to 1990’s and the increase in productivity was entirely arised from the technological change. In order to enhance the technical efficiency and total factor productivity in the agricultural sector, it is necessary to adapt new technologies which is accompanied by improving the competition conditions in the agricultural markets.
46 A COST MALMQUIST PRODUCTIVITY INDEX CAPTURING GROUP PERFORMANCE

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ABSTRACT

Traditionally where no input or output prices are available productivity change is measured using the Malmquist index. Maniadakis and Thanassoulis (2004) extended the index to cases where input prices are available so that productivity is measured in terms of costs, and allocative efficiency change is captured within the index. This paper using ideas from Camanho and Dyson’s approach for comparing groups of units on productivity change, develops models to compare groups on productivity which captures cost information. This is possible when input prices are available. The decomposition of the new index yields valuable information of the sources of productivity change of groups of units.

47 ON COMPARISON OF OECD BETTER LIFE INDEX AND THE DEA APPROACH

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ABSTRACT

Your Better Life Index, developed by the OECD, enables experts to compare well-being across 36 countries, using 11 dimensions, by giving their own weight to each of the dimensions. However, Your Better Life Index is a rating function from ratios. We have shown in our previous papers that, using a rating function as the performance assessment, experts may obtain a distorted image of the production units’ behavior. Moreover, the following assertions can be substantiated for the rating functions. Proposition 1. Rating functions are insensitive to large errors in some original data. Proposition 2. Some small errors in certain ratios of the rating function may increase the value of the function significantly. Our theoretical results on comparison of the Your Better Life Index and the DEA approach are illustrated by graphical examples and documented by computational experiments.
**48 A NOVEL DEA APPROACH TO ASSESS INDIVIDUAL AND OVERALL EFFICIENCIES IN TWO-STAGE PROCESSES**

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Suzanna M. Paleologou, Aristotle University of Thessaloniki, Greece

**ABSTRACT**

In the DEA context, a two-stage production process assumes that the first stage transforms external inputs to a number of intermediate measures, which then are used as inputs to the second stage that produces the final outputs. Chen et al. (2009) proposed an additive approach where the overall efficiency of the production process is defined as a weighted average of the efficiencies of the individual stages. As the weights are assumed functions of the DEA multipliers, they derive endogenously by the optimization process and are different for each evaluated unit. In this paper, we first show that the above assumption made for the weights unduly bias the efficiency assessments in favor of the second stage and we present an unbiased approach to assess the efficiencies of the two stages in an additive two-stage DEA framework. Then we enhance our models by introducing a sufficient condition that allows us to treat the deficiencies reported in the literature for the additive decomposition approach, such as the inability to derive the efficient frontier as well as the violation of the principle that the efficiency scores under VRS are not less than their counterparts under the CRS assumption.

**49 DIRECTIONAL DISTANCE FUNCTIONS AND CONSTRUCTION OF COMPOSITE FISCAL PERFORMANCE INDICATORS**

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**ABSTRACT**

We use DEA and a single-constant-input directional output distance function to construct a theoretically consistent composite fiscal performance indicator for the OECD countries. The proposed composite fiscal performance indicator is constructed by using the single-constant-input directional output distance function as an aggregator function and data on (a) the general government financial balance, (b) the general government structural balance and (c) the general government debt. The proposed formulation allows (a) some of the individual fiscal indicators (i.e., general government debt) to be treated as bad outputs and (b) for consistent and simple aggregation across countries.
50 ASSESSMENT OF EFFICIENCY OF GREEK AIRPORTS

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Andreas Kakouris, University of Aegean, Greece
Anastasios Pantelidis, University of Aegean, Greece

ABSTRACT

Purpose – The purpose of this study was to assess the efficiency of Greek airports
Design / Methodology / Approach – A sample of 20 airports was selected from the 45 airports
of the country. The efficiency assessment was done on the basis of Data Envelopment
Analysis and Stochastic Frontier Analysis, using DEAP v2.1 (DEA) and FRONTIER v4.1
(SFA), respectively.
Findings – Greek airports seem to be efficient because they use and allocate their available
resources so that to maximize their outputs (flights and passengers). Specifically, their
average efficiency amounts to values above 0.7 (scale [0, 1]) using both methods.
Research Limitations – The assessment of efficiency of Greek airports is based on two models
with three inputs and one output. Although the relationship between inputs and outputs is not
questionable according to the literature, there may be non – measurable variables that affect
the selected outputs.
Originality / Value – This is the first time that DEA and SFA have converged towards the
same goal: efficient assessment of Greek airports. The value of the results is important as the
efficiency indicators are used to identify the relatively inefficient airports and fosters best
practices in the industry.

51 ESTIMATION OF THE COST EFFICIENCY FRONTIER IN TUNISIA:
STOCHASTIC FRONTIER APPROACH VERSUS BAYESIAN APPROACH

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ABSTRACT

The production function generally establishes a relationship between "inputs" and "outputs".
It can also be designed as a frontier; it is possible for a firm or any other decision unit. The
use of stochastic frontiers in the analysis of productivity and firm efficiency has become
widespread. In this paper, we propose a parametric and Bayesian estimation of the cost
efficiency frontier. The measurement of technical efficiency avoids the wasteful uses of the
production factors. In order to change the tradition of some modellers, we try, with this
document, to provide an estimate of the capacity utilization resulting from the two approaches
of the quasi-fixed factor capital in the short run. In this estimation, we used the statistical data
for the period 1961-2010 for the five sectors of the global economy (Agriculture & fishing,
manufacturing industries, non-manufacturing industries, market services and non-market
services activities). The production of these sectors uses three factors of production, namely
labour, energy and capital. We used the SFA and the SURE methods to be able to estimate the
Translog cost function using STATA software. To meet the needs of applied research on
models of stochastic frontier via the Bayesian approach, we applied the WinBUGS software
that allows applying the method of Markov Chain Monte Carlo "MCMC".
52 PERFORMANCE ASSESSMENT AND QUALITY OF CARDIAC PROCEDURES IN RIO DE JANEIRO THROUGH DEA

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Maria Stella Castro Lobo, Federal University of Rio de Janeiro, Brazil
Angela Cristina Moreira Da Silva, State University of Rio de Janeiro, Brazil
Marcos Estellita Lins, UFRJ, Brazil

ABSTRACT

This work resulted from research developed in the context of CT-Saúde, a project supported by the Ministry of Health, which also keeps the DATASUS, a database that provides data on procedures and death of inpatients. A two-stage modeling is proposed to assess two processes: the first aims at providing services to cardiac inpatients, the second focuses on the inpatient outcomes. The methodology uses geometrical and graphical analysis to support weight restrictions formulation. Analysis of results comprises both primal and dual variables and their contribution to build performance indices, thus allowing confrontation with experts’ judgments regarding large hospitals assessment in the state of Rio de Janeiro.

53 RELEVANCE OF DATA ENVELOPMENT ANALYSIS TO THE ESTIMATION OF PRODUCTIVE EFFICIENCY IN THE INDIAN PORT INDUSTRY

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ABSTRACT

In this paper an attempt has been made to estimate the dimensional efficiency of major ports of India. In the original formulation, and in the vast literature that followed, the assumption was that all members of the input bundle affected the output bundle [1]. There have been efforts to employ split in input for DEA applications [1] and use of DEA/Factor Analysis [2] for improved results especially from policy making perspective. Several studies exists on application of conventional DEA approach to determine the efficiency of sea ports including major ports of India [3,4]. No studies suggest use of such deviations from conventional approach to Indian ports. In this paper the dimensions of performances of Indian ports have been captured using Varimax-Rotated Factor Analysis. The study identifies two major dimensions namely capacity dimension and the efficiency dimension that affect the port performance. The variables associated with each of these two dimensions were considered separately as inputs and Average Turn Round Time of ships (ATRT) as output, to measure the efficiency levels of the ports using DEA. The ranking of ports differed in these two cases and were also in different order when all members of the input bundle were used to determine the efficient ports. This implied that policies for performance improvement differ amongst ports. Some ports required capital-investments to improve its capacity dimension, while others required thrust on efficiency dimension, i.e., making policy changes related to process reengineering, structural and financial aspects of ports.
54  A ROBUST DATA ENVELOPMENT ANALYSIS MODEL FOR RANKING,
CASE STUDY: HOSPITALS OF TEHRAN

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Adel Azar, Tarbiat Modares University, Iran, Islamic Republic of

ABSTRACT

The current study is devoted to Data Envelopment Analysis (DEA) model with uncertain data for performance assessment of hospitals. The importance of health care is growing worldwide, and the health sector is receiving a good proportion of public funds. As health-care costs are increasing, efforts have been made to assess efficiency of hospitals. DEA has proven to be an effective and versatile tool for health care efficiency measurement, and its use has spread throughout the world. Despite many DEA approaches, there are few studies considering the uncertainty in data, and the unknown distribution of the random data together. The method has been used in this article is suggested by Sadjadi & Omran(2008) based on the novel robust optimization approach proposed by Bertsimas et al.(2004). This paper provides a measurement of Tehran hospitals efficiency utilizing Crisp DEA and Robust DEA, and compares the results to show the effects of uncertain data on the performance of DEA outputs. The results represent that the robust DEA approach can be reasonably reliable method for efficiency estimation and ranking strategies.

55  AN ALTERNATIVE APPROACH FOR DATA ENVELOPMENT ANALYSIS
CROSS EFFICIENCY EVALUATION

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Mehmet Unsal, Gazi University, Turkey
H. Hasan Orkcu, Gazi University, Turkey

ABSTRACT

Cross efficiency evaluation has long been proposed as an alternative method for ranking the decision making units (DMUs) in data envelopment analysis (DEA). This study proposes a weight restriction model that could be used in the second stage of the cross evaluation. Proposed model has additional constraints which are based on part and partial correlation coefficients for weights restriction. Numerical examples and simulation study are provided information regarding the usefulness and benefits of the proposed weights restriction model and its using in cross efficiency evaluation.
56 INCIDENCE OF INEFFICIENCY AND BAYESIAN APPROACHES

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Hasan Bal, Gazi University, Turkey
Resat Kasap, Gazi University, Turkey
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ABSTRACT

Data envelopment analysis (DEA) is a non-parametric method which is used in operations research and management science. Because DEA is a linear programming technique, studying of its statistical properties is very difficult. This study investigates the incidence of inefficiency as a latent variable, and proposes some Bayesian approaches in the literature to infer an appropriate posterior distribution for the incidence of inefficient DMUs.

57 AN EMPIRICAL ANALYSIS OF THE EFFICIENCIES OF TURKISH IRON AND STEEL COMPANIES DURING THE GLOBAL FINANCIAL CRISIS

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ABSTRACT

Global financial crisis that started in 2007 has been the focal point of managerial decisions taken across many economies and industries all over the world. Effects of the crisis differ greatly from one country or industry to another. Existing within the globally effected industries, iron and steel companies in Turkey have had their share in terms of the challenges brought about by the crisis. The purpose of this study first, is to analyze the efficiencies of the selected Turkish iron and steel companies located in the same geographic region between the years 2005 and 2010. Data Envelopment Analysis (DEA) was employed in this stage of the study. Second, the goal is to investigate the efficiency changes over the years. Malmquist Total Factor Productivity (TFP) index was calculated using the panel data in this stage. Analysis results indicate that regardless of the company size, the global financial crisis has had impacts on the iron and steel companies’ efficiencies not in the initial stages of the crisis but in the later years.
58 OPERATIONAL EFFICIENCY AND PRODUCTIVITY GROWTH OF INDONESIAN AIRPORTS

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ABSTRACT

This paper reports operating efficiency and productivity growth of 23 Indonesian airports for the periods of 2005 – 2010. Using the proposed Data Envelopment Analysis approach, we assume that the airports are operating at variable returns to scale, and aim to maximize their outputs. We employ the DEA method to measure the trend of airports’ operating efficiency. Second, the measurement of airports’ productivity and its decomposition is administered using the DEA-Malmquist productivity approach. The results show although there was a slight reduction in productivity growth, there is an increasing trend of the airports’ efficiency during the observation periods and all the airports were operating at the increasing return to scale.

