



**13<sup>TH</sup> International Conference**  
**on Data Envelopment Analysis**

**Book of Abstracts**

## Session 1

Tuesday 25<sup>th</sup> August, 2015

10:45–12:15

Energy and Regulation; Chair: Tore Langset Parallel Venue 1: SN 19.2	
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Performance Evaluation of Urban Water Supply Utilities in China</b> P039 <b>Minzhe Du, Bing Wang</b></p> <p>Based on Data Envelopment Analysis (DEA) additive model, this paper is an effort to develop a Bounded Adjusted Measure (BAM) model that uses a non-radial Luenberger productivity index to estimate dynamic productivity jointly with undesirable outputs. The BAM model can overcome the lack of discriminatory power of the Range Adjusted Measure (RAM) regardless of the returns to scale. Then we employ it to evaluate the performance of urban water supply utilities by using panel data for 209 cities in China over the period 2000 to 2012. The results reveal that in general, the level of productivity, efficiency and technology have been significantly improved over the past 13 years. The performance of water supply utilities in the developed cities is better than those in the less developed cities. Among them, the higher the degree of privatization of the urban water supply utilities, the better the performance.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Measuring Environmental Efficiencies of the 29 Chinese Provinces: Application of Three-stage DEA</b> P221 <b>Hailing Zhao</b></p> <p>This study applies a three-stage DEA to measure the environmental efficiencies of the 29 Chinese provinces from 2003 to 2012. The per capita GDP, proportion of secondary industry, units of GDP energy consumption, environmental regulations, and trade openness are treated as influence factors. The results show that the environmental efficiency of each province is improved after excluding environmental influences and random shocks. Compared with the results obtained in the first stage, the average of entire environmental efficiency increases by about 8%. There are 6 entirely efficient provinces in the first stage, while 9 provinces are environmentally efficient in the third stage. Furthermore, the environmentally efficient provinces are mainly located in the eastern region. The differences in the environmental efficiency figures amongst each region decrease after adjusting the data. Also, the nine year study shows that the influence factors have a remarkable effect on output's slacks.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Slacks-based Inefficiency Evaluation for China's Regional Industrial System with Undesirable Output Using a Network DEA Model</b> P060 <b>Yanmin Shao</b></p> <p>Since the reform and opening up of China, the industry has developed rapidly, and it is also the main resource of energy consumption and environmental problems. The industry accounts for about 70% of the country's environmental pollution. To achieve the sustainable development of the industry, improve the economic production efficiency and reduce the environmental pollution, it is necessary to evaluate the industrial production efficiency and environmental governance efficiency, and identify the source of inefficiency, then, provide suggestions on the improvement of the production and management. In this paper, after selecting the corresponding input and output variables, a network DEA model is proposed to evaluate the regional industrial economic production efficiency, wastewater treatment efficiency, and waste gas treatment efficiency after analyzing the industrial production system. Finally, this paper analyzes the efficiencies' spatial distribution and their determination.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>The Returns to Scale Assumption in Incentive Rate Regulation</b> P258 <b>Rajiv Banker, Daqun Zhang</b></p> <p>This paper challenges a common (though not universal) practice of maintaining the assumption of constant or non-decreasing returns to scale (CRS or NDRS) for benchmarking of local monopolies in incentive rate regulation. We consider the situation when firms get larger by acquiring customers that are costlier to serve, but detailed data on different types of customers are not available to regulators. If the output is specified only in terms of total number of customers or total sales (in monetary or quantity terms) without explicitly capturing the impact of different types of customers who may have different marginal costs, then we show that the estimated production function will appear to exhibit variable returns to scale (VRS) with a region of increasing returns followed by a region of decreasing returns to scale even when the true production technology has CRS or NDRS. This apparent region of decreasing returns is only an illusion caused by the mis-specification of the variables in the production function. We demonstrate the magnitude of the distortion in the efficiency of individual firms with extensive Monte Carlo simulation experiments. Our simulation results indicate that in most scenarios the VRS model performs much better than the CRS or NDRS models or a NDRS model that corrects for customer mix only in the second stage. These insights also caution scholars studying efficiency of different organizations in a broad range of contexts beyond regulation. When detailed data on all inputs and outputs are not used, the VRS production model needs to be employed without imposing any restrictions on returns to scale such as CRS or NDRS.</p>

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<b>Theory and Modeling; Chair: Mehdi Toloo</b> <b>Parallel Venue 2: SN 19.3</b>	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Fuzzy Multi-Period Efficiency Measurement with Weight Restrictions</b> P040 <b>Shiang-Tai Liu</b> In measuring the overall efficiency of a set of decision making units (DMUs) in a time span covering multiple periods, the conventional approach is to use the aggregate data of the multiple periods via a data envelopment analysis technique, ignoring the specific situation of each period. In the real world, there are situations that the observations are inexact and imprecise in nature and they have to be estimated. This study proposes using a relational network model to take the operations of individual periods into account in measuring efficiencies. The input and output data are treated as fuzzy numbers. Moreover, the assurance region approach is utilized in the model to reduce the weight flexibility. The overall and period efficiencies of a DMU can be calculated at the same time, and since the observations are fuzzy, the derived overall and period efficiencies are fuzzy as well. We show that the fuzzy overall efficiency is still a weighted average of the fuzzy period efficiencies.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Two Different Approaches to Stochastic DEA</b> P031 <b>Ole Bent Olesen, Niels Christian Petersen</b> Focus is on different views on extending DEA to a stochastic setting. The Management Science (MS) framework does not have as its focus to model deviation from the best practice frontier using a statistical model, i.e. a specific Data Generating Process (DGP). Stochastic DEA related to the MS framework focuses on incorporating measurement error (and possibly random inefficiency) into the reference technology, e.g. by replacing the observed input output observations with DMU specific distributions. The statistical (or econometric) framework insists on an axiomatic approach to a statistical model including a specification of a DGP. Data is regarded as a sample from a large population and a consistent estimator is important, since the impact from sampling noise on the estimated efficiency scores is needed. We illustrate the substance behind these differences in arguments and the critical attitude of each of these two "competing" frameworks towards the "other" framework.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Selecting Best Supplier by Advanced Cross-Efficiency (ACE)</b> P021 <b>Elham Rostamiyan, Franck Komi Adjogble, Behdad Vatani</b> In the competitive trade world, choosing the best supply chain is a vital problem. One of the most important processes performed in enterprises today is the evaluation, selection and continuous measurement of suppliers. In this paper we want to use advanced cross-efficiency (ACE) to select best supplier. Recently, Jahanshahloo et al. (2011, 544–549) proposed the use of symmetric weights for computing the elements of cross-efficiency matrix. In spite of fact that the proposed method decreases the number of zero weights, a large number of zero weights among input and output symmetric weights may still exist. To this end, this paper improves the proposed secondary goal model. The improved method generates more acceptable results in the ranking process of the decision-making units. Finally, a numerical example is provided to illustrate the applicability of the proposed method to find best supplier.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>A Bio-Objective Data Envelopment Analysis Model Using a Common Set of Weights</b> P193 <b>Adel Hatami-Marbini, Mehdi Toloo</b> Conventional data envelopment analysis (DEA) stems from benefit/cost theory to evaluate the technical efficiency of units as the ratio of weighted outputs to weighted inputs. DEA in this regard allows each unit to maximize its own efficiency under total input and output weights flexibility. However, the freedom of weights in DEA leads to distinct weights for each factor that is in question in some situations, in particular performance evaluation of centralized systems. The lack of power to discriminate between the efficient units is another issue in DEA models as well. In this paper, we develop a bi-objective common-weights DEA model involving two evaluation objectives; that is, minimizing the maximum and sum of inefficiencies to generate a common set of weights as well as to improve the discriminating power. We also show the role of lower limit on weights in the proposed model. A case study of banking industry is finally presented to illustrate the efficacy of the proposed approach.

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**Banking and Finance; Chair: Ibrahim H. Osman****Parallel Venue 3: SN 19.4**