59 EFFICIENCY ANALYSIS OF ACADEMIC DEPARTMENTS WITHIN A UNIVERSITY: A DEA WINDOW ANALYSIS APPROACH

Nur Azlina Abd Aziz, University of Technology MARA, Melaka, Malaysia
Roziah Mohd Janor, University of Technology MARA, Shah Alam, Malaysia
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ABSTRACT

Globally, universities play a significant role in the development of a country. They are centers of creating new ideas, generating and transferring knowledge that contributes to the quality life of the country and its people. Malaysia has positioned itself to be the hub of higher education in the Asia region where higher education sector has been allocated a large sum of funding by the Malaysian Government. The question on how efficient the universities operate becomes a crucial issue. However, it is not an easy task because universities are complex organizations that utilize multiple inputs to produce multiple outputs. Data envelopment analysis (DEA) model is known to provide a comprehensive and flexible relative performance in complex situation. This paper illustrates the use of DEA window analysis to examine the trend of efficiency changes of academic units of a public university in Malaysia over the period 2006-2011. In this method, an academic department is compared not only against other departments but also against itself in other period. The results reveal that a few departments are consistently efficient over the years. However, the efficiency scores of most departments fluctuate over time to different extents and quite substantially for some of them. These findings are useful for the short- and long-term long term planning of the university management.
60 IMPLEMENTATIONS OF THE BALANCED SCORECARD AND THEIR IMPACT ON ORGANISATION EFFICIENCY

Paul Rouse, University of Auckland, New Zealand
Lorenzo Lucianetti, University of Chieti and Pescara, Italy
Catherine Yung, University of Auckland, New Zealand

ABSTRACT

Using the results of a survey of Italian firms who have implemented a balanced scorecard, we investigate how different types of implementation affect organisation efficiency. Data Envelopment Analysis (DEA) is used to measure organisation efficiency using data obtained from companies’ financial reports. Results show that implementation does improve performance as measured by DEA. More specifically, firms that use strategy maps and employ a type III balanced scorecard experience greater improvements in efficiency.

61 STOCHASTIC FRONTIER MODELS AND COPULAS

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Vadud Najjari, Islamic Azad university, Iran, Islamic Republic of
Salih Çelebioğlu, Uşak University, Turkey

ABSTRACT

Current methods of modeling time dependence in stochastic frontier models are either improper or computationally infeasible. Also there is some assumptions on models that make it more complicated. As an example, if marginals had a distribution such as normal/half-normal, there is no known multivariate distribution that investigate the properties of them. There is some suggestions to solve this problems by copulas in the literature. In this study we will review them and nally we will try to solve this problem with hyperbolic Archimedean copulas that this type of copulas recently introduced in the literature.

62 NETWORK DEA AND OUTPUT INTERDEPENDENCY IN SOCCER

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Giannis Karagiannis, University of Macedonia, Greece

ABSTRACT

The purpose of this paper is to adjust the Network DEA model of Lewis et al. (2009) for output interdependency. We adopt this model to measure the overall efficiency of football clubs participated in the Greek premier league during season 2005-06. The league performance (production process) of a soccer team seems to consist of three internal activities (sub-processes) that function together aiming at the best possible final ranking. Specifically, the on-field (offensive and defensive) operations consume the skills of football players to provide goals scored and prevention of goals conceded that are used as inputs in the athletic
activity, which produces accumulated points. This structure can be sufficiently evaluated by a Network DEA model. The specific methodology has already been applied in various fields but never in soccer, which is a strictly competitive game in the sense that anything won by a team, it is lost by all others. Till now, this parameter had been neglected by network-type DEA models that being unable to account for output interdependency yielded unrealistic efficient frontiers. The contribution of this paper is to adapt the evaluation of both league performance and internal activities of football clubs to the procedure suggested by Collier et al. (2011) for equal output reduction that is able to correct the downward biased efficiency scores obtained from the standard linear programming technique taking account of output interdependency in DEA. Our findings suggest that the non-inclusion of output interdependency in the Network DEA model results in underestimating the number of operating efficient teams.

63 TECHNOLOGICAL SUPERIORITY

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ABSTRACT

A question often arising in productivity studies is whether one subsample provides better production possibilities than another subsample: One might for example question whether the regulatory framework of US banks provides better production possibilities than that of their European counterparts, whether the railway reforms in Europe have resulted in improved production possibilities over time for railway operations or whether one organizational form is better than another, for instance, whether cooperatives offer better production possibilities than investor owned firms.

In the present paper we suggest an approach to determining whether the production technology of one subgroup is superior to that of another subgroup. We do this by first outlining which characteristics, or axioms, an index of technological superiority should satisfy. This leads us to concluding that two families of indexes are potentially relevant: Those building on (relative) volumes of the dominance set and those building on the number of observations dominated by the members of the subgroups. The introduction of an additional axiom allows us to distinguish between the two classes and provide a characterization of the volume based index of technological superiority. Finally we discuss, and overcome, some practical problems related to the operationalization of this index.
64 CBA WITH DEA: MEASURING EXPENSE EFFECTIVENESS

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ABSTRACT

Based on a cost indirect output set, we develop a DEA model that can be applied to perform short-run cost-benefit analyses on firms’ production. Given a constraining budget for variable factors in production, a cost-benefit measure is derived from a DEA revenue maximization problem given that at least one factor is fixed. The cost-benefit measure, explicitly calculating the ratio of maximized revenue to the budget then measures how much revenue firms can optimally produce in the short-run, given that budget. The proposed model can be used to assess effects of policy measures. For instance, we can simulate regulations on production to study the effect of cost in terms of lost revenue. As an empirical illustration, we apply the short-run cost-benefit modeling approach to firm level panel data from the Swedish energy sector, covering the years 2004 to 2008. Capital and labor are modeled as fixed production factors and energy as a variable factor. The data includes undesirable outputs (CO2, SO2, and NOx) and by specifying a pollution generating technology we model these outputs as by-products in production, which is highly relevant when, e.g., analyzing climate and energy policy related topics.

65 EFFICIENCY-BASED PERFORMANCE EVALUATION USING DATA ENVELOPMENT ANALYSIS

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Fatma Arslan, Sakarya University, Turkey

ABSTRACT

In today’s manufacturing environment, productivity analysis is significant in order to monitor their progress for enterprises. Data envelopment analysis (DEA) is a very effective method for measuring the relative efficiencies of a set of decision making units (DMUs) which uses multiple inputs to produce multiple outputs. In this paper, the efficiency problem in factory units in defense industry based on materials’ lateness purchasing which is caused the customer demands couldn't meet on time is examined. There is a lot of criteria affecting this trouble and this situation gives a rise to conflict among departments due to couldn’t be determined the causes of the problem. In order to solve this challenge, DEA non-parametric method in which the set of inputs and outputs are evaluated together is preferred in this study. Firstly, DMUs are detected from related departments such as Production Planning and Control, Material Management, Research & Development and Technology and Quality Management. At continuation of this study, homogeneous inputs and outputs for DMUs are defined. As a result, it is expected to find out ineffective DMUs in order to make them more productive, and decrease the inactive times caused by materials absence.
66 TURKEY AND THE EUROPEAN UNION COUNTRIES EDUCATIONAL PERFORMANCE

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Hasan Bal, Gazi University, Turkey

ABSTRACT

Analysis of performance is a concept that has talked about sources of system and circumstance of determining effective and efficient. Efficiency analysis is a method for evaluating of system performances at recent years. Data envelopment analysis (DEA) can handle multiple inputs and multiple outputs makes it an attractive choice of technique for measuring the efficiency of education field. The paper begins by exploring the advantages and drawbacks of the various methods for measuring efficiency in the higher education context. In this study, one of the process of measuring the effectiveness of systems with DEA activities have used in the field of education in Turkey and European Union countries, the relative total measuring activity is the analysis of technical and scale.

67 CAPTURING ENERGY EFFICIENCY IN IRON AND STEEL PRODUCTION
– AN EMPIRICAL ANALYSIS USING DEA AND MPI

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Semida Silveira, KTH Royal Institute of Technology, Sweden

ABSTRACT

European iron and steel industries work towards increased energy efficiency of production to meet requirements set by EU policies, such as the Energy Efficiency Directive. However, current energy efficiency evaluation tools, such as the Specific Energy Consumption (SEC), give only crude estimates on the improvements in the context of iron and steel production. In this study, we survey the state-of-the-art of Malmquist Productivity Index (MPI) methodology and Data Envelopment Analysis (DEA) techniques to identify an approach that captures the energy efficiency trends in iron and steel production. We found the combination of MPI with slacks-based DEA models to be especially useful in this context. The chosen method was used in an empirical case, analysing energy efficiency of European iron and steel production. The results showed improvements of 16 % up until 2007. However, the years of the global economic recession yielded drastic decreases in energy efficiency. These results stand in contrast with the results of the currently used SEC. The empirical analysis considered each Member State as a decision-making-unit and was performed over the time period 1992 – 2010.
68 QUALITY OF LIFE PERFORMANCE OF RURAL AREAS: CASE OF BURSA

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Handan Türkoğlu, Istanbul Technical University, Turkey
İlker Akgün, Turkish Naval Academy, Turkey

ABSTRACT

In general, rural development covers activities and opportunities which aim to help rural settlements. On the other hand, inadequate possibilities, low level of development and population decrease create vulnerability in rural areas. In Turkey, infrastructure problems, low level of quality of life (QOL) and economic problems are among main reasons of rural communities to survive. Therefore, to develop strategies to increase QOL in rural areas became important to decrease rural urban migration and increase rural attractiveness. This paper investigates QOL performance of rural areas in Bursa. Bursa, as one of the metropolitan cities in Turkey, is very famous with its rural characteristics and rural production including its industrial and innovative character. The study was conducted during the preparation of Bursa Development Plan in 2011. Data from 148 villages are obtained via questionnaires. Therefore, data envelopment analysis (DEA) is performed to see the QOL performance of rural areas in Bursa in order to better understand what future alternatives/strategies are needed to obtain rural development. The results show that the location is very important in terms of QOL performance. Therefore, remote villages have the lowest performance, while villages close to urban centers possess more QOL.

69 EFFICIENCY IN THE EUROPEAN BANKING SECTOR: PERIPHERAL VERSUS CORE ECONOMIES

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Michail Xanthopoulos, Geniki Bank, Treasury Operations, Greece

ABSTRACT

The centralization of monetary policy and the transfer of supervisory procedures to the European Central Bank (ECB) was the first step in an effort to create an integrated banking industry with more efficient transfers of funds and capital, higher degree of competition among the Euro-area banks and therefore, improved services to the real economy. However, the structural differences between the economies within the European Monetary Union have traditionally posed significant obstacles in ECB’s effort to establish a highly competitive and intergraded interbank market. This mandate became even harder after the escalation of the sovereign debt and banking crisis which revealed the structural weaknesses of Eurozone and resulted in a segmented interbank market. This paper investigates the efficiency evolution in the European banking sector focusing on whether environmental factors have resulted in significant efficiency differentials between the core (e.g. Germany, The Netherlands, Austria, Belgium, France) and peripheral economies (Greece, Spain, Portugal, Ireland, Italy). The dataset is retrieved from a large sample of European banks and covers a period between 2005 and 2011. The methodology employed to obtain efficiency is based on DEA, and Brockett and Golany (1996) procedure is applied to examine the efficiency differences among the aforementioned groups. Moreover, the paper aims to provide further insights and recommendations on banking efficiency for the management of financial institutions.
70 EVALUATING RESEARCH PERFORMANCE IN GREEK UNIVERSITY DEPARTMENTS OF ECONOMICS USING DEA

Giannis Karagiannis, university of macedonia, Greece
Stelios Katranidis, university of Macedonia, Greece

ABSTRACT

In this paper the research output of Economics departments’ in Greek universities is assessed using as DMUs their faculty members. We employ two DEA models, namely the conventional output-oriented model and the single-constant input model. In the former case, a categorical variable reflecting the quality of faculty members’ doctoral studies is used as an input while in the latter case input quantity is set equal to one for all faculty members. In both model specifications we consider a single output, i.e., the number of journal publications, and two attributes, i.e., a journal quality ladder and the total number citations.