<b>Title:</b>	<b>A New Ranking Method Based on Marginal Efficiency Contribution: An Empirical Analysis of Chinese Commercial Banks</b>
<b>Paper-ID:</b>	P015
<b>Authors:</b>	<b>Ning Zhu, Jens Leth Hougaard, Bing Wang, Zhiqian Yu</b>
<b>Abstract:</b>	In this paper, we introduce a new ranking method based on marginal efficiency contribution to overcome some shortcomings of super-efficiency ranking method. It is interested in the marginal effect of efficiency change to obtain a complete ranking. Three efficiency contribution indexes, namely marginal efficiency contribution index, individual efficiency contribution index, and average efficiency contribution index, are utilized to empirically examine the performance of 16 Chinese listed commercial banks over the period 2008 to 2012. It is found that the overall efficiency contribution of Chinese banks maintains a positive growth rate, and three efficiency contribution indexes for the large commercial banks surpass those for the small-medium commercial banks. Moreover, it reflects the diminishing effect of marginal efficiency contribution in Chinese banking industry, and the changes of marginal efficiency contribution are closing to 1.
<b>Title:</b>	<b>Technical Efficiency of the Global Systemically Important Financial Institutions (SIFI)</b>
<b>Paper-ID:</b>	P109
<b>Authors:</b>	<b>Irina Ipatova, Henry Penikas, Victoria Sapozhnikova</b>
<b>Abstract:</b>	The development of the global financial system and constantly growing influence of large financial players around the world has led to the necessity of creating the Status of Systemically Importance in 2011. The status of systemically importance is applied to those financial institutions, whose bankruptcy leads to the collapse of the whole financial system. A necessary condition for successful operation of the system as a whole is an effective performance of its components. Thus, in this paper we evaluate two following issues: if the global systemically important financial institutions are effective and whether the status enhances the efficiency of financial institutions or not. This paper uses a data set of 29 systemically important banks and 29 non-systemically important banks over the time period 2008-2014 to evaluate their technical efficiency by applying DEA method.
<b>Title:</b>	<b>Observing Choice of Loan Method in Not-for-profit Microfinance Efficiency: A Non-oriented Data Envelopment Analysis Application</b>
<b>Paper-ID:</b>	P274
<b>Authors:</b>	<b>Indra Widiarto, Ali Emrouznejad, Leonidas Anastasakis</b>
<b>Abstract:</b>	Grameen Bank Bangladesh had developed a globally-adopted group lending method in microfinance that had been commended in literatures and implemented globally. It utilises peer monitoring mechanism and dynamic incentive to lower credit risks in collateral-free loan to the poor. However, many microfinance institutions (MFIs) eventually perceive this as costly and restricting loan growth thereby resorted to traditional individual lending method to enhance sustainability. Separately, village banking method was developed to boost outreach and to create self-sustaining village microbank. This study seeks to empirically observe the loan method – efficiency relationship and to examine the best loan method globally; focusing on not-for-profit MFIs that are widely regarded as best microfinance provider. Non-oriented Data Envelopment Analysis meta-frontier approach is used for efficiency assessments of 628 MFIs from 87 countries in 6 regions, followed by Tobit regression in second stage analysis.
<b>Title:</b>	<b>The Lebanese Banking Sector: A Combined Data Envelopment and Granger Causality Analysis for Predicting a Bank Failure and Assessing Mergers and Acquisitions</b>
<b>Paper-ID:</b>	P284
<b>Authors:</b>	<b>Ibrahim H. Osman, Baydaa Al-Ayoub, Abdel Latef Anouze</b>
<b>Abstract:</b>	The Lebanese banking sector (LBS) is one of the strongest contributors to the Lebanese Economy. LBs has a continued growth since the 1990's despite the surrounding environment of national crises; regional and international conflicts. In this paper, we investigate the performance efficiency of the LBS over 17-year period from 1997-2013 using a combined approach using data envelopment analysis and granger-causality to identify the input/output variables that affect performance efficiency. In addition, we employ other financial indicators to understand the dynamic of the analyzed events. The analytical results highlighted the main features of failed banks as well as successful and failed mergers.

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**Health; Chair: Jon Chilingirian**  
**Parallel Venue 4: SN 19.7**

<b>Title:</b>	<b>Evaluation of Determinants of Health System Efficiency for OECD Countries Using Bayesian Stochastic Frontier Analysis and Bayesian Beta Regression</b>
<b>Paper-ID:</b>	P187
<b>Authors:</b>	<b>Mehmet Ali Cengiz, Emre Dünder, Erol Terzi, Serpil Gumustekin</b>
<b>Abstract:</b>	Public expenditures on health are a matter of concern for governments in most OECD countries. These expenditures have recently accelerated and are putting pressure on public budgets. Therefore, health policy makers have focused on the performance of their health systems and many countries have introduced reforms to improve the performance of their health systems. This study investigates the most important determinants of healthcare efficiency for OECD countries. There are two steps in this study. First we measure 29 OECD countries' healthcare efficiency by Bayesian stochastic frontier analysis using the data from the OECD Health Database and cover the period between 1997 and 2010. At second stage, we expose the multiple relationships between the health care efficiency and characteristics of healthcare systems across OECD countries using Bayesian Beta regression
<b>Title:</b>	<b>Trade-Off Between Hospital Technical Efficiency and Health Care Quality: Nonparametric Conditional Methodology</b>
<b>Paper-ID:</b>	P065
<b>Authors:</b>	<b>Yauheniya Varabyova, Rudolf Blankart, Jonas Schreyögg</b>
<b>Abstract:</b>	Rapidly growing health expenditures over the recent decades have put pressure on hospitals to increase the efficiency of resource allocation. One way to achieve higher levels of technical efficiency is to reduce the amount of employed staff. If lower levels of staff are associated with worse service quality, hospitals would face extremely difficult trade-offs between improving efficiency and maintaining good patient service. In order to examine a potential trade-off between efficiency and quality, we relied on conditional nonparametric partial frontier analysis of order-m. The resulting estimator does not envelop all data points and for that is more robust to outliers than the standard envelopment estimators like Free Disposal Hull (FDH) or Data Envelopment Analysis (DEA). By conditioning the efficiency estimator directly on quality indicators, we account for the influence of different quality outcomes on the shift of the frontier and the distribution of efficiency scores.
<b>Title:</b>	<b>Assessing Performance of Health Stations in Hualien County, Eastern Taiwan Using Data Envelopment Analysis and Balanced Scorecard Approach</b>
<b>Paper-ID:</b>	P096
<b>Authors:</b>	<b>Shu Chen Liu, Shinn Sun, Shing Chen Hu</b>
<b>Abstract:</b>	The purpose of this study is to assess overall and individual performances, and productivity change of the 13 health stations in Hualien County, Eastern Taiwan over 2010-2014, and examine the effects of environmental variables on the LTCSO overall performance. This study integrates Data Envelopment Analysis (DEA) and Balanced Scorecard Approach to measure four types of individual performances in terms of financial measure, customer measure, internal business process, and learning and growth measure. The study adopts outputs-oriented weighted slacks-based measure DEA to assess the of these 13 health stations. This study employs cross efficiency measure to identify the best practices in individual and overall performances, applies Malmquist index to estimate productivity change of overall performance over a five-year period. Finally, Tobit regression is used to examine effects of environmental variables. Some important managerial implications and suggestions are presented.
<b>Title:</b>	<b>Does Success Lead to More Success? An Examination of Individual Surgeon Performance Across Multiple Hospitals Using DEA</b>
<b>Paper-ID:</b>	P064
<b>Authors:</b>	<b>Andrew Wilson, Jon Chilingirian</b>
<b>Abstract:</b>	Numerous statistical studies have established a positive association between surgical volume and high performance in health care. In the U.S., high volume surgeons often practice at multiple facilities, assuming individual performance can be transferred between facilities. Hence, we address the research question--Do high volume surgeons achieve similar results irrespective of the practice setting? Using severity adjusted hospital discharge data from the Commonwealth of Massachusetts, we benchmarked surgeons' performance at hospital A with their performance at hospital B with DEA. We found that superior performance (lower lengths-of-stay and lower utilization of ancillary services) in one hospital did not result in similar performance elsewhere. The research suggests that the place where the surgeon practices may have a significant influence on performance.

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Transportation; Chair: Alessio Ishizaka Parallel Venue 5: PK 4.1	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Impact of Privatization of Ports on Relative Efficiency of Major Ports of India</b> P199 <b>Mrinal Dasgupta, Deepankar Sinha</b> Till the introduction of the liberalization process in the 1990s Indian policymakers were guided by the philosophy of self-reliance and public sector dominance. The Port sector was also no exception. All major ports were owned and operated by the government. Following the reforms of 1990s, lot of changes took place in the Indian ports including handing over of terminals of the major ports of India to the private operators. In this paper the efficiency levels of the container terminals of the major ports of India were measured for the pre-liberalization and post liberalization periods to find out the effect of privatization on the relative positions of various terminals. Data Envelopment Analysis (DEA) was used for this purpose. The study found no clear indication of the effect of privatization on efficiency levels of the container terminals. The analysis was done using DEAP software package.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Benchmarking Alternative Fuel Vehicle Using DEA: Outlier Analysis with Policy Recommendation</b> P053 <b>David Gray, Amar Nayak, Ali Emrouznejad</b> This paper develops a novel approach to benchmark Alternative Fuel Vehicles (AFV) with comparable diesel cars. Within this framework we set a DEA model with number of factors such as ownership cost, range, power, weight and miles per gallon for several of alternatively fuelled vehicles powered by electric, hybrid, fuel cell, Ethanol, and compressed natural gas. The results show that Japanese PHEV and hybrid engines developed by Honda and Toyota have the potential to outperform conventional diesel vehicles if their costs and weight are improved marginally. This study confirms that the main constraining factor of AFVs is range, and hence these technologies are still best suited for city driving (hence policy incentives must focus on increasing ownership in urban areas). From the results we recommend 1) greater financial incentives, 2) encouraging research into reducing the weight and cost of the fuel unit and 3) modifying tax regimes in favour of AFV to create a level field.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Evaluation on the Efficiency of Logistics Industry in Wuhan City Circle</b> P250 <b>Shu Liu, Lei Chen</b> Along with the rapid development of urbanization in China, there rise city circles which are beyond the traditional administrative divisions and become the basic elements of economic re-integration divisions. The Wuhan City Circle (WCC) is the core area in Hubei province on population, industry, and economy. Because logistics has the basic network service features, this existing differences restrict the economic development of the WCC. By building logistics efficiency evaluation model based on DEA method and analyzing the logistics system from internal and external efficiency, we measure the relative level of the actual urban logistics efficiency and effectiveness based on the presence of logistics differences, and analyze of causes of the differences. We found that the average variable-return-to-scale technical efficiency of logistics in the WCC region is 0.865. We provide police recommendations to promote the development of logistics in the WCC.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Fair Centralized Allocation of Resource Limitations Among Processes</b> P120 <b>Sebastian Ihrig, Claus Brech, Thomas Fliedner, Alessio Ishizaka</b> Increasingly competitive business environments force firms to strive for efficient resource usage by business processes. When setting process improvement targets, particularly cost reductions, decision makers face a tradeoff between target effectiveness and fairness. We propose a decision support approach to set improvement targets to meet a fixed overall goal. Data Envelopment Analysis is used to derive benchmarks as upper bounds to the cost reduction of each process. Under the assumption that processes lose utility with the increase of reduction targets, we allow decision makers to control the level of fairness and utilitarianism with regards to overall social welfare. Based on Hooker and Williams (2012) we developed a Mixed-Integer linear program to set targets for each process to meet an overall cost reduction goal while accounting for social welfare. To validate our approach, we applied it to a first tier automotive supplier to define cost reduction targets for indirect processes.