71 INDIAN POWER DISTRIBUTION SECTOR: PERFORMANCE ANALYSIS AND WAY AHEAD

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Shilpa Sethia, AF Mercados EMI, India
Puneet Chitkara, AF Mercados EMI, India
Anish De, Mercados, India
Sanchit Kumar, Mercados, India

ABSTRACT

Power sector development is central to India’s growth. This study assesses the performance of Electricity Distribution Companies (DISCOMs) in the 20 major Indian states over the years 2006-2010 – deploying Input oriented Data Envelopment Analysis in cross-sectional and time-varying data. Since, standard DEA models may identify more than one state utility as efficient – approach used in this paper uses factor weights which are obtained from unbounded runs of DEA, to set upper and lower limits on weights in the “bounded” formulation. The results indicate that performance of several Discoms is sub-optimal, leaving a potential for cost reduction and possible reduction in energy losses. This model developed herein is envisioned to be instrumental to policy makers and managers to improve the efficiency of inefficient Discoms and thereby increase competitiveness. However, as Indian states are economically and politically diverse from each other, there is scope to vary the organizational structure across states. This paper provides a means to do so. The agenda for policymakers is to identify the situation in their respective states and choose a reorganization path that is the best compromise. The study also serves as a guiding tool for financing institutions by facilitating identification of credit worthiness of different State Discoms.
72 ASSESSING SUSTAINABLE INTENSIFICATION OF AGRICULTURAL SYSTEMS USING A FARM ECO-EFFICIENCY INDEX: A DATA ENVELOPMENT ANALYSIS APPROACH

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Richard Bennett, The University of Reading, United Kingdom
Julian Park, The University of Reading, United Kingdom

ABSTRACT

Sustainable Intensification (SI) of agriculture has received widespread political recognition, not only in the UK but also internationally. The concept recognises the need to simultaneously raise yields, increase input use efficiency and reduce the negative environmental impacts of farming systems to secure future food production and to sustainably use the limited resources for agriculture. The objective of this paper is to outline a policy-making tool which can be used in the context of SI to assess economic value and environmental pressures generated at a farm level. Farm level data derived from the Farm Business Survey of England was used to relate the economic value of agricultural goods produced with the environmental impacts involved in the production process. Based on the method introduced by Kuosmaned and Kortelainen (2005), Data Envelopment Analysis was adapted to consider the substitution possibilities between economic value and environmental pressures generated by farming systems in an aggregated index of eco-efficiency. The particular advantage of this technique in relation to the adoption of a weighting scheme is that it does not require subjective judgment about the weights assigned to the environmental pressures. The results are used to suggest strategies of integration of farming practices and environment policies in the framework of SI of agriculture. Paths for improving the index of eco-efficiency and therefore reducing environmental pressures are also revealed.

73 THE BALANCE OF DECISION MAKING UNITS (DMUS) REGARDING THE IMPOSED STRATEGIES

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Masoumeh Rajabi Tanha, Iran University of Science and Technology, Iran, Islamic Republic of

ABSTRACT

The paper points out to define and compute the balance factor of DMUs. The importance of this attitude of DMUs is underlined by the fact that adapting with defined strategies is unavoidable and very important for managers. In 2006, Golany, et al. computed a balance factor as a ratio of the scores obtained via the BSC-DEA and DEA models. This model deals with some problems in the real applications. So, in this paper, we present a definition of aligning of the strategies as the balance of DMU and develop a new model based on directional DEA models to evaluate DMUs.
74 INVERSE EFFICIENCY SIMULATION

Berenice Dupeux, Gent University, Belgium
Jeroen Buysse, Gent University, Belgium

ABSTRACT

Most of ex-ante impact assessment policy models have been based on a parametric approach. In this paper we develop a novel non-parametric approach enabling us to ex-ante predict the impact of policy changes. The concept of the approach is to use non parametric efficiency analysis as a methodology for calibrating the farm’s technology and behavior. The simulation model uses these calibrated allocative and technical efficiencies of each Decision Making Unit (DMU) and the frontier as specification of the technology. Contrary to the parametric approach, the production function is determined by the data itself and the effect of the explanatory variables. Hence the arbitrary choice of a specified production function is removed preventing the misspecification of the distribution of inefficiency terms. Data Envelopment Analysis (DEA) techniques are used to capture farmer behaviors and draw production frontiers. In this paper, estimation results are improved thanks to the use of panel data. The model is tested on several datasets. Monte Carlo methods are used for different values of each different factors such as: technology, inefficiency distribution, or sample size.

75 MEASURING THE EFFICIENCY OF PRIMARY HEALTHCARE ORGANIZATIONS IN THE CAPPADOCIA REGION USING DATA ENVENLOPMENT ANALYSIS

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ABSTRACT

Healthcare is an important sector that serves people of all ages. There are different steps and facilities used for providing health care services in Turkey. Mainly these facilities are primary, secondary and tertiary healthcare organizations. In the first step the primary healthcare organizations (PHOs) do exist. The PHOs give preventive healthcare services and this kind of services are among the main pillars of the primary healthcare. In this study the relative efficiency of PHOs that serve in the Cappadocia region will be evaluated. The most appropriate inputs and outputs that reflect the sector will be used for comparing the PHOs, namely DMUs. Efficiency measures will be computed using the Data Envelopment Analysis (DEA) method. Efficient and inefficient PHOs will be found and in order to make improvements some suggestions will be made for the inefficient ones. Finally, constraints of this study and the research areas will be pointed out for future research on this subject.
76 APPLYING DEA-MBP TO ENVIRONMENTAL AND COST BENCHMARKING IN ELECTRICITY GENERATION: A CASE STUDY OF IRAN STEAM POWER UTILITIES

Foroogh Shadman Lahiji, University Putra Malaysia (UPM), Malaysia
Khalid Abdul Rahim, University Putra Malaysia (UPM), Malaysia
Behrouz Arabi, University of Malaya, Malaysia

ABSTRACT

Energy and environment are essential for sustainable development. To make sure that energy fulfils the needs for economic growth and sustainable development more attention should be paid to energy and environment efficiency. Electricity generation by fossil fuels has had tremendous benefits for society, but these have come with significant environmental impacts. Since the first inclusion of pollution variable in Data Envelopment Analysis (DEA) methodology by Fare et al. (1996), substantial number of DEA studies has been published. The electric power sector producing 42% of the world’s anthropogenic carbon dioxide (CO2) emissions in 2010 (IEA, 2012) considered as the major contributor to local air quality degradation and global environmental impacts such as greenhouse phenomenon. The study provides seasonal cost and environmental efficiency analysis of steam power plants in Iran during 2007-2009. Employing the DEA-MBP (Material Balance Principles) methodology produces detailed tradeoffs on cost and environmental efficiency of each unit which would help to inform decision making units regarding not only the efficiency frontier other than to specific efficient units that known as peers or role models. Therefore, simultaneous cost and environmental efficiency analysis could be the missing ingredient to link environmental, economic and energy sciences toward sustainable development.

77 A MATERIALS BALANCE PRINCIPLE ENABLED MALMQUIST LUENBERGER APPROACH USING A SLACK-BASED MODEL

Behrouz Arabi, University of Malaya, Malaysia
Susila Munisamy, University of Malaya, Malaysia
Ali Emrouznejad, Aston University, United Kingdom
Foroogh Shadman Lahiji, University Putra Malaysia, Malaysia

ABSTRACT

Incorporating Materials Balance Principle (MBP) in the industrial and agricultural performance measurement systems with pollutant factors has had an increasing tendency in recent the years. Many conventional methods of performance measurement have not been compatible with material flow conditions. In this paper we discuss pros and cons of incorporating MBP in the non-parametric frontier, distance and hyperbolic models and introduce extents to which MBP can be deployed in this category of models. In addition we introduce a Malmquist Luenberger MBP enabled model. This model is compared to a similar model incorporating MBP using the trade-off approach and is applied to measure the productivity and eco-efficiency trend of power plants. Results reveal a similar finding for both models certifying the robustness and applicability of the model.
78 MEASURING DYNAMIC EFFICIENCY OF HIGHWAY MAINTENANCE OPERATIONS

Kostas Triantis, Virginia Tech, United States  
Saeideh Fallah-Fini, Virginia Tech, United States  
Hazhir Rahmandad, Virginia Tech, United States  
Chema de La Garza, Virginia Tech, United States

ABSTRACT
In this paper we discuss a dynamic efficiency measurement model for evaluating the performance of highway maintenance operations where the inter-temporal dependencies between consumption of inputs (i.e., maintenance budget) and realization of outputs (i.e., improvement in road condition) are explicitly captured. We build on a micro representation of pavement deterioration and renewal processes and study the impact of the allocation of scarce maintenance budgets over time. We provide a measure of efficiency that contrasts the optimized budget allocations to the actual ones. The developed model is then applied to an empirical data set of pavement condition and maintenance expenditures over the years 2002 to 2007 corresponding to seventeen miles of interstate highway that lay in Roanoke county in the state of Virginia. The policies that were found through optimization showed that road authorities should give higher priorities to preventive maintenance than corrective maintenance. In essence, by applying preventive maintenance, the road authorities can effectively decrease the need for future corrective maintenance while spending less overall. Our results also show that highway maintenance performance measures obtained independently at different instances of time without assuming any inter-temporal dependence between input and output levels lead to the underestimation of the true efficiency scores.

79 OECD COUNTRIES SOCIO-ECONOMIC PERFORMANCES BY THE GOAL PROGRAMMING DATA ENVELOPMENT ANALYSIS MODELS

H.Hasan Örkcü, Gazi University, Turkey  
Mustafa İsa Dogan, Gazi University, Turkey

ABSTRACT
The measurement of a country’s welfare is one of the most critical and highly debated issues in economic research. For this purpose, a large number of economic theories have been developed. This study focuses on the socio-economic performance evaluation problem of countries with the data envelopment analysis.
Data envelopment analysis (DEA) has been a very popular method for measuring and benchmarking relative efficiency of peer decision making units (DMUs) with multiple input and outputs. Beside of its popularity, classical DEA models have some drawbacks such as unrealistic input-output weights and lack of discrimination among efficient DMUs. Goal programming data envelopment analysis models, GPDEA-CCR and GPDEA-BCC, proposed by Bal et al (2010), also improve the discrimination power of DEA.
In this study, primarily related to the implementation of socio-economic performance measurement data envelopment analysis literature is presented, then the OECD countries, using data for the year 2011 socio-economical performance measurement, are evaluated using classical and goal programming data envelopment analysis models.
<table>
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<th>80</th>
<th>TOTAL PRODUCTIVITY GROWTH IN THE FACULTIES OF ANBAR UNIVERSITY USING MALMQUIST PRODUCTIVITY INDEX</th>
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<tr>
<td>Ahmad Battal,</td>
<td>Anbar University, Iraq</td>
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<td>Subhi Jarwaan,</td>
<td>Anbar University, Iraq</td>
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**ABSTRACT**

The aims of this study is to evaluate the productivity growth of nineteen Faculty of Anbar University (FAU) in Iraq. The FAU performance is determined on the change in total factor productivity (TFA) and technical efficiency. We used the output orientated DEA-Malmquist index in estimating the productivity growth from panel data of 19 of FAU in two periods of time 2010-2011 and 2011-2012 academic years, the model calculated using two educational outputs and two inputs. The results showed that (14) FAU or or 73.6% are efficient. In terms of total factor productivity, FAU obtained an index score of 0.879, which means that (7) FAU or 36.8% remarkable productivity growth. The technological index shows that (2) FAU or 10.5% only shows a technological progress.

<table>
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<th>81</th>
<th>REGIONAL EFFICIENCY MEASUREMENT OF TURKISH MANUFACTURING INDUSTRY</th>
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<tr>
<td>Yücel Özkara,</td>
<td>Republic of Turkey Ministry of Science, Industry and Technology; Directorate General for Productivity, Turkey</td>
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<tr>
<td>Mehmet Atak,</td>
<td>Gazi University, Department of Industrial Engineering, Turkey</td>
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</table>

**ABSTRACT**

Regional development is an important issue in countries’ agenda. At regional level, industrial planning and implementation of development policies play a critical role. Decision makers of economy care about efficiency and productivity levels for planning and policy making of industry. In industry, the basic determinant of economic growth is manufacturing industry. There are many studies on structural analysis and dynamics of progress. Nevertheless, there is lack of studies at the regional level in the manufacturing industry and it is the motivation of this study. At this context, Turkey’s regional productivity measurement of manufacturing industry between 2003-2009 is conducted with data envelopment analysis. Turkey has 26 regions due to NUTS (Nomenclature of Territorial Units for Statistics) Level-2, and this study covers these regions. Number of people employed, electricity consumption and capital stock is used as the input and production is used as the output.
82 REGIONAL PRODUCTIVITY DIFFERENCES OF PUBLIC HOSPITALS IN GREECE

Roxani Karagiannis, Centre for Planning and Economic Research, Greece

ABSTRACT

The aim of this paper is to provide productivity measures in regional level for public hospitals in Greece during the period 2007-2011. The empirical analysis is based on input-oriented Malmquist index decomposed to technical efficiency, scale efficiency and technological change. For this purpose, we employ a nonparametric (linear programming) model in which the degree of productivity could be determined from data on observed inputs, like as the number of beds, the number of physicians or the number of other hospital personnel and outputs, like as the number of patient admissions or the number of outpatient visits.

83 DYNAMIC NETWORK DEA: AN APPLICATION TO THE PROVISION OF PUBLIC SERVICES

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Sebastian Lozano, Department of Industrial Management - University of Seville, Spain

ABSTRACT

Network DEA has become a widely used methodology because several interrelated stages can be distinguished instead of black boxes and thus revealing more sources of inefficiency. However, there has not been much research on methods measuring changes over time based on Network DEA, specifically when there are variables that have an effect on the followings periods of time. So the main purpose of this paper is to introduce a general Dynamic Network DEA, which allows setting both outputs of and intermediate products within the Network DEA model as carry-over activities between two consecutive periods. This model is illustrated through an application to measure the dynamic efficiency in the provision of public services by the U.S. states.

84 SAFETY PERFORMANCE OF HEAVY AND LIGHT INDUSTRIAL PROJECTS BASED ON ZERO ACCIDENTS TECHNIQUES

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Jesus de La Garza, Virginia Tech, United States
Jennifer Rogers, ConocoPhilips, United States

ABSTRACT

The purpose of this paper is to develop a benchmark for evaluating safety performance of construction projects performed by Construction Industry Institute’s member companies. There are various methods for creating and implementing a construction safety plan, one of the most notable is the Construction Industry Institute’s (CII) Zero Accidents Techniques (ZAT). In this study we identify a relationship between the level of ZAT implementation and
safety performance on industrial construction projects. A regression-based heterogeneity analysis is implemented to identify characteristics of construction projects that have statistically significant levels of impact on safety performance. This heterogeneity analysis supplies the information necessary to cluster construction projects in groups that are homogeneous in terms of their operation and the environment in which they operate. The safety performance of construction projects (with respect to their level of implementation of ZAT) within and across clusters are evaluated and compared with each other using the non-parametric meta-frontier framework.

The two main findings in this study are: (1) there is a significant log-log relationship between the DEA performance scores and recorded incidents of construction projects; (2) there are differences in the safety performance between the heavy and light industrial construction sectors.

| 85 | RANKING DESIGN REQUIREMENTS IN QUALITY FUNCTION DEPLOYMENT WITH A NEW DATA ENVELOPMENT ANALYSIS METHOD |

**Jafar Pourmahmoud, Azarbaijan Shahid Madani University, Islamic Republic of Iran**

**Elnaz Babazadeh, Azarbaijan Shahid Madani University, Islamic Republic of Iran**

**ABSTRACT**

Nowadays, organizations that pay attention to quality and customer requirements (CRs) survive in the modern competitive market place. Quality function deployment (FD) is an extremely important quality management tool that is useful in product design and development and for benchmarking. The goal of FD is producing a product with high quality. In this way ranking the design requirements (DRs) is so important. FD-DEA fails in ranking the DRs when there are insufficient DRs or the number of DRs is not more than three times of the sum of the number of factors. In this paper, we will propose a new DEA methodology which generates more sensitive scores for DRs. Then we will extend it in imprecise environment. In this way, we will use two specially constructed DEA models to get the best and lower bound of the best scores for each DR. Then, using the concept of ranking in an equitable way, we will devote a unique score for each DR and so the ranking will be performed. It is expected that the new methodology can play an important role in the studies and applications of the FD.

| 86 | A NEW GROUPED DATA ENVELOPMENT ANALYSIS METHOD FOR PRIORITY DETERMINATION IN QUALITY FUNCTION DEPLOYMENT |

**Elnaz Babazadeh, Azarbaijan Shahid Madani University, Islamic Republic of Iran**

**Jafar Pourmahmoud, Azarbaijan Shahid Madani University, Islamic Republic of Iran**

**ABSTRACT**

Quality Function Deployment (FD) is a methodology for translating customer requirements (CRs) into relevant engineering design requirements (DRs). It is a team-based and disciplined approach to product design, engineering and production and provides in-depth evaluation of a product. The FD team is responsible for assessing the relationships between CRs and DRs
and the interrelation between DRs. In practice, each member demonstrates significantly different behavior from the others and generates different assessment results, leading to the FD with uncertainty. In this paper we will enter each member's subjective assessment into the house of quality (HOQ), and construct a new data envelopment analysis method in group situation which differs from multi-objective decision making models. Then, without using Charnes-Cooper transformation, we will transform the proposed model into a linear programing problem in a completely different manner. We will call the proposed model "Grouped-QFDEA".

87 COMPETITIVENESS IN TURKISH BANKING: 2002-2011

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ABSTRACT

Using a novel approach, we derive “shadow unrealized profit scores” as well as “shadow input-output prices” for each year and bank in the Turkish banking sector from 2002 to 2011. We demonstrate that these scores operationalize the Hicksian concept of “monopolistic quiet life.” We show that the Turkish banking sector came closer to the “zero profit condition” over time. Similarly, the variances of “shadow prices” exhibit a significant decline over our sample period, indicating a closer approximation to the “law of one price”. We conclude that there are differences in profit efficiency between banks with different ownership types and sizes. In particular, state-owned banks display the lowest inefficiency while foreign-owned banks the highest. Finally we find total asset and branch network sizes are positively related to profit efficiency, implying important scale and scope economies.

88 FUZZY DATA ENVELOPMENT ANALYSIS: A PRIMAL-DUAL APPROACH

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ABSTRACT

In this paper, a model, based on compound of the primal and dual of the fuzzy data envelopment analysis models, is presented. The proposed model is a non-linear programming problem that gains the optimal solution in a competition and consistency between the optimal solutions of primal and dual. The method is also suitable for solving interval programming problems.
ON DETECTING INFLUENTIAL OBSERVATIONS IN DEA

Irma Acarlar, Gazi University, Turkey  
Harun Kinaci, Gazi University, Turkey

ABSTRACT

In Data Envelopment Analysis (DEA) the production possibility set which is obtained by efficient decision making units (DMUs), is sometimes different from expectation. In particular, one of these efficient DMUs may extend the production possibility set and decreases the efficiency scores of inefficient DMUs. Hence in this paper we discuss some influential DMUs and review some related studies in the literature. Then we propose a new method for detecting on influential DMU from one of the efficient DMUs. Our method will be explained with an empirical example.

SELECTION OF PRODUCT DESIGN USING MODIFIED DATA ENVELOPMENT ANALYSIS MODELS

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ABSTRACT

Developing new products and releasing the best among them in the right time in competitive markets is inevitable for any company. In order to gain customer’s confidence in the product, every manufacturer tries to maximize the satisfaction derived by the customers using their product. This is achieved by increasing the quality of the product by considering certain performance attributes of the product. Among the available designs developed by the manufacturer, selecting the best design is a complicated problem when the number of designs and the performance attributes are increasing. The success of the new product depends on the selection method used by the manufacturer to evaluate the different designs. Present paper applies Modified Data Envelopment Analysis to choose the best design among the available ones. The performance attributes of the products are recognized as either beneficial or Non beneficial. The beneficial attributes are considered as outputs and Non beneficial attributes as inputs. The main advantage of the method is that there is no need to have designer’s preferences over the performance attributes and results are more accurate.
ASYMMETRIC COST BEHAVIOR AND DEA EFFICIENCY SCORES

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ABSTRACT

This paper analyzes how the direction of sales change and the resultant asymmetric cost behavior affect DEA efficiency scores. The prior Accounting literature documents that managers’ optimal decisions trading off capacity adjustment costs against slack capacity costs are based on their assessment of future demand trends, and lead to asymmetric cost behavior. First, following a prior sales increase (decrease), managers’ expectations for future demand become more optimistic (pessimistic), which makes them more (less) willing to increase resources when current sales increase and less (more) willing to decrease resources when current sales decrease. Second, managers’ decisions about resource levels depend on both current and prior sales changes because of adjustment costs for all resources, including both labor and fixed assets. These deliberate decisions about resource adjustments in turn alter the contemporaneous input to output relations in DEA efficiency scores in a predictable fashion.

We use Annual Business Statistics data sets from the Turkish Statistical Institute to analyze how current and prior sales changes lead to systematic differences in DEA efficiency scores. The data set includes a panel of 18,300 firms from 2003 to 2009. Our findings are consistent with the theory of asymmetric cost behavior where adjustment costs and expectations of managers about future demand lead to asymmetric response of cost to sales increases and decreases. We find that cost stickiness conditional on a prior sales increase lead to lower DEA efficiency scores, and cost anti-stickiness conditional on a sales decrease lead to higher DEA efficiency scores, everything else being equal. Prior sales decrease would make the managers more pessimistic about future demand and when current sales decrease, they would be more willing to cut down resources. Among the firms that have current sales decrease, the ones that have prior sales decrease have higher DEA efficiency scores since they decrease resources more compared to firms that have prior sales increase. On the other hand, prior sales increase would make managers more optimistic about future demand, and when current sales increase, they would be more willing to expand resources. Among the firms that have current sales increase, the ones that have prior sales increase have lower DEA efficiency scores since they increase resources more compared to firms that have prior sales decrease. These results indicate that the direction of sales change has a significant impact on current input-output ratios and, therefore, asymmetric cost behavior should be taken into account while analyzing and interpreting DEA efficiency scores.

Additionally, we test whether our results hold when measures of labor adjustment costs are included in the analysis. We use ratio of termination fees paid to employees to total labor cost, and lagged ratio of outsourced employees to total employees as two measures of labor adjustment costs. Termination fees incurred represent the direct cost of adjusting the labor resources. Outsourced labor have lower adjustment costs compared to firms’ own labor, and thus higher share of outsourced employees in total employment can increase firms’ flexibility to adjust resources. We find that firms that have higher termination fee share among labor cost have higher efficiency scores. Similarly, firms have higher lagged outsourced employees ratio are more efficient. These results support that idea that resource adjustment flexibility leads to higher efficiency score.
92  TWO-STAGE ANALYSIS OF BANKING EFFICIENCY IN NIGERIA

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ABSTRACT

This study attempts to establish the efficiency scores of the Nigerian banking system, and subsequently identifies important variables determining the efficiency level. Data Envelopment Analysis is used to measure the efficiency and Panel Data Analysis is used to explain the determinants. Using total deposits and operating expenses as inputs and loans and other investments as output in the data envelopment analysis (DEA) across a panel of 17 banks over 5-year period to 2009, it was observed that efficiency improved during the sampled period. In general, old generation banks are more efficient as exhibited by their progressive approach to the frontier benchmarks. It is also found that the result based on Hausman test selection and some statistical criteria shows that a market specific factor (shareholders’ networth- SHN) and a firm specific factor (Loan loss provision- LLP) are the two most common factors that determine the efficiency. This study therefore recommends that Loan loss provision (LLP) and shareholders’ networth (SHN) be given top priority in understanding the variations in the Deposit Money Banks’ efficiency.

93  A NEW APPROACH FOR THE SECONDARY GOAL IN DEA

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Irmak Acarlar, Gazi University, Turkey

ABSTRACT

As an extension of Data Envelopment Analysis (DEA), cross-efficiency provides substantial information about inefficient Decision Making Units (DMUs) and there are several models proposed to calculate cross-efficiency. Liang et al. (2008) studied on cross-efficiency and they proposed alternative models on the secondary goal in DEA. Third of these models minimizes the mean absolute deviation variable related to DMUo. With regard to this model, our main endeavor is to suggest a new model for the secondary goal. We use average of the absolute deviation from median of deviation variable, instead of absolute deviation from their mean as in the model by Liang et al. (2008). We will use the data in Liang et al (2008) then the results of our and their secondary model will be compared. Also we will apply our model in several artificial data that are left and right skewness and their results will be compared with several other current models like as Liang models, CCR, BCC, etc.
94 RANKING ALL UNITS BASED ON MODIFIED CONSTANT RETURNS TO SCALE DATA ENVELOPMENT ANALYSIS MODEL

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ABSTRACT

The motivation of this study is to propose an equitable method for ranking all decision making units based on modified constant returns to scale data envelopment analysis model using facet analysis. For this purpose, first the minimum and maximum efficiency values of each unit are computed under the assumption that the sum of efficiency values of all DMUs is equal to unity using modified DEA model. Then, the rank of each DMU is determined in proportion to a combination of its minimum and maximum efficiency values.