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**Agriculture; Chair: Giannis Karagiannis**

**Parallel Venue 6: PK 4.4**

<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Total Factor Productivity Change and Innovation in Farms Producing Paddy in Barfa District of Samsun, Turkey</b> P017 <b>Selime Canan, Vedat Ceyhan</b> The purposes of the study were to measure the total factor productivity change of farms producing paddy, explore the innovation capacity of farms producing paddy and test whether the income sourced from efficiency increase was sufficient for being innovative, or not. The farm level data collected from randomly selected 60 farms. To measure productive efficiency, DEA was used while we used Malmquist productivity index for exploring the change in total factor productivity. Innovation index was calculated in order to reveal innovation capacity of farms. Research results showed that the percentage of the farms getting enough income from efficiency increase for being innovative for first, second and third group farms were 31%, 40% and 62%, respectively. The study suggest initiating the farmers for certified seed use via extension services and increasing the technology level through buying machine for drying, peeling and land leveling for increasing the productive efficiency.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Technical Efficiency in Cotton Farming in Pakistan: A Bootstrapped DEA Metafrontier Approach</b> P135 <b>Muhammad Watto, Amin Mugeru, Manoj Thibbotuwawa</b> This study estimates technical efficiency (TE) and the factors affecting TE in cotton farming in Pakistan. The study applies a bootstrapped DEA metafrontier approach using a cross-sectional dataset of 189 cotton growers comprising of 98 tube-well owners and 91 water buyers. It is well documented that tube-well owners have more reliable access to irrigation water supplies compared to the water buyers. We, therefore, hypothesise that tube-well owners and water buyers can belong to two different categories operating under different states of technology. We find that, on average, TE scores estimated under groupfrontiers are comparable. However, the average bias corrected TE estimates for tube-well owners (85%) and water buyers (82%) are slightly different when estimated using a metafrontier. The second stage truncated regression model points to the need for policies such as better seed quality and outreach extension services to improve technical efficiency in cotton farming.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Total Factor Productivity Growth in the U.S. Agricultural Sector: Interstate Analysis Using “Bads” and “Goods”</b> P057 <b>Nataliya Plesha, Subhash Ray, Richard Nehring, Eldon Ball</b> Conventional measures of productivity, technical efficiency and technical change are based on marketed outputs and inputs, but they ignore changes in by-products of a specific subset of polluting inputs or bad outputs. Because awareness of the environmental effects of production has led to a number of policies focused on adjusting conventional measures of productivity for external environmental effects in the U.S. agricultural sector overall, the state-level initiatives have been left out of the scope. It is particularly interesting to study the variations in state-level productivity growth measures to get a better representation of the specific (crop producing states) segments of the total factor productivity in U.S. agriculture. The focus in this paper is on how the measured productivity differs when one accounts for weak disposability between bad outputs and polluting inputs in the estimation.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Efficiency Analysis of PGI Beans Farms in Greece</b> P173 <b>Giannis Karagiannis, Katerina Melfou</b> In this paper we examine individual, aggregate and structural efficiency of Protected Geographical Indication (PGI) beans farms in Greece using a sample of around 100 producers from the Florina province. In particular at the individual level we examine the extent of technical and scale efficiency and we determine the most productive scale size for the sample farms. At the group level, we examine aggregate and structural efficiency, the former being the weighted average of individual scores and the latter obtained by the performance of the average production unit. The empirical results show that technical efficiency is a bigger matter than scale efficiency, with more farms operating with increasing rest urns to scale. On the other hand, structural efficiency found to be less than aggregate indicating the extent of reallocation inefficiency.

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Other Applications; Chair: Emine Demet Mecit Parallel Venue 7: Neuer Senatssitzungssaal	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Stochastic Cost Efficiency of Supply Chain</b> P267 <b>Mostafa Korzaledin, Mahnaz Mirbolouki</b> The main goal of this paper is a consideration of cost efficiency evaluation models related to some supply chain when dealing with imprecise data. Data envelopment analysis (DEA) and stochastic frontier analysis (SFA) methods are two different methods to assess the performance, which are non-parametric and parametric methods respectively. Both methods are proposed for deterministic data and they can be generalized to inaccurate data. One way to implement imprecise data is assuming them as random variables. In this research project, after reviewing and introducing new models to evaluate cost efficiency related to the special circumstances of the supply chain using DEA, these models are developed to probabilistic form. Also, deterministic and linear equivalents are defined using Symmetric Error Structure. At final, by a real example related to energy organizations, the DEA models are compared to SFA Translog model.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Efficiency Measurement of Regional Development Agencies in Turkey</b> P116 <b>Alpagut Yavuz</b> Differences in wealth, prosperity and development rates at regional level are important issues especially in developing countries. As a developing country, Turkey has regional disparities and inherit different local dynamics. In 2006, a new regional development approach was put into practice in Turkey. First, using the NUTS system, 26 regions were defined. Next, Development Agencies (DAs) for each region were established in a three-year period in order to reduce disparities and accelerate regional development. The main objective of these DAs is to provide various support mechanisms to institutions, associations and individuals. Thus, DAs require performance evaluation in order to ensure the institutional effectiveness and success of their activities. In this study, efficiencies of 26 DAs are analyzed using Data Envelopment Analysis between the years of 2010 and 2013. Then, Malmquist total factor productivity index is used to identify the efficiency changes over the same period.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Quality Efficiency of Scotch Single Malt Production – An Empirical Two-Model DEA Approach</b> P023 <b>Magnus Richter</b> Production of scotch whisky has reached very high levels of technical efficiency within the last years regarding the most cost-intensive factors (e.g. labor). Because of the low/zero prices of the remaining factors (e.g. barley, water, air) inefficiencies concerning their input will hardly decrease distilleries' profits as well. Thus enhancing quality seems more important. In the paper a Two-Model DEA is applied on empirical data of scotch whisky to identify quality benchmarks. Quality is incorporated by considering distilleries as quality producing DMUs whose outputs are modeled using the rating scheme of MURRAY'S Whisky Bible. Its categories Nose, Taste, Finish and Balance serve as output measures so that the distillation technology can be checked for quality-benchmarks. The model is designed as recommended by Dyson et al. (2001) and shows that exceeding the legal minimum of storage time (3 years) considerably decreases quality efficiency of whisky production.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>An Evaluation of Efficiencies for Turkey's Cities with Data Envelopment Analysis (DEA) in Terms of Cinemas: A Super Efficiency Application</b> P047 <b>Emine Demet Mecit, İhsan Alp</b> The cinema sector has received a great contribution to the economy and culture. The efficiencies of the theaters from the cultural activities were evaluated in the literature. But, the cinemas have not been evaluated with DEA yet. Therefore, Turkey's cities in terms of cinemas in 2013 were evaluated with DEA in this study. Two inputs and two outputs were determined for 72 cities (DMUs). Inputs are the number of cinema halls for the DMU under evaluation, seating capacity for the DMU under evaluation. Outputs are the number of films shown and the number of audiences. Finally, the efficient DMUs were ranked by super efficiency method.