95 MEASURING DYNAMIC-NETWORK INEFFICIENCY WITH AN APPLICATION TO REGIONAL ECONOMIES

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ABSTRACT

We model the performance of DMU (decision-making units) using DEA (data envelopment analysis) within a dynamic-network framework. Network DEA deals with the situation where a division employs exogenous inputs and intermediate inputs to produce intermediate outputs and exogenous outputs. Dynamic DEA copes with the situation where efficiency is gauged based on overtime optimization by allowing for carry-over activities. We formulate a weighted multi-period dynamic multi-process network slacks-based inefficiency (WDNSBI) measure by incorporating the structure of networks and dynamics. WDNSBI is defined by the objective function of the optimization problem that includes neither the slacks associated with divisions nor periods. That is, the efficiency status of the evaluated DMU is identified by the slacks of exogenous inputs and final outputs alone. In modeling we consider lagged and standard carry-over activities, joint production characteristics, and so on. We apply this methodology to Japanese prefectural time series data. Prefectural technology comprises activities of two sectors, called the human capital generating sector and the physical capital formation sector. Each sector has its own exogenous inputs, and carry-overs in preceding and subsequent periods as well as final output. We assume that the final output is produced jointly by activities of the two sectors.
TRANSPORTATION PERFORMANCE ASSESSMENT BASED ON ENERGY AND ENVIRONMENTAL OF TURKEY AND THE EUROPEAN COUNTRIES

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Harun Kinaci, Gazi University, Turkey

ABSTRACT

Transportation is one of the essential sectors for each country and each citizen. To travel from one place to another for holiday or work is a mandatory need for people. At the same time transporting of goods is a mandatory need for producing countries or company. These needs are also increasing day by day. There are some problems brought by the growing transportation sector. Two of these are energy consumption and the greenhouse gases emission. This study takes these two problems as input to evaluate the transportation performance of European countries. Here the output is determined as the total amount of transported passengers and freight. Data Envelopment Analysis (DEA) is used for evaluating the performance. DEA is a technique based on mathematical modeling. Each country is defined as Decision Making Unit (DMU). An efficiency score was calculated for each DMU in this study. DEA assigns weights to inputs and outputs of DMUs such that makes their efficient scores maximum. In this study some applications has been made with well know models of DEA and obtained results was interpreted.

MEASURING AND MODELLING PRODUCTIVITY IN EDUCATION: STATE-OF-THE-ART AND RESEARCH FRONTIERS

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ABSTRACT

Modeling the educational services for the measurement of productivity and efficiency has been of high interest among researchers in both economics and operations research since the dawn of Data Envelopment Analysis (DEA). Indeed, productivity and economic efficiency are of societal importance for three primary reasons. First, the financial endowments by governments or municipalities are increasingly attributed to institutions based on their relative efficiency. Second, in areas with fixed endowments, institutions are often assigned additional students and tasks meeting demographical and educational challenges. This amounts in practice to compelling demands for productivity and efficiency improvements. Third, many jurisdictions have partially deregulated the curriculum design and pedagogical profile to the local schools, allowing them to compete for students. Naturally, such educational pseudo-competition calls for both productive efficiency and service differentiation. Benchmarking techniques such as DEA have been applied to address some or all of these concerns through a multitude of models with varying properties and assumptions. In this paper, we review the existing literature from 1978 to 2013 to determine state-of-the-art in performance assessment of education services. We present a unified framework for categorizing the nonparametric performance analysis articles in education sectors. We conclude our paper with open research areas and suggestions for further empirical and theoretical work.
98 TURKISH DECISION SUPPORT SYSTEM FOR PERFORMANCE ANALYSIS WITH C# PROGRAMMING LANGUAGE

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ABSTRACT

Data Envelopment Analysis, one of the method of performance analysis, is the non-parametric method in which relative efficiency is measured by using obsevance values of variables belonging to decision making units. Different types of computer packet programmes may be used for Data Envelopment Analysis. However, there are some deficiencies in these packet programmes prepared in foreign languages. In this study, completely Turkish performance analysis package program has been developed with Microsoft Visual C# programming language covering each of the various features such as the input-oriented and output-oriented CCR (Charnes Cooper Rhodes) - BCC (Banker Charnes Cooper) models in order to complete the deficiencies. This packet programme is thought to bring added value to our country (Turkey) as it is more useful than its equivalents and it is a domestic article.

99 PORTFOLIO PERFORMANCE EVALUATION USING DEA AND QUANTITIES OF LINEAR REGRESSION

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ABSTRACT

Abstract
In financial literature, a portfolio is an appropriate mix investments held by an institution or private individuals. Evaluation of portfolio performance has created a large interest among employees also academic researchers because of huge amount of money are being invested in financial markets. Among many evaluation methods, Data Envelopment Analysis (DEA) is one of the best ways for assessing the relative efficiency a group of homogenous decision making units (DMUs) that use multiple inputs to produce multiple outputs. We know that portfolio performance measure based on mean-variance-skewness framework, which the variance of the portfolios is used as an input to the DEA and excess return and skewness are the output, its covariance is not equal to zero. So sharp’s single factor model is used with linear regression for efficiency evaluation. In this method because of covariance between two stocks is considered zero, content of computation is reduced.
### 100 Malmquist Productivity Analysis for Tourism Industry in Turkey, 2000-2011

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Eren Gümüş, Gazi University, Turkey  
Nimet Yapıcı Pehlivan, Selcuk University, Turkey

**ABSTRACT**

This paper discusses the productivity analysis of Tourism Industry in Turkey from 2000 to 2011. The Malmquist index was used to indicate the Tourism Industry Capital Structure changes from 2000 to 2011. The period has seen significant changes in the structure of the Turkey industry both as reflection of these shocks but also as the result of on-going market forces. For example, 2001 financial crisis was influenced the tourism industry and the sector has experienced big declines. Because of this reasons we analyzed the Turkeys’ tourism industry. In application part, Malmquist index is applied to years from 2000 to 2011 in Turkey according to the various indicators.

### 101 Measurement of Investment Efficiency of Regions in Turkey via Fuzzy Analytical Hierarchy Process/Data Envelopment Analysis

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Nimet Yapıcı Pehlivan, Selcuk University, Turkey

**ABSTRACT**

This paper presents an integration of fuzzy analytical hierarchy process (FAHP) and data envelopment analysis (DEA) for assessment regions of Turkey. In this algorithm at first we used the FAHP method for converting the qualitative variables to quantitative variables and then we ranked the decision making units (DMUs) by using DEA method. In the application part, we applied integrated FAHP/DEA algorithm for evaluating the regions of Turkey. This is the first study that integrated DEA and AHP for regions of Turkey based on both qualitative and quantitative indicators.

### 102 The Examination on Relative Efficiencies of High Schools in Gaziantep by Data Envelopment Analysis (DEA)

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**ABSTRACT**

Data Envelopment Analysis is one of most widely used method for measuring the relative efficiency of decision-making units on the basis of multiple inputs and outputs. DEA is derived from linear programming helping resource allocation decisions. DEA is a linear programming-based technique for measuring the relative performance of organizational units.
where the presence of multiple inputs and outputs makes comparisons difficult. Also it is defined as methodology used to evaluate the efficiency of entities (programs, organizations etc.) which are responsible for utilizing resources to obtain outputs of interest. Relative efficiencies of twelve high schools in Gaziantep by DEA are examined. Schools chosen for the study reflect all high schools in Gaziantep since percentage of registration to universities for the schools is almost the same for all high schools in Gaziantep. Inverse of average of 11th grade students in a class, inverse of average of weekly course hour of each 11th grade teacher, number of students taking OSS exam (University Entrance Exam), and average of attending OSS exam preparation courses are taken as inputs. Outputs of the study are several OSS results. The scores showed that any high school can determine potential increase and decrease by values. DEA is powerful tool to measure relative efficiency.

103 MEASURING “SUSTAINABLE VALUE” BY STOCHASTIC FRONTIER ANALYSIS: A COMPARATIVE STUDY FOR TURKEY

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ABSTRACT

Theoretically, to diagnose whether the sustainability reached is weak or strong, the degree of substitutability between various types of capital stock basis the main discussions. “Sustainable value”, is used to measure the efficiency of existing resource use and to define what sort of substitutability exists in the economy. In the empirical literature, studies that measure country-wise “sustainable value” is quite new and limited, and the methodology these studies employ show similarities.

In this study, “sustainable value” is measured by using stochastic frontier analysis for OECD countries, which include Turkey. The measure employs one output variable while more than one economic, social and environmental input variable are included. The main aim is to compare countries in terms of efficient resource use, to find economic, social and environmental factors that moves the country towards or away from efficient use and to calculate these factors’ impacts. Based on these findings the study is expected to have solid policy implications.

The study shows differences with respect to the methodology used and its country coverage when compared to similar empirical studies on the same issue.
104 SOCIAL AND FINANCIAL EFFICIENCY IN NGO-BASED ISLAMIC MICROFINANCE

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ABSTRACT

Islamic microfinance has been developed as a faith-based alternative to conventional microfinance for underprivileged Muslim communities; it adheres to the principle of interest prohibition in Islam by extending Islamic contract-based financing in lieu of interest-based loans extended by conventional microfinance institution (“MFIs”). It is also theoretically claimed to provide solutions to some of embedded weaknesses in conventional microfinance. However, as for MFIs, the real performance of Islamic microfinance institutions (“IMFs”) lies in meeting their double bottom objectives of social outreach and financial sustainability thus MFIs have to be efficient in these. Traditional financial ratios mainly used as performance measurement of IMFs and MFIs have not provided comprehensive picture of these efficiencies. Unlike the case of MFIs, presently there are hardly any comprehensive studies beyond those using financial ratios to analyse IMFs performance in these two objectives.

This study thus proposes Data Envelopment Analysis to measure IMFs performance in their social and financial efficiency. Using data from several developing countries, it specifically analyses NGO-IMFs as not-for-profit IMFs/MFIs have been regarded as having wider outreach due to absence of profit-maximisation motives. It studies sustainability-outreach relationship in NGO-IMFs and recommendations to improve their efficiencies.

105 CENTRALIZED RESOURCE REDUCTION AND TARGET SETTING UNDER DEA CONTROL

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ABSTRACT

Data envelopment analysis (DEA) is a powerful tool for measuring the relative efficiencies of a set of decision making units (DMUs) such as schools and bank branches that transform multiple inputs to multiple outputs. In centralized decision-making systems, management normally imposes common resource constraints such as fixed capital, budgets for operating capital and staff count. In consequence, the profit or net value added of the units subject to resource reductions will decrease. In terms of performance evaluation combined with resource allocation, the interest of central management is to restore the general efficiency value of the DMUs. The paper makes four contributions to the literature: (1) we take into consideration the performance evaluation of the centralized budgeting of hierarchical organizations along with
sales and market allocation within manufacturing and distribution organizations; (2) we address the evaluation problems that the central decision maker does not desire to deteriorate the efficiency score of the DMUs after input and/or output reduction; (3) we develop a common set of weights (CSW) method based on the goal program (GP) concept to control the total weight flexibility in the conventional DEA models; (4) we extend a new approach to optimize the inputs and/or outputs contraction such that the efficiency of all DMUs will get bigger than or equal to the efficiency of previous change. We ultimately present a numerical example involving with three inputs and two outputs to illustrate the applicability and efficacy of the proposed approach.

106 ON FINDING THE BEST PERFORMER IN DATA ENVELOPMENT ANALYSIS

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ABSTRACT

In standard models of data envelopment analysis (DEA), the best-performers have full-efficient status and from the experience, we know that more than one unit have this efficient status. To discriminate between the performances of full-efficient DMUs is one of the most frequently studied and interesting research subjects. Different authors have studied the problem of finding best-efficient DMU from different viewpoints. However, as far as we have understood, there is no explicit definition on the best efficient DMU. An explicit or implicit criterion to define the best-performer is missed in all of the previous studies. So, different approaches have introduced different units as the best efficient unit. All of the proposed models choose one of the efficient units as the best efficient and there is no guarantee that the best efficient introduced by these methods are really the best. In some cases, a super-efficient DMU is introduced as the best efficient and in some other cases the best efficient is not the super-efficient. In addition, the most of proposed approaches use the MILP models to determine the best efficient unit that are not affordable.

In this paper, in order to find the best efficient unit, we propose a simple procedure. We first provide a definition of a best efficient DMU and then using a simple calculation, the best efficient DMU is determined. Numerical examples are used to compare our procedure with existing models.
107 IMPACT OF COMPETITION ON TOTAL FACTOR PRODUCTIVITY, EFFICIENCY AND TECHNICAL CHANGE: EVIDENCE FROM TUNISIAN MANUFACTURING FIRMS

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ABSTRACT

This paper aims at measuring the impact of competition on productivity growth and on its components i.e. technical change and efficiency change in the Tunisian manufacturing sector at the firm level. We use firm data over the period 1997-2002 and a non-parametric approach to estimate TFP and its components, and we use panel data econometrics, to determine the effects of competition. Our results suggest that the dominant driving force of TFP was technical efficiency. The second source of total factor productivity growth which is technical change plays a negative role in the productivity growth until 2000; a timid technological progress was observed after 2000 in the Tunisian manufacturing. We find that Competition had strongly positive effect on total factor productivity growth, efficiency improvement and technological progress. Likewise, the existence of non-linear effect of the competition on TFP and its factors is verified. At low competition level, more competition raises TFP at the firm level; yet, with high levels of competition, a rise in competition has a negative impact on productivity. The Schumpeterian effect appears and the capacity of firm to innovate decreases. To gain from competition, even at a high level of competition, Tunisian authorities must sustain firms to be more innovative.

108 EFFECT OF OIL PRICE SHOCKS ON BANKS’ PERFORMANCE

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ABSTRACT

Oil is a crucial economic element where its price fluctuation impacts on economic activities. In spite of the large body of literature which focuses on the impact of oil price shocks on the key macroeconomic variables, very few studies have investigated the effect of oil price on bank performance. This study will fill the gap in the previous literature and use two stages of analysis; the first stage employs Data Envelopment Analysis to measure the performance of banking sector in 11 Middle Eastern countries, whereas, Generalised Least Square (GLS) estimation is used in the second stage to study the impact of oil price on banking performance. The result of measured efficiency score from the first stage is used in our dataset consisting of 1406 observation from 157 publicly quoted commercial, investment and Islamic banks in during the period 2000-2011.
109  ESTIMATING EFFICIENCY AND PRODUCTIVITY GROWTH OF THE FLOUR MILLS OF THE GRAIN SILOS AND FLOUR MILLS ORGANISATION

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Stephen Ramsden, Nottingham University, United Kingdom
Paul Wilson, Nottingham University, United Kingdom

ABSTRACT

The Grain Silos and Flour Mills Organisation (GSFMO) is a monopoly milling organisation in Saudi Arabia. However, the organisation has been facing financial problems for a number of years. In addition, there is a variation in the human and machine productivity between all branches, as well as a rising trend in the costs associated with salaries, operating and maintenance costs. All the above factors are indicative of the potential for reduced economic efficiency of the flour mills to be observed.

The aim of this study is to first estimate the technical and economic efficiency (TE and EE) of nine flour mills of the GSFMO (1988-2011), using Data Envelopment Analysis (DEA) and Stochastic Frontier Production Function (SFA) approaches. Secondly, it seeks to explain variation in efficiency levels between the mills. Productivity growth for 2008-2011 is also estimated. Both primary data (interviews with branch managers) and secondary data issued by the GSFMO were utilised.

DEA results showed that under VRS, TE was greater than TE for the same branches under CRS. Regarding productivity growth results for the period (2008-2011), no consistent patterns were found across branches in the mean total factor productivity growth (TFPG), technical change (TC), and efficiency change (EC).

110  ASSESS A SET OF CENTRALIZED OPERATION UNITS WITH A COMMON SET OF WEIGHTS FOR THE MULTIPLE PERFORMANCE INDICES

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ABSTRACT

The paper is dealing with the problem that a set of centralized operation units is assessed by a set of inputs and outputs performance indices. We develop a linear programming model with the conditions that the sum of weighted input values of each operation unit is no less than it’s sum of weighted output values and with the objective function to maximize the performance for overall units to obtain the common set of weights for the set of performance indices. According to the primal and dual solutions of the model, the DM could have full ranks of the units. The model is unit-invariant for the indices. To coincide to the practical situations, one may add side conditions to the model such as virtual weight constraints and non-discretionary. An alternative model is the conditions that the sum of weighted input values of each operation unit is no less than it’s sum of weighted output values are relaxed from the model. More exciting results are explored.
111 A NEW MODEL BASED ON MEAN ABSOLUTE DEVIATION FOR EFFICIENCY EVALUATION OF TURKISH ELECTRIC DISTRIBUTION COMPANIES

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Esra Lafci, Gazi University, Turkey
Gizem Erkan, Gazi University, Turkey
Hasan Bal, Gazi University, Turkey

ABSTRACT

Data Envelopment Analysis (DEA) is a methodology that uses the linear programming to find out the relative efficiency of homogenous decision making units (DMUs) with common inputs and outputs. It is very popular method in management science and operations research. Although DEA has become a very popular method of performance measurement, it still suffers from some shortcomings. The cross efficiency evaluation is an approach to avoid these problems. Liang (2008) proposed an alternative approach to cross efficiency evaluation with using the secondary goal. In this study, we extend this idea and investigate a new model which is based on a statistical dispersion measure, mean absolute deviation. We use the new model to evaluate the electric distribution efficiency of Turkish companies in electric distribution sector.

112 A REVIEW ON ARASH METHOD IN DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Arash Method (AM) is a new technique in data envelopment analysis (DEA), which estimates the performance of decision making units (DMUs) with flexible linear programming based on additive DEA model (ADD). It is able to simultaneously discriminate between inefficient and technically efficient DMUs without using statistical techniques, super-efficiency methods or requiring additional information in the case of weight restrictions. It benchmarks both inefficient and technically efficient DMUs together. AM is also able to measure the cost-efficiency of DMUs when cost information is available. It can be extended as a non-linear programming to have all the properties of linear AM and all capabilities of Slack-based measure (SBM) model. A practical definition based on AM score not only can find the best technically efficient DMUs, where small errors occurred in their input values even if data are accurate, but also provides an assurance that “small” errors in the measurement of input quantities did not result in “large” errors in the calculation of the efficiency index, which prompted introducing the axioms of continuity. This study clearly discusses about the capabilities of AM in comparison with most of previous DEA models with some numerical examples.
113 DECISION MAKING UNITS WITH INTEGER VALUES IN DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Usually in many applications some of inputs or outputs data may characteristically be integer values such as the number of students, hospitals and vehicles. However, the traditional data envelopment analysis (DEA) models would project a decision making unit (DMU) onto targets that generally do not respect such type of integrality constraints. There are some methods in DEA to assess the performance of those DMUs with integer-valued data. This study surveys the previous Mixed Integer linear programming (MILP) and illustrates the flaw of them with some counter examples. The study improves the previous MILP models and characterizes its capabilities with a numerical example. The simulations have been also performed with Lingo11 win64 software.

114 IMPROVING THE DISCRIMINATING POWER OF DEA MODELS: APPLICATIONS OF PRODUCTION TRADE-OFFS AND HYBRID RETURNS-TO-SCALE MODELS

Victor Podinovski, University of Warwick, United Kingdom
Wenjuan Zhang, University of Warwick, United Kingdom

ABSTRACT

In this talk we discuss our recent experience with the construction of weight restrictions based on the trade-off approach, in DEA models based on variable, constant and hybrid (combining VRS and CRS) returns-to-scale technologies. This includes applications in different sectors, including education. We also highlight theoretical and methodological issues arising in such applications, and new results recently obtained to address them. We conclude by observing that the use of production trade-offs is beneficial in various applications, in particular when the observed sample of units is small.
115  ELASTICITY MEASUREMENT ON DEA FRONTIERS WITH PRODUCTION TRADE-OFFS

Kazim Baris Atici, Hacettepe University, Turkey
Victor V. Podinovski, Warwick Business School, United Kingdom

ABSTRACT
Production trade-offs in DEA can be defined as technological judgements that represent possible simultaneous changes to the inputs and outputs in the technology under consideration. They are the dual terms induced in the envelopment DEA models by weight restrictions stated in the multiplier forms. The specification of trade-offs enables the incorporation of additional knowledge about the production process in the DEA models. In this paper, we aim to provide the elasticity of response measurement on DEA frontiers in the case where production trade-offs are incorporated in the given technology. Recently, elasticity of response measures for DEA frontiers has been developed for both CRS and VRS technologies. Obviously, the introduction of the production trade-off relations to DEA linear programs causes changes in the production possibility set considered and the efficient frontier obtained. Such a consideration brings up a need for new theoretical developments in the calculation of elasticities of response between inputs and outputs. Progressing upon recent work about elasticity measurement, in this paper, we extend elasticity measurement theory to the technologies that incorporate production trade-offs. We illustrate the proposed theory in a real world agriculture case and discuss the results.

116  DEA APPLICATION IN BRAZILIAN ENERGY TRANSMISSION SECTOR

Tiago Soares, Furnas, Brazil Ana Lopes, UFMG, Brazil Angélica Baptista, CEMIG, Brazil
Rajiv Banker, Temple University, United States

ABSTRACT
On 10/24/2012, ANEEL, the Brazilian Regulatory Agency of Electrical Energy, sent to the Ministry a study proposing the methodology Data Envelopment Analysis - DEA to determine the efficiency of electricity transmission companies operating in the country, in regard to their operating costs. This study was used in order to establish the tariffs for those companies that chosen to renew their concessions, maturing in 2015, for over thirty years. Eight companies, in a model of panel data for the years 2007 to 2011, had its regulatory operating costs measured. Variables have been considered, such as: operating costs as input, and transmission lines length, total MVA power transformer, number of transformers and number of switchgear, as products. The transmission lines length was disaggregated by voltage level and divided into 6 products. The weights of these products were limited, using a model of weight restrictions. The results arrived at an average efficiency around 51%, which was additionally adjusted for quality of service. For this adjustment ANEEL divided the 8 companies in 5 groups. The first group adjustment was 0.49, while for the others groups were 0.39, 0.29, 0.19 and 0.10, respectively. Bring the ANEEL’s model for discussion by academic community is therefore the aim of this article. There are several critics because the results of the model impacts negatively the revenues to be received by transmission companies, which gives damage for the economic and financial stability of them, since the new revenue is 33% less than the costs performed by the companies in the last year.
117 PUBLIC SECTOR EFFICIENCY AND THE PERFORMANCE PARADOX

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ABSTRACT

The paper focuses on the public sector efficiency and the performance paradox. The concept is divided into three parts: theoretical background, empirical evidence and findings. The efficiency of public expenditure has been analyzed in the OECD countries. The theoretical part presents literature review, main thesis and goals of the study. The conventional wisdom has been discussed and the major factors which might differentiate efficiency scores have been separated. The variety of methods and efficiency indicators have been taken into account. After conceptual part the DEA efficiency has been computed with DEA method tools. In the last part I discuss the reasons contrasting efficiency scores and formulate findings.

118 BETTER QUEUE MANAGEMENT USING DEA: AN APPLICATION IN A LARGE PUBLIC HOSPITAL

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Ali Emrouznejad, Aston University, Birmingham, UK, United Kingdom
Prasanta Kumar Dey, Aston University, Birmingham, UK, United Kingdom

ABSTRACT

Queue management is considered as one of the very important criteria which define the performance and efficiency of any service industry, including healthcare. DEA has numerous applications in healthcare. However, it has not been used before for efficiency measurement where waiting time is one of the criterion involved.

This paper applies Data Envelopment Analysis (DEA) for better queue management in the field of healthcare. This empirical study will be carried out in the largest Armed Forces hospital of Pakistan, the Military Hospital (MH), Rawalpindi. The objective is to suggest propositions which can be utilized by healthcare institutions in other developing countries having similar bottlenecks in the patient flow and where appointment system cannot be implemented.
119 ELECTRICITY EFFICIENCY OF TURKISH CITIES AND ELECTRIC SUPPLY INDUSTRY

Nevin Koc, Gazi University, Turkey
Kadir Onur Dağdeviren, Gazi University, Turkey
Hasan Bal, Gazi Univeristy, Turkey

ABSTRACT

Data envelopment analysis (DEA) has been used commonly in a variety of fields since it was developed, and its development continues through interacting with other techniques. Since the method can be applied to multiple inputs and outputs, it interacts with multivariate statistical methods. Principle component analysis (PCA) is a multivariate analysis method used to destroy the independence structure between variables or to reduce the number of dimensions. In this study, we used both DEA and PCA methods for ranking Turkish cities and electric supply industry according to electricity efficiency.