**Session 2**Tuesday 25<sup>th</sup> August, 2015

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**Energy and Regulation; Chair: Behrouz Arabi****Parallel Venue 1: SN 19.2**

<b>Title:</b>	<b>Quality and Efficiency – A DEA-based Analysis of the Austrian Electricity Distribution Sector</b>
<b>Paper-ID:</b>	P066
<b>Authors:</b>	<b>Roland Görlich, Ulrich Rührnössl</b>
<b>Abstract:</b>	Regulatory economics suggest that incentive regulation might impose a negative effect on the quality provided by energy networks. Cap and yardstick mechanisms are aiming for efficiency increases, which might reduce the quality of service provision. Although, empirical results regarding the relationship between regulatory models and quality levels are often not conclusive, many regulators have implemented quality incentives of various forms. This paper reviews the theoretical and empirical literature, provides an overview about international examples of quality regulation including an overview about the Austrian situation and performs an empirical analysis using data of Austrian electricity DSOs. A comparison between different DEA models (different input specifications) as well as a sensitivity analysis regarding the price of quality form the basis for policy implications and recommendations for regulatory action.
<b>Title:</b>	<b>Productivity Development among Norwegian Electricity Distribution Utilities – The Impact of Capital Assessment and Technological Progress</b>
<b>Paper-ID:</b>	P171
<b>Authors:</b>	<b>Roar Amundsveen, Hilde Marit Kvile, Thor Martin Neurater</b>
<b>Abstract:</b>	Increased productivity among the DSOs may be seen as one out of several criteria for regulatory success. In this paper we will apply the Malmquist productivity index to analyze a data set from 2001 to 2013. An updated productivity analysis is interesting in itself to compare with earlier studies. Further, it is possible to analyse how three different regulatory periods have influenced productivity based on the relatively long time span in the data set. Based on our experience of benchmarking of this industry, we will especially address and discuss how valuation and measurement of capital may influence the results. Further, there are several factors that influence the production technology in this industry. One is technological development of distribution assets in itself, which may lead to increased heterogeneity among DSOs in different investment cycles.
<b>Title:</b>	<b>Application of the StoNED Method in the Regulation of Electricity Distribution in Finland: The Regulator's Perspective</b>
<b>Paper-ID:</b>	P095
<b>Authors:</b>	<b>Matti Ilonen</b>
<b>Abstract:</b>	The Finnish regulatory model for electricity distribution networks (DSO) is an incentive based revenue cap model. Finnish Energy Authority (EA) has applied efficiency benchmarking in the regulation of DSOs since 2001. In 2008 EA introduced SFA-method to complement the DEA-method in benchmarking. Since the beginning of 2012 EA has applied StoNED – method (Stochastic Non-smooth Envelopment of Data). The Finnish environment is challenging to efficiency analysis due to a large sparsely populated area and heterogeneity of DSOs. Currently there are 80 DSOs in Finland operating in different environments (urban, suburban, rural, different soil and climate conditions). There have been numerous court cases where DSOs have challenged the validity of benchmarking. DEA will continue to apply StoNED – method in the regulatory period starting 2016. Improvements to the current model include i.a. utilizing panel data and separating inefficiency and error terms with Kernel deconvolution method.
<b>Title:</b>	<b>Understanding Malaysia's Water Industry Productivity Growth: Past, Present and Future</b>
<b>Paper-ID:</b>	P091
<b>Authors:</b>	<b>Kok Fong See</b>
<b>Abstract:</b>	This study examines the TFP change of the Malaysian water industry from 1999 to 2012. Since traditional Malmquist productivity index overestimates productivity change, a global Malmquist Luenberger index (GML) method incorporating undesirable output is used in the study. The results show that the Malaysian water industry experienced a negative average TFP growth of 0.57 percent per year over the study period. Negative in technical change being the main contributor to the TFP. We find that water utilities from states where people have a higher GDP per capita income enjoy slightly higher TFP growth than those from the states with a relatively low GDP per capita income. The findings hope to provide useful inputs that can be incorporated into future reforms of the industry.

**Session 2**

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Theory and Modeling; Chair: Yongjun Li Parallel Venue 2: SN 19.3	
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>An Alternative Methodology Based on Group Decision Making Technique to Analyse Questionnaire Data</b></p> <p>P052</p> <p><b>Majid Zerafat Angiz L., Mozghan Akbari Naghani, Rusdi Indra Zuhdi Murat, Mohamad Hashim Othman</b></p> <p>Questionnaire is a powerful research tool intended to collect data from statistical populations and to analyse them. This is usually done by statistical analysis. In this paper, a different methodology relied on Data Envelopment Analysis and group decision making technique is presented to analyse the influences of effective factors on psychiatric patients, In other words, patients' concerns on the effects of their diseases are pondered. For this purpose, a proper structure derived from questionnaire is created to match it by aggregating preference ranking circumstances. Ultimately, as an application and to verify the validity of the model, a case study regarding a group of patients is presented.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>An Economic Measure of Capacity Utilization in the Short Run under Constant Returns to Scale: A Nonparametric Analysis using DEA</b></p> <p>P081</p> <p><b>Subhash Ray, Sangmok Kang</b></p> <p>In economics textbooks the capacity output level of a firm is defined by the point where its long run average cost curve reaches a minimum. If, however, the technology exhibits constant returns to scale globally, the long run average cost curve is horizontal and there is no unique minimum point. It is possible, none the less, to define a short run capacity output level where the short run average cost curve reaches a minimum. It is also the point of tangency between the short run and the long run average cost curves of the firm. Because the output level is a decision variable alongside the quantities of variable inputs, DEA for short run cost minimization requires the solution of a non-linear programming problem. This paper shows how one can invoke economic theory to find the minimum point of the short run average cost curve by solving a linear programming problem. State level data from the 2007 Census of US Manufactures are used in an empirical application of the proposed method.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Sensitivity Analysis of Efficiency in Stochastic DEA Using Confidence Interval</b></p> <p>P061</p> <p><b>Mahnaz Mirbolouki, Mohammad Hassan Behzadi, Mostafa Korzaledin</b></p> <p>The classic data envelopment analysis (DEA) deals with deterministic inputs and outputs for a set of decision making units (DMU's). However, this assumption may not be true, since data in many real world applications have uncertainty essence, depending on unknown factors and conditions such as collecting data. In order to deal with imprecise data, there are two well known methods considered as random and interval variables. In this research by considering imprecise inputs and outputs as random variables, we restrict them in their confidence interval of the mean. Then we propose an analysis of efficiency with respect to the level of error which is considered in these confidence intervals.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>A Robust Data Envelopment Analysis with Uncertain Data</b></p> <p>P226</p> <p><b>Lizheng Wang, Yongjun Li, Luka Neralić, Liang Liang</b></p> <p>One of requirements of DEA method is that all inputs and outputs should be precise, which isn't satisfied in many real applications when uncertainty is involved in input and output data. Based on the philosophy of robust optimization, this paper proposes a new method to definite the uncertainty and a robust DEA approach to deal with the uncertain data. The efficiency based on the proposed approach has three properties: monotonicity, convergence and stability. We prove that as the level of uncertainty increases, the efficiency score continues reducing and converges to a fixed value. And the efficiency score of our approach is not bigger than the one of CCR, but the score can keep high reliability by giving up a little optimality. A numerical example shows these properties of the proposed approach in this paper.</p>

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**Banking and Finance; Chair: Nurhan Davutyan**  
**Parallel Venue 3: SN 19.4**

<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Efficiency Analysis of State Owned and Private Commercial Banks Operating in Bangladesh: A DEA Approach</b> P140 <b>Muhammad Amir Hossain</b> There are mainly two broad types of banks operating in Bangladesh, such as; State Owned Banks (SOBs) and Private Commercial Banks (PCBs). These banks are functioning in a competitive environment. The main objectives of this study are to find out most efficient bank and how much inefficient other banks with compare to most efficient bank and what steps should be taken by inefficient banks to be most efficient. In the present study DEA approach has been applied which is non-parametric in nature. Input oriented models under CRS, VRS and Cost Efficiency DEA have been applied for all selected banks. An attempt has been made to work out Technical Efficiency, Scale Efficiency, Allocative Efficiency and Cost Efficiency of each selected bank separately. After applying these measures PCBs have been found better compared to SOBs. On the other hand Southeast Bank has been found as the most efficient and Sonali Bank has been as the least efficient bank analyzing last 5 years.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Efficiency and Productivity of Local Public Insurance Offices in Sweden</b> P005 <b>Christian Andersson, Jonas Thelander, Jonas Månsson</b> This study investigates technical efficiency and productivity for local public social insurance offices in Sweden 2010–2013. Efficiency is computed using a DEA-framework and bootstrapping is used to produce confidence intervals. Productivity is computed using the Malmquist index integrating consumer satisfaction following the work of Färe et al. (2002). The inputs used are: staff adjusted for sickness absence, office space as an approximation for capital and a variable for expected workload. The expected workload variable corrects for differences between insurance offices when it comes to attributes of individuals with cases at different offices. The outputs in the model consist of completed cases and activities in six different benefits, grouped together based on the complexity of the benefit. Data is collected from the Swedish Social Insurance Agency. In total 44 local public insurance offices are analysed. Preliminary results, using a CRS-model, show an average inefficiency of 7%.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Bank Efficiency Prior and After the Financial Crisis: DEA Analysis of Swiss Cantonal Banks</b> P251 <b>Galia Kondova, Tobias Hummel, David Bobst</b> This paper applies a data envelopment analysis (DEA) to study the changes in efficiency among all 24 Swiss cantonal banks in the period 2006-2014. The efficiency analysis was conducted by applying both the production and profitability DEA models. The results provide evidence of decreasing technical efficiency on average. There is evidence that the scale effect of increased amounts of deposits and mortgage loans at the cantonal banks in the years after the financial crisis is outweighed by the shrinking interest rate margins and the introduced higher capital requirements. There are several best performers that have kept their leading position throughout the whole period, namely, Appenzeller Kantonalbank, Freiburger Kantonalbank, Luzerner Kantonalbank and Zürcher Kantonalbank. The huge size differences among the best performers provide evidence that bank size plays a subordinated role in determining efficiency among Swiss cantonal banks.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Measuring the 'Lost Return on the Dollar' for Turkish Banking</b> P254 <b>Nurhan Davutyan, Vuolat Us</b> Using Deposits, Purchased Funds and Personnel as inputs, Loans and Other Assets as outputs we investigate the performance of Turkey's banking industry for the 2002-2013 period. The model implements the approach developed in: Ray S, J. Aparicio, and J. Pastor (2013), An Overall Measure of Technical Inefficiency at the Firm and at the Industry Level: The 'Lost Return on the Dollar' Revisited, EJOR, 226(1): 154-162. The model allows us to decompose the 'Lost Return' into its technical and allocative components. Thus we track down and analyze the differential impact of 2008-2009 global financial crisis depending on bank size. We also look into the role of ownership structure on banks' competitive choices.