120 INVESTIGATION OF ELECTRICAL ENERGY EFFICIENCY OF TURKEY BY THE DATA ENVELOPMENT ANALYSIS

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Onur Dönmezcelik, Republic of Turkey Ministry of Energy and Natural Resources, Ankara, TURKEY, Turkey

ABSTRACT

Data Envelopment Analysis (DEA), as introduced in Charnes, Cooper and Rhodes, is a methodology for the assessment of relative efficiency of a homogeneous set of decision making units (DMUs) that use several inputs to produce several outputs. DEA applied to a wide range of fields. Especially transportation (airports, airlines), health (hospitals), education (schools, universities), government (municipalities, governments), finance (banks), energy (power plants, electrical services) and industry (factories) can be used in this method. In recent years, DEA also has been used widely in the field of electrical energy. However, these applications are almost negligible for the electricity sector in our country. Turkey is one of the world's most quickly growing energy markets with rapidly growing economy. In addition, Turkey is facing an increasing demand in the all areas of the energy sector, accordingly in the electricity sector today. In this context, the classical DEA could be used for giving the right decisions in the area of electricity for the administrations, these decisions are very important to decide the future energy policy.
121  THE STUDY OF ENVIRONMENTAL PERFORMANCE IN DONGGUAN'S PULP AND PAPER INDUSTRY

Min Dai, School of Economics, Jinan University, Guangzhou, China, China

ABSTRACT

This study’s ultimate goal is to analyze environmental performance index (EPI) at firm level. In order to assess the environmental performance of enterprises in the traditional pollution-stack industry-pulp and paper that produce both good and bad outputs, this study utilizes data about their smoke, ammonia, sulfur dioxide, chemical oxygen demand, industrial waste water and air to construct the EPI. As an empirical application, the method is applied to a case study of the pulp and paper industry in Dongguan, China, from 2003 to 2009, to demonstrate how the EPI can provide initial perspectives on trends in multiple emissions by pulp and paper mills. Although each of the approaches has strengths and weaknesses, DEA has often been criticized because it is “deterministic” and fails to account for noise in the data. With too many missing values in the original data, we delete the enterprises whose data can’t be recovered and use a Bayesian approach to impute the rest. Furthermore, this paper also presents smoothed bootstrap methodology for constructing confidence intervals for the weighted and unweighted geometric means of DEA and econometrically estimated industry index through part of enterprises .The procedure is nonparametric since no distributional assumptions are required. This analysis can serve as a benchmark for current pulp and paper making operations, and the findings are employed to draw policy implications for environmental protection and shed light on sustainable development in the pulp and paper industry.

122  RANKING OF TURKISH AIRPORTS USING MOORA AND DEA

Hamit Alper Durak, Gazi University, Turkey
Esra Öztürk, Gazi University, Turkey
Hasan Bal, Gazi University, Turkey

ABSTRACT

Airports have very important role on a country’s economic development. Today, air transportation is a popular way to reach from one place to another place. Turkey’s transportation sector has made great achievements in recent years. In this study, 39 Turkish airports’ efficiencies are evaluated by data envelopment analysis (DEA) and multi-objective optimization on basis of ratio analysis (MOORA). Turkish airports are also ranked according to these two methods and the results are compared
123 EFFICIENCY MEASUREMENT OF PORT HINTERLAND TRANSPORT WITH A COMBINED AHP-DEA-MODEL

Verena Flitsch, Hamburg University of Technology, Germany

ABSTRACT

Accompanying the rise of containerization in goods transport after the invention of the container ship by Malcom McLean in 1956 the role of ports changed. From being simple start and ending points in shipping, container ports developed to become critical nodes in international supply chains. In recent years, DEA has been mainly applied to measure the efficiency of individual organisations in ports such as terminal operators or port authorities. The hinterland connection has been disregarded. Therefore, the aim of this research project is to apply a process-based DEA model combined with Analytical Hierarchy Process (AHP) to assess the efficiency of container port hinterland transports. First, the transformation process in port hinterland transport is determined and a reference process is derived. Second, mathematical DEA model selection is of special concern. Third, a process-based DEA model is set-up. In cooperation with partners from the port industry the model will be implemented and empirically validated.

124 EFFICIENCY OF R&D EXPENSES BY USING DATA ENVELOPMENT ANALYSIS (DEA)

Melih Gunes, Gazi University, Turkey

ABSTRACT

Research & Development play a crucial role in the development of countries. In this sense, the ratio of r&d expenses in incomes of countries is an important indicator. In this study, data development analysis is used considering three variables related to 16 countries. GDP and per capita purchasing power are considered as input, and the portion of r&d expenses in GDP as output.

125 SCORING THE WORLD BANKING SECTOR SINCE THE FINANCIAL CRISIS

Mahmut Karayel, Alta Bering Management Technology Consultants, United States

ABSTRACT

We created two different scores for selected banks from North America, Turkey and Europe. The risk score and the profitability score are both based on quarterly data. We observe that our scores are a short term predictor of market performance. Further, we observe that the average score of the population is a short term predictor of industry performance. We claim the reason for this is that the volatility in the fundamental data is observable before the
volatility in the stock price is observed. During the volatile times the dispersion of scores are wider, anchoring one end on the perfect score, hence the average score is lower. We show that, looking at a segmented picture of risk score and profit score offers better insight than either looking at only one of these scores or creating a DEA model with numerous variables that covers both aspects of performance.

126 ENTERPRISE PERFORMANCE OPTIMIZATION SOFTWARE

Mahmut Karayel, Alta Bering Management Technology Consultants, United States
Mehmet Gozol, Alta Bering Management Technology Consultants, Turkey
Onur Bilgili, Alta Bering Management Technology Consultants, Turkey

ABSTRACT

We will give a tutorial introducing Alta Bering's EPO software via two real life examples. EPO is a platform that facilitates the target setting (budgeting / resource allocation) process in large organizations based on Data Envelopment Analysis (DEA). As the intended user is a corporate analyst or an analytical manager, EPO's emphasis is data visualization. We will demonstrate corporate budgeting as a process:

a) Set up the data in "Performance Warehouse" which facilitates communication with data sources, cleaning and filtering of data, statistical analysis and correlation based analytical tools, and visualization of data. This is also where the analyst would decide to segment the data to compare like-for-like or to focus on a certain segment.

b) Build a comparative analytics model in "Model Construction". The user sets up and executes the EPO here. Constant and Variable Returns to Scale (VRS and CRS) and Slack Based optimization (SBM) are implemented. Easily setting up leaues (peeling of the frontier) facilitates reasonable targets. Side constraints are allowed that allows management intervention (e.g., "A Branch’s total staff may not increase more than 2 FTE", or "A salesperson’s sales target should not increase by more than 40% in one year", etc.)

c) "Managed Targets" allows the corporate analyst to reconcile EPO targets to top-line budgets: (e.g., The Western region's total sales target should not exceed 30% of the overall company’s sales target.) EPO uses a dynamic programming-like algorithm here that tries to satisfy all the rules while keeping the solution as close as possible to the EPO solution.

d) "Intelligent Targets", most popular with managers, allows users to visualize the efficiency results, targets, actual data, all graphically by any slice or dice comparison. For example, whether the Managed Target rules are satisfied can be visually and quickly checked here. Comparison of optimized targets to actual data (historical situation depicted by the data) is the primary focus.

e) EPO can "Publish" the publish targets to an Excel spreadsheet, a desktop SQL database, or a corporate database (with appropriate security credentials).

The software will be available to the attendees of this tutorial.
A DEA MODEL TO ASSESS THE FAMILY DOCTOR PERFORMANCE FOR THE DIABETES MELLITUS CLINICAL PATHWAY

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Naleef Fareed, Virginia Commonwealth University, United States
Elena Tanfani, University of Genova, Italy
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ABSTRACT

In most National Health System, especially when universal coverage is provided, family doctors act as gatekeepers because almost all healthcare services (e.g., diagnostics, hospital, and drugs) are only delivered if there is a formal prescription provided by a primary care doctor. Although the flow of healthcare resources is primarily initiated by the prescriptions made by family doctors, studies that evaluate their performance, especially those using a consolidated methodology (e.g., quality and efficiency), are scarce an in the corpus of the health services literature. In this context, the specific aim of this paper is to propose a method for assessing primary care performance.

The novelty of the proposed model is twofold. First, physician performance is assessed following a clinical pathway point of view that focuses on homogeneous groups of patients, which are in this case those affected by diabetes. Secondly, we argue that performance should not be limited to efficiency (the economic point of view), but should also refer to effectiveness (the clinical point of view).

The efficiency assessment is not based on the family practice as a whole, but on a single disease. In particular, the paper refers to diabetes as a chronic pathology that rapidly increases with the aging of the population. Data from a sample of family physician practices in Italy are collected, and a non-parametric method, Data Envelopment Analysis, is used to evaluate their efficiency performance. The results from the study evaluation found 35 practices out of 96 that were efficient based on the standard DEA model. The number of efficient practices decreased based on three restricted models that explored various behavioral preferences of physicians in relation to patient visits, medication administration, and referrals to hospitals.

The efficiency assessment is completed by a post-hoc evaluation of effectiveness, which in this study’s case is defined as patients’ adherence to prescribed guidelines (i.e., appropriateness). This assessment identified only two practices that were high in efficiency and high in appropriateness. The methodology used in this paper is generalizable and could be applied to many other chronic conditions, which may constitute the prevalent activities within the primary care realm.
DEA-EFFICIENCY OF TRADITIONAL FARMING WITH CONSIDERATION OF GRASSLAND BIODIVERSITY: THE CASE OF THE UKRAINIAN CARPATHIANS

Irina Solovyeva, Justus-Liebig University, Germany
Ernst-August Nuppenau, Justus-Liebig University, Germany

ABSTRACT

Land abandonment and/or agricultural intensification are the most probable scenarios which could be expected for remote mountainous areas in Eastern Europe. Both of them can be a threat to the situation existing in the rural areas of the Ukrainian Carpathians where a high degree of connectivity between farming activities and the ecosystem still exists. In this area certain agricultural practices are more conducive to biodiversity than others. In the paper we aim at building an economic-ecological model to evaluate the efficiency of farming performance in this area with special consideration of such positive environmental externality as grassland biodiversity. DEA (Data Envelopment Analysis) is considered as a suitable method for this evaluation and for identification of the farming management patterns which are most efficient from economic and environmental perspectives. The data from socioeconomic and geo-botanic surveys conducted in the Ukrainian Carpathians were used to show how the method can be applied to evaluate the farming efficiency at the research sites. This paper is a contribution to the development of the DEA method for the purposes of evaluation of environmental aspects in agricultural production and a trial to analyse economic and environmental performance of farming practices which produce such positive externality as biodiversity.

MEASURING THE PRODUCTIVITY OF TELECOMMUNICATION: A COMPARISON FOR THE COUNTRIES OF EU AND TURKEY

Ferdane Burcu Karayazlı, Gazi Üniversitesi, Turkey

ABSTRACT

With advanced technology, Telecommunication has become an important part of the world economy. By taking the base years 2007, 2008, 2009, 2010, 2011, efficiency and total factor productivity of member states of EU and Turkey and their performances by using Data Envelopment Analysis and Method of Malmquist total factor productivity index are indicated in this study. To be determinate the input and output, literature research is used. Also, there is 1 dummy variable and 3 output variable which are determinated. The former is equalized to 1 for all countries. The latter is made from fixed(wired) broadband subscriptions, percentage of individuals using internet and mobile cellular telephone subscriptions. For 28 countries which are choosen as decision- making units, the model of CCR is solved as the output oriented. In addition to this, with the Malmquist Index, countries’ total factor productivity is calculated.
130  AN IMPROVED RANKING FOR DECISION MAKING UNITS USING
OPTIMISTIC AND PESSIMISTIC APPROACHES

Abdullah Aldamak, Ryerson University, Canada
Saeed Zolfaghari, Ryerson University, Canada

ABSTRACT

The standard data envelopment analysis (DEA) model usually evaluates decision making units (DMUs) using the best relative efficiency approach. This approach is known as the optimistic approach and it is very common that this model returns many units with 100% efficiency scores, making it hard to rank these efficient DMUs. More often decision makers are interested in reaching a complete ranking to all DMUs in the data under evaluation. Many ranking methods were proposed in DEA literature. In this paper, a new ranking method is proposed to achieve a better ranking. The method combines optimistic and pessimistic approaches with the virtual DMUs approach. Two virtual DMUs are introduced to any data set in order to adjust the efficient and inefficient frontier lines to envelop more units. Then optimistic and pessimistic approaches are applied and combined by using a DEA index number (AIN) and arithmetic average to compute the final score of each DMU in the data under evaluation. It is found that combining the pessimistic/optimistic approaches with the “super” and “worst” virtual DMUs returns a better ranking and higher discrimination power of the DEA model. Two illustration examples are provided with two dimensional data and multiple dimensional data.