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**Health; Chair: Panagiotis Zervopoulos****Parallel Venue 4: SN 19.7**

<b>Title:</b>	<b>Cross-Efficiencies: Input vs Output based Effects – Using the DEA Approach for an Evaluation of European Health Systems</b>
<b>Paper-ID:</b>	P155
<b>Authors:</b>	<b>Andreas Dellnitz, Elmar Reucher</b>
<b>Abstract:</b>	Classical CCR and BCC models follow the principle of best possible self-assessment of each DMU compared to other economic entities. Another, more objective and peer-oriented approach is based on the determination of so called cross-efficiencies. Here, each DMU is evaluated by a peer's optimal weights in a more objective way. Whilst under the assumption of constant returns of scale (CRS), calculation of cross-efficiencies is independent of input or output orientation, this is not the case for variable returns of scale (VRS). In this case, some input-oriented cross-efficiencies may even be negative. However, what does this entail in authentic situations? A meaningful application of this, an example taken from the European Health System, convincingly illustrates this phenomenon. Resulting from this, recommendations as to how to overcome negative DMUs' inefficiencies from a given peer's viewpoint will be discussed.
<b>Title:</b>	<b>Efficiency Measurement of Health System OECD Countries Using Data Envelopment Analysis</b>
<b>Paper-ID:</b>	P152
<b>Authors:</b>	<b>Eda Kocak, Fazıl Gökgöz</b>
<b>Abstract:</b>	This paper focuses primarily on health services of the member countries of the OECD and after the input and output parameters to be used for the field work have been established, the activities of 34 countries who are members of the OECD have been assessed in the field of health, using Data Envelopment Analysis. In the analysis, the countries have been divided into two groups as the ones falling below and above the OECD mean per capita total health expenditures and then their efficiency measures have been made. The efficiency analyses have been examined using the data of the years 2011 and 2012 and interpretations have been provided by reviewing the differences in the efficiency scores between the years. Finally, the scale efficiencies of the countries and the development rates that have been found for the changes that could be conducted on the input factors for the improvement of the efficiency levels of the inefficiency countries have been reviewed.
<b>Title:</b>	<b>Performance Assessment of Public Mental Hospitals in Taiwan: Application of DEA and BSC Approaches</b>
<b>Paper-ID:</b>	P111
<b>Authors:</b>	<b>Meei-Lian Tzeng, Shinn Sun</b>
<b>Abstract:</b>	The purpose of this study is to assess overall and individual performances, and productivity change of the 15 selected public mental hospitals in Taiwan over 2009-2014, and examine the effects of environmental variables on the hospital performance. This study integrates Data Envelopment Analysis (DEA) and Balanced Scorecard Approach to measure four types of individual performances in terms of financial measure, customer measure, internal business process, and learning and growth measure. The study applies output-oriented assurance region DEA to assess the performance of these 15 hospitals. This study employs cross efficiency measure to identify the best practices in individual and overall performances, uses Malmquist index to estimate productivity over a six-year period. Finally, Tobit regression is used to examine effects of environmental variables on overall performance of the surveyed hospitals. Some important managerial implications and suggestions are presented.
<b>Title:</b>	<b>Incorporating Target Levels with Possibility of Noise in Performance Measurement: Evidence from Primary Health Care</b>
<b>Paper-ID:</b>	P100
<b>Authors:</b>	<b>Panagiotis Zervopoulos, Panagiotis Mitropoulos, Ioannis Mitropoulos</b>
<b>Abstract:</b>	Noise in data is not uncommon in real-world cases, although it is commonly omitted from performance measurement studies. In this paper, we develop a stochastic DEA-based methodology to measure performance when the endogenous (e.g. efficiency) and exogenous variables (e.g. perspectives of patients' satisfaction), which are incorporated in the assessment, are inversely related. This methodology identifies benchmark units that are not only highly performing but are also assigned scores for their exogenous variables, which are at least equal to user-defined critical values. We apply the performance measurement methodology to the 14 largest Cypriot health centers. The advantages of our methodology are pointed out through comparative analysis with alternative stochastic DEA approaches.

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**Education; Chair: Jill Johnes****Parallel Venue 5: PK 4.1**

<b>Title:</b>	<b>Efficiency in the Universities of Mexico 2008-2012: A Study through Dynamic-Network DEA Model</b>
<b>Paper-ID:</b>	P085
<b>Authors:</b>	<b>César L. Navarro-Chávez, Odette Delfin</b>
<b>Abstract:</b>	This research aims to measure the efficiency of universities in Mexico in 2008-2012, using Network-Dynamic DEA. It is used an output oriented VRS model, in Network DEA model, it was contemplated two nodes: teaching and research. In teaching node, the inputs were: funding, teachers and doctors enrollment; as output: teacher with doctor degree. This output is used as an intermediate link to research node and the outputs for this node are: doctors with SNI and ISI publications. The years considered are 2008 and 2012, and the carry-over that is used to attach one year with another, is doctor enrollment as input and postgraduates as output. Network DEA scores show that teaching node is who determines the efficiency of universities, because in 2008, 8 universities were effective and for 2012 were 10, by contrast to research node, where only 2 universities were effective for 2008 and 3 universities for 2012. This reflects a deficiency in the area of research for most universities in Mexico.
<b>Title:</b>	<b>Comparison of Countries According to Academic Performance Change over Time with Malmquist DEA Analysis</b>
<b>Paper-ID:</b>	P099
<b>Authors:</b>	<b>Ayhan Gölcükcü, Hasan Bal</b>
<b>Abstract:</b>	It is an open question: Developing countries have highly academic performance or countries that have highly academic performance are developing? This is a key question of economic development because without ensuring scientific and technical development, sustainable development is unfeasible. Our study is an attempt to compare the 162 countries academic performance change over time which is related to gross domestic product per capita and population. Therefore Malmquist DEA Analysis is used to explain the transforming capability of countries the capital arising from the population and economic prosperity to the scientific development over time. Results of our study are not only a guide for developing countries but also an indicator for developed countries for their sustainable wealth.
<b>Title:</b>	<b>Construction of Universities' Typology via DEA</b>
<b>Paper-ID:</b>	P253
<b>Authors:</b>	<b>Irina Abankina, Fuad Aleskerov, Veronika Belousova, Leonid Gokhberg, Kirill Zinkovsky, Sofya Kiselgof, Vsevolod Petrushchenko, Sergey Shvydun</b>
<b>Abstract:</b>	This paper provides a review of different approaches to university typologies, discusses the choice of indicators and mathematical tools for grouping universities using common criteria and evaluating their performance based on classical and modified DEA approaches. The authors develop a typology which was tested in the Russian context, taking into account indicators of research and educational activities implemented by domestic universities and their efficiency score. The typology is based on clustering universities by the availability of resources, research and educational performance and efficiency score. It groups universities by type and includes a decision tree for classifying them taking into account their heterogeneity. It serves as a basis for the content analysis of a wide range of universities, and for shaping targeted policies aimed at particular groups.
<b>Title:</b>	<b>Mergers in Higher Education: Assessing the Efficiency of Non-, Pre- and Post-mergers Higher Education Institutions in England 1996/97 to 2012/13 Using an Output Distance Function</b>
<b>Paper-ID:</b>	P206
<b>Authors:</b>	<b>Maria Papadimitriou, Jill Johnes</b>
<b>Abstract:</b>	Quantitative studies on the empirical effect of merging on efficiency are few. This paper aims to fill this gap and follows a two-stage procedure. Firstly, bootstrap (DEA) is applied in an output distance function context to derive overall and pure technical efficiency scores for all publicly funded English HEIs from 1996/97 to 2012/13. An inter-temporal efficiency frontier was estimated as well as within year frontier that allows for technological changes. Secondly, variation in HE efficiency is explained through a random effects panel data model with merger being one of the explanatory variables amongst type of HEI, source of funding, the subject mix, and time dummies. The possible effects on efficiency stemming from overseas campuses and third stream activities are also investigated. Preliminary results indicate that merging appears to have a significant positive effect on efficiency. In addition source of funding and university type are significant determinants of efficiency.