131  A COMPARISION OF DEA AND MCDM METHOD: A CASE STUDY.

Ahmet Öztel, Bartın Üniversitesi İ.İ.B.F., Turkey
Mehmet Said Köse, Bartın Üniversitesi İ.İ.B.F., Turkey

ABSTRACT

In this study proposed use of DEA for solving Multiple Criteria Decision Making (MCDM) problems and were compared with other MCDM methods. For this purpose, were evaluated a company's sustainability performance and results compared.
132 THE DEA AND FUZZY AHP APPROACH TO HEALTH-CARE ORGANIZATIONS' PERFORMANCES

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Gül Didem Batur, Gazi University, Turkey
Ender Sir, Adana Military Hospital, Turkey
Serpil Erol, Gazi University, Turkey

ABSTRACT

This paper processes of Fuzzy AHP and Data Envelopment Analysis (DEA) to select the units with most efficiency. The research deals with an actual application of health-care organizations. This research is a two-stage model designed to fully rank the organizational alternatives, where each alternative has multiple inputs and outputs. DEA and Fuzzy AHP ranking do not replace the DEA classification model; rather, it furthers the analysis by providing full ranking in the DEA context for all units. To achieve this goal relative efficiencies of the selected health-care organizations are obtained by means of a detailed pair-comparison.

133 CARBON EFFICIENCY EVALUATION UNDER IMPRECISE AND ASYMMETRIC INFORMATION

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ABSTRACT

Carbon efficiency evaluation requires careful consideration on the form and data that are not necessarily crisp in nature. Since outputs can be both desirable and undesirable in environmental models, the asymmetrical nature of the inputs and outputs plays an important role in providing an accurate ranking of efficiency scores. This paper proposes a fuzzy ranking method based on the DEA framework that handles both symmetrical and asymmetrical fuzzy numbers. The proposed method allows the carbon evaluation to be evaluated at different -levels. In order to illustrate the performance of the proposed method, it is tested against two numerical examples and compared with the results obtained from alternative methods. An application of energy dependency among 23 European Union (EU) member countries is further used to validate and describe the efficacy of our approach under asymmetric fuzzy numbers.
134 USING THE DATA ENVELOPMENT ANALYSIS CCR MODEL TO MEASURE TECHNICAL EFFICIENCY OF OIL REFINERIES

Oday Jarjies, Musol University, Iraq
İhsan Alp, Gazi Univeristy, Turkey

ABSTRACT
This paper is to approach the data envelopment analysis (DEA) To measure the relative efficiency of oil refineries in Iraq during the period of three years, 2009, 2010 and 2011. The study shows that DEA is an effective tool for the Ministry of Petroleum (MOP) to monitor the performance of oil refineries. In order to grow as one of the most important sectors in Iraq, The authors followed a case study methodology where data about the inputs and outputs of refineries are gathered and analyzed to compute the relative efficiency of the refineries. Based on the results obtained, 66.6% of the refineries were efficient in 2009, while 58.4% of them were efficient in 2010, and 75% of them were efficient in 2011 and the overall efficiency of the refineries studied was about 80%, 72% and 90% respectively. A project methodology where data about the inputs and outputs of refineries are gathered and analyzed to compute the relative efficiency of the refineries. In the oil sector in Iraq, this paper shall augment our knowledge on how oil refineries in Iraq may apply DEA to measure their efficiency, and how they might use the results to overcome efficiency problems. The results of the present paper are limited to the oil refineries studied; the DEA approach could trigger the attention of policy makers in the MOP to apply DEA to improve their efficiency of other DMUs.

135 I-MEET FRAMEWORK FOR THE EVALUATION OF E-GOVERNMENT SERVICES FROM ENGAGING STAKEHOLDERS’ PERSPECTIVES

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Abdel Latef Anouze, Olayan School of Business, American University of Beirut, Lebanon
Nitham M. Hindi, College of Business and Economics, Qatar University, Qatar
Zahir Irani, Brunel Business School, Brunel University, United Kingdom

ABSTRACT
I-MEET is an Integrated Model for Evaluating E-government services Transformation from stakeholders’ perspectives. It is based on an integration of concepts from value chain management and business process transformation to optimize the system-wide value chain of providers and users simultaneously. It aims to align stakeholders on a common global value against local disintegrated approaches where each stakeholder optimizes its e-service value at the expense of others. The measured variables are derived from the literature and focused groups. The identified variables are then categorized into Inputs and Outputs after a statistical validation using Structured Equation Models on pilot data collected on a sample of e-services in Qatar, Lebanon and UK. Finally, the Data Envelopment Analysis is conducted to derive an aggregated value of an e-service from the various inputs and outputs measures. Finally, the DEA values on e-service are further analysed with respect to the characteristics of the stakeholders using a data mining approach. The novelty of the combined assessment results is the capability of providing suggestions for strategic improvement of an e-service from all engaging stakeholders’ perspectives to transform public administrations and to assist the interactions of governments with citizens, businesses and other government agencies.
**136 STATISTICAL SUMMARY OF DEA 2013**

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Mehmet Unsal, Gazi University, Turkey  
Hasan Bal, Gazi University, Turkey

**ABSTRACT**

As an alternative to a famous quote about statistic; there are three kinds of facts; lies, damn lies and statistics. The difference of statistics from the others is the question asked. The expected answer of true and clear questions will always be true. Hence, we are asking questions about DEA2013 in different point of view and give various answers according to “what the question really meant” and “what we really want to ask”. In this aspect, our study is a good guide to authors that are arranging a conference and to young researcher about scientific method. We will make a statistical summary of DEA2013 conference by graphics in various points like authors, countries, key words, organizations etc., phase by phase and give formulas for clarifying the results in each phase.

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**137 USING OF FRACTIONAL FACTORIAL DESIGN (R K-P) IN DEA TO SELECTION**

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Hulya Bayrak, Gazi University, Turkey  
Kubra Durukan, Kırıkkale University, Turkey

**ABSTRACT**

Data envelopment analysis (DEA) is a linear programming based technique for measuring the relative performance of organisational units where the presence of multiple inputs and outputs makes comparisons difficult. We used [5] propose after it has been developed an input - output selection method that uses fractional factorial design, which is a statistical approach to find an optimal combination. Energy efficiency and greenhouse gas emissions are closely linked in the last two decades, we demonstrate the proposed method using data that increase energy efficiency and heating gas emissions in the EU countries.
138  A SURVEY OF DYNAMIC DEA MODELS

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Fernanda Rocha, Federal University of Rio Grande do Norte - UFRN, Brazil
Daniel Aloise, Federal University of Rio Grande do Norte - UFRN, Brazil

ABSTRACT

This research aims to present the development stages of the dynamic modeling in the context of data envelopment analysis (DEA). Classical models of DEA measure the systems' performance in a static way and independent over the time, assuming the inputs and outputs as fixed. The complexity of current production systems, traditional DEA models can’t capture the effects of time concerning to the processes and sub-processes of organizations. However, dynamic models operate considering the interrelationships in modeling (structure), which enables more accurate measurements of overall and periods efficiency. For conduct this survey, it was noted in the literature different dynamic models between the period of 1994 to 2014. The results showed a recent development of models with computational gains, the usage of complementary techniques to obtain more reliable results and also a indication of the different applications of this theme in managerial decision making.

139  EVALUATING AND PREDICTING BANK PERFORMANCE: A HYBRID APPROACH OF TREE-BASED ENSEMBLE METHODS AND DATA ENVELOPMENT ANALYSIS

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ABSTRACT

Performance evaluation essentially identifies anomalies and inadequacies in the management strategy thus making it a vital part in any bank management. On the other hand, it delivers solutions for inefficient banks to aid them in improving those of the efficient ones. Modern banking manager’s era of complex environment plays a fundamental role in deciding their relative efficiency by operating in a rather dynamic atmosphere. Hence, investigating the role of environmental variables is a necessity in determining the overall performance evaluation. In a situation where there is a few number of variables, the researcher can use the second stage analysis. However, the available methods would be of limited use when the number of variables is fairly large. In the following paper, we propose an integrated frame combining hybrid tree-based methods, Data envelopment analysis (DEA) and logistic regression to study bank performance, and then we apply it on a sample of MENA banks. In simpler terms, Data envelopment analysis is used for computing the efficiency of a bank. Inasmuch as tree-based ensemble methods are used to identify the most important environmental variables for bank efficiency, and ultimately logistic regression is used to predict the bank efficiency and to imperatively sketch its association with the selected environmental variables.
EXPENDITURES ON SECURITY IN BRAZILIAN STATES

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Fernando Gonçalves Castanheira Junior, UERJ, Brazil

ABSTRACT

This paper aims to analyze the efficiency and effectiveness of public expenditures on security (PES) in the Brazilian states during the period 2005-2008. We show that low efficacy and non-statistical significance of PES found in the literature can be explained by inefficient use of these resources. We used Data Envelopment Analysis to estimate the relative efficiency between the Brazilian states, producing a ranking of efficiency. The inputs were public expenditures on security per capita and public expenditures on security per homicide. The output was homicide rates. By using statistical procedures, we divided the sample into two groups: efficient and inefficient states. So, we could estimate econometric panel data models for the two samples and in the original model. In the econometric models we used homicide rates as dependent variable. Among the covariates we were especially interested in public expenditures on security (PES). Other covariates were GDP per capita; educational levels; poverty; unemployment rates; Gini Index; single-parent families; and urbanization. A main finding is that the PES are statistically significant and can reduce homicide rates only in those DMUs (states) assessed as efficient in our DEA models.

A NEW GENERALIZED DEA MODEL TO ALIGN A PREDEFINED INDEX

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ABSTRACT

In this paper, a new generalized data envelopment analysis (DEA) model is developed to present an arrangement of the model based on a predefined index. In the generalized DEA approach developed in this paper there is no flexibility of choosing inputs and outputs but the selections of weights restrictions among with some defined weights restrictions are as flexible as possible in the sense that a selection is done to maximize the correlation of the vector of the obtained efficiencies and the vector of the predefined index for all DMUs. The aligned model has more discrimination in comparison with CCR model. The scale difference of these two models defines a new factor in the Malmquist index decomposition, which can be used to show the effect of the predefine index in the productivity changes.
**ABSTRACT**

Turkey adopts export led growth model after 1980 and has currently 19 free zones. Free trade zones are attraction centers for foreign investors and for domestic investors who wants to direct their vast majority of production to export. The purpose of government incentives given to these regions is to increase encouraging exports and foreign direct investments. The effectiveness of free trade zones plays a great role on the decision of the number and structure of potential free zones in future. Relative performances of 11 free zones which have most employment ratio are compared with data envelopment analysis and the results are examined.

**ABSTRACT**

One research issue in the context of Data Envelopment Analysis (DEA) is the problem of nondiscretionary factors and undesirable outputs in production process. Given difficulties in both model construction and data availability, very few published paper simultaneously consider the above two issues. This paper attempts to make a closer look by applying DEA-based performance evaluation models to treat multiple nondiscretionary factors in presence of undesirable outputs.

**ABSTRACT**

This paper aims to present an implementation of classical DEA models in the environment R. Data Envelopment Analysis has a variety of models ranging from the classics DEA models up to approaches that combine the DEA models with methods such as the Monte Carlo simulation, statistical models and fuzzy logic.
There are several computational programs dedicated to the DEA, ranging since the commercial softwares up to webpages. Additionally, the DEA models can be programmed into the electronic spreadsheets or any other computer language. This latter alternative is interesting because it offers flexibility in the implementation of DEA models. The advent of the R program, a free software and open source, highly extensible, offers a variety of functions for data analysis and graphics routines through native functions or obtained in the R packages distributed on the Internet. Through the R the analysts can obtain low-cost solutions and free of restricted options offered by the dedicated DEA programs. We show both CCR and BCC DEA models in the multiplier and envelope forms, output-oriented or input-oriented. We also discuss the possibilities to extend the implementation of more sophisticated DEA models on R platform. We use inputs and outputs from Brazilian electricity distribution utilities.
# DEA2013: SESSIONS PROGRAM

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**Chairman:** İhsan Alp

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Chairman: Serpil Erol

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Chairman: Ana Lopes

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Chairman: Lei Chen

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**TEPE 4**

Chairman: Joshua Ignatius

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*Chairman: Yüksel Bek*

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**TEPE 4**

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**TEPE 5**

Chairman: Serpil Erol

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**Chairman:** Francisco Vargas

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### SESSION VII (Theory&Modelling)  SUNDAY (30 June 2013)- 10:30-12:00

#### TEPE 2

**Chairman:** Victor Podinovski

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**TEPE 5**

**Chairman:** Reşat KASAP

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