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Agriculture; Chair: Vedat Ceyhan Parallel Venue 6: PK 4.4	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>A Comparison between Malmquist and Multilateral Productivity Indexes: A Case of Japanese Rice Sector</b> P073 <b>Katsunobu Kondo, Jun Sasaki, Yasutaka Yamamoto</b> Kondo, Sasaki and Yamamoto (2014) measured Malmquist productivity index (Färe, Grosskopf, Lindgren and Roos, 1992) for the Japanese rice sector over the period 1996-2006 using Data Envelopment Analysis (DEA) and found that the productivity growth for Japanese rice sector was stagnant. In this study, we aim to reexamine whether the productivity growth for Japanese rice sector was stagnant by measuring nonparametric multilateral productivity index (Caves, Christensen and Diewert, 1982) over the same period 1996-2006 and comparing the empirical results between Malmquist and multilateral productivity indexes.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>The Efficiency and Productivity of Agriculture Sector in Asian Countries: An Application of DEA and Malmquist Index</b> P159 <b>Muhammad Omer Chaudhry, James Odeck</b> Developing Asian countries rely heavily on agriculture. In this study “DEA” is applied to estimate the technical efficiency of the agriculture sector along with Malmquist productivity Index to examine the productivity in agriculture sector of Asian countries. Agricultural value added is taken as output and total arable land, labor and capital stock in agriculture sector as inputs while estimating the efficiency of agriculture sector. In the second stage, the inefficiency scores are regressed with country specific factors in order to explain the observed differences in efficiency scores. These country-specific factors include the economic and geographical grouping along with the state of social infrastructure e.g. total road & railway network, size and topography of the country etc. In 2nd stage DEA, this study has employed truncated regression analysis. The data is collected for 20 Asian countries for period 1990-2010.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Conditional FDH and Fractional Regression Models to Study the Determinants of the Brazilian Agricultural Performance</b> P068 <b>Geraldo Souza, Eliane Gomes</b> In this paper we use nonparametric methods to assess agriculture technical efficiency in Brazil. We fit regression models to the Free Disposal Hull (FDH) based conditional measures of efficiency to assess the influence of contextual variables in the performance scores. The measures of efficiency are based on ranks and the scores are computed for county data, drawn from the 2006 Brazilian Agricultural Census. The output is the total value of the county agricultural production and the inputs are the expenditures on labor, land and technological inputs. The conditional frontier assumes variable returns to scale and is output oriented. Contextual variables related to financial credit, technical assistance, social, demographic and environmental dimensions are used to explain the conditional production efficiencies by means of General Method of Moments and fractional regression, controlling for county correlation and heteroskedasticity. All contextual variables are statistically significant.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Production Efficiency and its Determinants of Beekeepers in Turkey</b> P038 <b>Vedat Ceyhan, Murat Emir, Ahmet Güler</b> The study examined the production efficiency of beekeeping in Turkey. The research data were collected from randomly selected 455 beekeeping businesses. Two stage procedure was followed in the study. In first stage, efficiency scores estimated by using data envelopment analysis, while Tobit regression was performed to reveal efficiency determinants. Research results showed that the net income per colony was \$140, and the expenditure per colony was \$61. Research results also showed that the mean technical efficiency was 0.84, while that of allocative and economic efficiencies were 0.75 and 0.62, respectively. In small beekeepers, the age of the beekeepers, management type, mobility and the number of colony affected the efficiency negatively, while credit use and income per colony had positive effect. However, participation the education program, marketing type, the number of colony influenced the efficiency negatively in medium and large scale beekeepers.

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**Other Applications; Chair: Clara Bento Vaz**  
**Parallel Venue 7: Neuer Senatssitzungssaal**

<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Research Productivity in Data Envelopment Analysis</b> P086 <b>Shinn Sun</b> The purpose of this study is to identify who are the top DEA theoretical and applied researchers; identify which institutions contribute most productive DEA theoretical and applied research; and identify which countries contribute the most productive countries in the DEA theoretical and applied research. This study collects 3999 articles (919 theoretical articles and 3080 applied articles) published in English by academic journals and professional journals over 1978-2011. This study uses the adjusted count approach suggested by Lindsey (1980) for accounting research productivity of a researcher. The results of this study show that: (i) Zhu is the top DEA theoretical researcher and Sueyoshi is the top applied researcher; (ii) Islamic Azad University contributes the most productive theoretical research and Technical University of Lisbon contributes the most productive applied research; and (iii) USA is the most dominant country both in theoretical and applied research.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Fuzzy Multi-Criteria Decision Making Approaches for the Selection of Renewable Power Generation Technologies</b> P102 <b>Mehmet Emin Baysal</b> The selection of the best alternative renewable power generation technologies is a difficult Multi-Criteria Decision Making (MCDM) problem. This is so because the issue involves many features of MCDM problem, particularly missing and ambiguous data in the decision process. Since the ambiguity can be perfectly handled by fuzziness, two models based on fuzzy technique have been used; the Order of Preference by Similarity to Ideal Solution (TOPSIS) and Data Envelopment Analysis (DEA). This paper illustrates an example of decision making process by using these techniques. Six different technologies have been used as the alternatives in fuzzy TOPSIS and as the Decision Making Units (DMUs) in fuzzy DEA. While it is tried to reach the selection of the best alternative renewable energy power generation technology satisfied under the technical, economic and social criteria with their sub-criteria explained by linguistic variables in fuzzy TOPSIS, same criteria are used to calculate outputs in fuzzy DEA.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Efficiency of Municipal Governments in Slovakia</b> P077 <b>Miroslav Huzvar, Zuzana Rigova, Katarína Sýkorová</b> Traditional methods for assessment of the municipal government performance focus on the quality of services provided for the citizens. However, municipal governments are also expected to efficiently use and manage public assets and resources. Thus it is important to evaluate the efficiency of their performance from the economic perspective. In our analysis we focus on the economic efficiency of the municipal governments of selected cities in Slovakia. By the state legislation, a regular planning on annual basis along with an application of internal and external measures for controlling the performance of individual municipal governments is obliged. A DEA approach allows us to extend this viewpoint and compare the municipalities among themselves. Due to the legislation constraints, appropriate inputs and outputs need to be carefully considered. We illustrate this approach on evaluation of property management efficiency, taking into account publicly available data.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>An Application of DEA to the Third Sector: The Case of Children and Youth Households</b> P107 <b>Clara Bento Vaz, Ivo Mendes, Jorge Alves</b> The Portuguese state has transferred some areas of its social program for third sector entities, including private social welfare institutions. This transfer of powers is supported by providing economic subsidies, being public entities responsible to monitor the efficient management by those institutions. This research aims to present a contribution to monitor the efficient management of resources by the institutions that look after children and young people. The DEA method is used to assess the technical efficiency of eight institutions from Bragança district, during the years 2010 to 2013. This model evaluates each institution in reduction of resource levels used to provide social services to the level of users observed in each unit. This approach should be used to complement the assessment of quality in providing social services, which is currently performed by the regulator, in order to allow monitoring the overall performance of such institutions.

**Session 3**

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Energy and Regulation; Chair: Luka Neralić Parallel Venue 1: SN 19.2	
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>DEA-based MPI Analysis of Electricity Distribution Co-operatives in the Philippines</b></p> <p>P164</p> <p><b>Trishit Bandyopadhyay, Fernando Roxas</b></p> <p>About a hundred Electricity Distribution Co-operatives (EC) in the Philippines work under the oversight of National Electricity Administration (NEA) of the Philippines. NEA is interested in the improvement of efficiency and productivity of the ECs. Compared to efficiency studies, there are not many productivity-related studies of the ECs of Philippines, especially for long term horizons. The present study analyses the productivity change of the ECs over a twenty-year period, from 1992 to 2012. The productivity metric is anchored in Malmquist Productivity Index (MPI) based on Data Envelopment Analysis (DEA), where the Decision Making Units (DMUs) are the ECs. The outputs of each DMU are energy delivered (MWH) to consumers and number of connections in an EC. The inputs are nos. of employees, ckt-km and energy transmission loss (MWH). Preliminary results show that MPI across co-operatives converged with time.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Impact of DEA-based Incentive Regulation on Cost Reduction in Electric Utilities in Brazil</b></p> <p>P285</p> <p><b>Rajiv Banker, Daqun Zhang</b></p> <p>This paper empirically investigates whether incentive regulation reforms stimulate managerial effort to reduce costs using two separate samples of distribution and transmission firms in Brazil. In the past decade, ANEEL, the Brazilian regulator for electricity industry, has switched to a high powered price/revenue cap regime and adopted several benchmarking techniques for rate setting. Using a panel of Brazilian distribution firms from 2003 to 2012, we find that operating expenses of electric distribution firms in Brazil have been significantly reduced after the use of benchmarking based on data envelopment analysis (DEA). In particular, the cost reduction is most pronounced in privately-owned (i.e. international-owned, Brazilian-owned and family-owned) utilities, but not significant in Brazilian state-owned utilities. Looking at the transmission sector, we find there were no significant changes in operating efficiencies of Brazilian transmission firms during 2007 to 2011, consistent with the fact that DEA benchmarking affected only a small fraction (2%) of revenues of transmission firms. Overall, our findings suggest that ownership and comprehensive benchmarking play an important role in cost reduction.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Performance Evaluation of Electricity Generated from Renewable Sources of Turkey and European Union Member States</b></p> <p>P191</p> <p><b>Serpil Gumustekin, Talat Senel</b></p> <p>The purpose of using renewable energy sources (RES) in production of electric energy are: increasing popularity of the usage of renewable electricity sources for producing electric energy, adding these sources safely and economically to the business world with good quality, increasing the diversity resources, recycling waste, protecting the environment and improving the industrial sector that is needed in the process of realising these aims. The primary RES in Turkey and EU countries are: solar, wind, geothermal, hydro and biomass. This study aims to obtain performance scores to evaluate of electricity generated from renewable sources of Turkey and 25 EU countries by using Data Envelopment Analysis. The data set covers the year 2013 and energy indicators used in the analysis were taken from Eurostat for all countries. The results of the analysis show that electricity generated from renewable sources most important goal for the future.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Evaluation of the Relative Efficiency of Electricity Distribution Centers in Croatia Using DEA</b></p> <p>P097</p> <p><b>Maja Mihelja Zaja, Rajiv D. Banker, Dubravko Hunjet, Luka Neralić, Richard E. Wendell, Ante Zaja</b></p> <p>This paper studies the relative efficiency of 21 electricity distribution centers in the Republic of Croatia using input (output) oriented CCR and BCC models of Data Envelopment Analysis (DEA). For electricity distribution centers as Decision Making Units (DMUs), we consider the number of employees, transformer capacity, distribution energy losses and operating costs as inputs, with total electricity sales, total number of customers and peak load as outputs. The paper presents and analyzes the computational results of the relative technical efficiency of electricity distribution centers for the period from 2005 to 2013.</p>



## Session 3

Tuesday 25<sup>th</sup> August, 2015

15:45–17:15

Theory and Modeling; Chair: İhsan Alp Parallel Venue 2: SN 19.3	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>On Relations of Different Sets of Units Used for Removing Inadequacies in the DEA Models</b> P104 <b>Vladimir E. Krivonozhko, Finn R. Førsund, Andrey V. Lychev</b> Some authors proposed to use specific production units in the primal space of inputs and outputs to overcome some inadequacies in the DEA models. We established the following main results. For BCC model, the following two chains of inclusions are valid. The set of exterior units according to Edvardsen et al. (2008) belongs to the set of units generated by the model of Thanassoulis et al. (2012), that belongs to the set of terminal units, that belongs to the set of units with respect to the definition of Bougnol and Dulá (2009). And the set of anchor units according to the definition of Thanassoulis et al. (2012) belongs to the set of units generated by the model of Thanassoulis et al. (2012), that belongs to the set of terminal units, that belongs to the set of units with respect to the definition of Bougnol and Dulá (2009). Our theoretical results are confirmed by extensive and instructive graphical examples and also verified by computational experiments using real-life data sets.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Modified AP Model for Ranking DMU by Finding a Direction with the Least Length Stage</b> P115 <b>Mehdi Kamari, Abbaas Ali Noura, Masoud Sanei, Ghasem Tohidi</b> The ranking method proposed in this paper is established to find a direction with the least length stage that leads to production possibility set by eliminating the data on the DMU o. For evaluating DMU o, this direction is making used of a nonlinear algorithm which is named cutting plane. By using the proposed method we have different ranking for DMU in front of AP model, that we have shown it by numerical example, the nonlinear model gives us the best direction rather than a prefixed direction , so the rank of DMUs are varied and more trustworthy than AP method. Other advantage of proposed model is: when we have equal length stage, have another items for ranking.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>A Two-stage Prediction Model for DEA Efficiency Scores</b> P273 <b>Abdullah Aldamak, Saeed Zolfaghari</b> 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 CCR model or optimistic approach, where all DMUs are evaluated according to the efficiency frontier. The pessimistic DEA model is another well-known DEA model that ranks all DMUs according to the inefficiency frontier. Results across both models have large variation. In the literature, it is well known that using only one model leads to biased evaluation, also it is known that both models are solely used for data evaluation and alternative models are suggested for efficiency prediction. In this paper, we propose a DEA model for score prediction and efficiency evaluation by combining both approaches after incorporating regression analysis into each model. The second stage of the proposed model combines both approaches to obtain a final predicted score.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>A Monte Carlo Study on the Efficiency Evaluation for Fixed and Variable Sized Hierarchical Decision Making Units</b> P054 <b>İhsan Alp</b> In this study, a Monte Carlo method is conducted for the comparison of two possible methods in evaluating the relative efficiency scores of fixed and variable sized upper decision making units (uDMUs) each with additive inputs and outputs and consisting of many sub decision making units (sDMUs). The problem appeared for the first time during the evaluation of efficiency scores of teams in FIFA World Cup. In such an evaluation, the players and the teams can be thought as sDMUs and uDMUs, respectively. The team efficiency scores can be evaluated by starting the (individual) player scores or the teams (groups) data. Unlike to the my former study, in this case, uDMUs have the same (fixed, regular) size was evaluated along with the variable (irregular) size uDMUs; and for both cases the experiments of the efficiency assessments having different number of uDMUs and different input-output numbers are repeated 1000 times.

**Session 3**

Tuesday 25<sup>th</sup> August, 2015

15:45–17:15

Banking and Finance; Chair: Mette Asmild Parallel Venue 3: SN 19.4	
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Efficiency and Productivity Change in Islamic and Conventional Banks: Evidence From the Gulf Cooperation Council Countries</b></p> <p>P205</p> <p><b>Jill Johnes, Marwan Izzeldin, Vasileios Pappas</b></p> <p>We examine efficiency in Islamic and conventional banks in the GCC region during 2006-2012 using DEA and a meta-frontier approach. We find no significant difference between Islamic and conventional banks in terms of average gross efficiency. But net efficiency is significantly higher for conventional than Islamic banks suggesting superior performance in terms of technical efficiency (managerial competence and/or scale); type efficiency is higher for Islamic than conventional banks. Thus the Islamic banking business model leads to greater efficiency in the GCC over this period. A meta-frontier Malmquist productivity analysis of efficiency and productivity over time suggests that the financial crisis has been more pronounced in the conventional banking sector. The gap between the group and meta-frontiers widened in the wake of the crisis, but there are signs that this is now narrowing.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Diversification-consistent Data Envelopment Analysis in Finance</b></p> <p>P211</p> <p><b>Martin Branda</b></p> <p>We focus on a new class of models called diversification consistent DEA. The DMUs are various investment opportunities available on financial markets (assets, portfolios), their inputs are characteristics with lower values preferred to higher, e.g. risk measures, and higher outputs are preferred to lower ones, e.g. expected return can be used. An important property of the models with diversification is that the optimal solution corresponds to an efficient investment opportunity, thus it can be used by investors to revise their inefficient portfolios. We propose various types of the diversification-consistent models and discuss their relations to Pareto-Koopmans efficiency. In particular, we focus on extensions of the radial and directional distance models when general deviation measures and coherent risk measures serve as the inputs. The proposed approaches are applied to access efficiency of US industry representative portfolios listed in the Kenneth-French library.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>The Different Approaches of Banking Efficiency: A Meta-analysis</b></p> <p>P215</p> <p><b>Lucas Macoris, Alexandre Salgado Junior, Eduardo Falsarella Junior</b></p> <p>The importance of banking efficiency has been shown to be increasingly relevant not only for researchers, but also to decision makers. However, due to the divergence of the authors in their approaches and concepts of measuring such efficiency, its contents still lie scattered in the literature, demanding deeper studies on the characteristics of each of these main approaches. In this sense, this article proposes to consolidate such a concept showing the main features of banking efficiency approaches used in other literature, using techniques of meta-analysis and content analysis. Based on the results, it was found that despite some disagreements, each of the main approaches for banking efficiency has distinct characteristics, in that each is more suitable for certain specific applications, thus contributing to new empirical studies in the area.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Inefficiency Patterns amongst Different Types, and Generations, of Bangladeshi Banks</b></p> <p>P196</p> <p><b>Mette Asmild, Dorte Kronborg, Kent Matthews</b></p> <p>In a recent paper, Asmild, Kronborg and Matthews (2015) introduced the concept of Inefficiency Contributions, which enable formal analysis of which variables contribute more or less to the overall level of inefficiency. In this paper we apply this methodology to a data set of Bangladeshi Banks. The results show, not surprisingly, that there are differences between governmental banks and other banks in where the inefficiency is mainly located. But, more interestingly, they also show that there are differences in the patterns of inefficiency amongst different generations of conventional banks.</p>

**Session 3**Tuesday 25<sup>th</sup> August, 2015

15:45–17:15

Health; Chair: Shinn Sun Parallel Venue 4: SN 19.7	
<b>Title:</b>	<b>Measuring Efficiency of Sales Territories for Medical Devices in Brazil through Data Envelopment Analysis</b>
<b>Paper-ID:</b>	P123
<b>Authors:</b>	<b>Renato B. Da Cunha, Camilo José Bornia-Poulsen, Denise Lindstrom Bandeira</b>
<b>Abstract:</b>	With the increased capacity of data processing within companies of all sizes, the use of indicators and tools for quantitative analysis has become common in several areas, allowing companies to achieve better efficiency, proper resources allocation, and to set more realistic performance expectations. While many industries feature a variety of data and studies, the medical devices market has almost no information available for customer demands, market forecasts or estimated market share at a regional level. Through the analysis of 43 sales territories of medical companies in Brazil, this abstract uses the DEA technique as a model for comparative efficiency analysis that can assist the decision making processes, even with a restricted and limited database. The application provides results that highlight the points for improvement in inefficient territories in order to homogenize the efficiency of regions by benchmarking them, to improve overall competitive level
<b>Title:</b>	<b>Intra- and Inter-group Composite Indicators Using the BoD Model</b>
<b>Paper-ID:</b>	P145
<b>Authors:</b>	<b>Roxani Karagiannis, Giannis Karagiannis</b>
<b>Abstract:</b>	We extend the radial DEA model with a single constant input, often referred to as the Benefit-of-the-Doubt (BoD) model, to account for programmatic efficiency (defined to be the gap at a given level of inputs between group frontiers) and then we develop theoretically consistent aggregation rules to compute within (i.e., managerial) and between (i.e., programmatic) group efficiencies. We show that the simple arithmetic average remains the theoretically consistent aggregate of within and overall efficiency while input shares, based on within-group potential input use, are required for aggregating programmatic efficiency. We applied the proposed methodology to analyze financial performance of public and private hospitals in Greece by means of financial ratios referring to their liquidity performance. We then examine the extent of programmatic efficiency differences between the two types of ownership both at the individual and the aggregate level.
<b>Title:</b>	<b>Hospital Efficiency with Endogenously Determined Direction Vectors</b>
<b>Paper-ID:</b>	P243
<b>Authors:</b>	<b>Murat Bilsel, Nurhan Davutyan</b>
<b>Abstract:</b>	This study aims to measure the inefficiencies of 330 state owned general hospitals in Turkey using directional distance functions. In addition to the inputs and outputs, the model includes death to inpatients ratio to measure the quality of care. Choice of direction vector is an important issue, because it determines the projections of inefficient DMUs to the frontier. Use of endogenously determined direction vectors allows the DMUs to be projected to the nearest point on the frontier. Since all of the hospitals in question are managed by the Ministry of Health, aggregation of projections to the frontier provides valuable insight to the policymakers by showing which inputs should contract and which outputs should expand on macro scale.
<b>Title:</b>	<b>A Performance Study of Long-term Care Service Organizations in Hualien, Eastern Taiwan: Integrated Data Envelopment Analysis and Balanced Scorecard Approach</b>
<b>Paper-ID:</b>	P087
<b>Authors:</b>	<b>Hsiuling Lee, Shinn Sun</b>
<b>Abstract:</b>	The purpose of this study is to assess overall and individual performances, and productivity change of the 14 selected Long-Term Care Service Organizations (LTCSOs), 11 private and 3 public, in Hualien, Eastern Taiwan over 2010-2014, and examine the effects of environmental variables on the LTCSOs overall performance. This study integrates Data Envelopment Analysis (DEA) and Balanced Scorecard Approach to measure four types of individual performances in terms of financial measure, customer measure, internal business process, and learning and growth measure. The study adopts input-oriented assurance region DEA to assess the performance of these 14 LTCSOs. This study employs cross efficiency measure to identify the best practices, and Malmquist index to estimate productivity change over a five-year period. Finally, Tobit regression is used to examine effects of environmental variables. Some important managerial implications and suggestions are presented.

**Session 3**Tuesday 25<sup>th</sup> August, 2015

15:45–17:15

**Education; Chair: Vincent Charles****Parallel Venue 5: PK 4.1**

<b>Title:</b>	<b>Measuring the Efficiency of National Education System: The Network DEA approach</b>
<b>Paper-ID:</b>	P128
<b>Authors:</b>	<b>Syarifa Hanoum, Sardar M.N Islam</b>
<b>Abstract:</b>	Data envelopment analysis (DEA) has reached broader attention among researchers in public sectors, including education. The focus of efficiency measurement in education field is varied, such as schools, universities, and departments or study programmes. Nonetheless, the education system in the national level is barely touched. The objective of this paper is to examine the possibility of measuring national educational system using DEA. Due to the complexity of the system that comprises the independent but interrelated schools structure, one of further DEA developments so-called Network DEA (NDEA) is taken as an approach. NDEA is applied to model the network structure of Indonesian national education system that consists of four stages: primary school, junior high school, high school, and higher educations. This method is applied to a data set of the education network of 33 provinces in Indonesia.
<b>Title:</b>	<b>Efficiency of Primary Education and its Determinants: An Investigation of Public, Private and Non-governmental Schools</b>
<b>Paper-ID:</b>	P240
<b>Authors:</b>	<b>Ahmad Nawaz, Bisma Jadoon</b>
<b>Abstract:</b>	This study aims to find the drivers to efficiency among public, private and NGO run primary schools. In this context, a primary survey was conducted to collect the data from 42 public, private and NGO schools in the Abbottabad region of Khyber Pakhtunkhaw Province of Pakistan. By employing data envelopment analysis, results show that students of private schools perform better than the public and NGO schools. Further, second stage Tobit regression analysis show that teachers training do not have a substantial impact on students' performance so policy makers should focus on improving the quality of training. Compulsory attendance has a negative impact on students' motivation so factors other than attendance like teachers behavior should be focused. Furthermore, English language, school size and attendance are found to be the drivers to efficiency.
<b>Title:</b>	<b>An Analysis of Efficiency of Learning-teaching Performance Using Data Envelopment Analysis</b>
<b>Paper-ID:</b>	P174
<b>Authors:</b>	<b>Necdet Osam, Solmaz Ghaffarianasl, Sahand Daneshvar</b>
<b>Abstract:</b>	Students' Evaluation of Teaching Surveys (SETs) has become an indispensable part of the university evaluation to uphold the quality of education in the university. Although, the survey has always been applied to assess the effectiveness of the teachers' performance in the class, it may rarely be applied to assess the efficiency of instructors' teaching performance in smaller scales. Data Envelopment Analysis (DEA), a non-parametric assessment approach, has been applied in various fields for performance benchmarking and relative efficiencies measurement among homogeneous evaluated decision making units (DMUs). The present study applied DEA to assess both the efficiency of teachers' performance and to identify the most significant indicators of teaching-learning performance using SETs questionnaire. It also prioritizes the significant teaching indicators which affect the students' learning performance. The result of the research is illustrated by a case study.
<b>Title:</b>	<b>Efficiency-based Brand Equity of Business Schools</b>
<b>Paper-ID:</b>	P192
<b>Authors:</b>	<b>Vincent Charles</b>
<b>Abstract:</b>	Business schools administrators are constantly under pressure to justify the impact of their marketing activities. Although there is a large body of research on brand equity (BE), little has been done with regards to business schools. To address this gap, the present research paper adopts a satisficing DEA approach to measure the BE of business schools in Peru. Measuring the efficiency-based BE in the presence of stochastic noise allows identifying efficient brands vs. inefficient brands in terms of students' perceptions. In this context, the paper shows that administrators should consider the relative importance of BE in their overall BE evaluation. Moreover, the research paper proposes strategies based on the outcome of the research to retain in efficient state to enjoy their premium. The paper concludes with directions for future research and implications for administrators who wish to set up a BE measurement system of their business schools.

**Session 3**Tuesday 25<sup>th</sup> August, 2015

15:45–17:15

**Agriculture; Chair: Joseph Allendorf****Parallel Venue 6: PK 4.4**

<b>Title:</b>	<b>A Coin Has Two Sides: Which one is Driving China's Green TFP Growth?</b>
<b>Paper-ID:</b>	P028
<b>Authors:</b>	<b>Guangtian Liu, Bing Wang, Ning Zhang</b>
<b>Abstract:</b>	This paper proposes a non-radial and non-oriented measure of TFP without the infeasibility problem – BGDDM – and uses it to explore the drivers of China's green TFP from 1999 to 2012 by decomposing GLPI from two different perspectives – the view of technology-contribution and the view of factors-contribution. Empirical results are as follows: first, China's green TFP improves by 2.02% annually from 1999 to 2012, although this improvement has recently slowed. Second, technological progress is the main driver of green TFP from the technology-contribution view; reductions in COD and SO <sub>2</sub> , as well as labor saving, are the main drivers from the factor-contribution view. Third, China suffers from two kinds of "double deterioration": the deterioration of efficiency and scale effect, as well as that of harmony, in both traditional TFP and green TFP among the Three Regions.
<b>Title:</b>	<b>Data Envelopment Analysis with Classification and Regression Tree – A Case of Technical Efficiency of Dairy Farms in Estonia</b>
<b>Paper-ID:</b>	P232
<b>Authors:</b>	<b>Helis Luik, Ants-Hannes Viira, Reet Poldaru, Jüri Roots, Rando Värnik</b>
<b>Abstract:</b>	In recent years, Estonian dairy producers have made extensive capital investments. More than 60% of dairy cows are kept in modern cowsheds built in last 10 years and the share of dairy cows kept in the new cowsheds is expected to increase in the future. The average milk yield has increased 71% from 2000 to 2014. We assume that technology has a significant impact on the milk yield and farm's technical efficiency. The magnitude of investment and intensity of production are affected by farmer's age, education etc. The main aim of our study is to provide the understanding of the factors that affects dairy farm's technical efficiency using the classification and regression tree (CART) analysis of data envelopment analysis (DEA) results. DEA determines the efficiency scores but cannot give details of factors related to efficiency, especially if these factors are in the form of non-numeric variables. The CART enables to explore the sources of inefficiency in Estonian dairy producer.
<b>Title:</b>	<b>Measuring the Impact of Public Subsidies on Technical Efficiency: A Nonparametric Conditional Efficiency Approach</b>
<b>Paper-ID:</b>	P166
<b>Authors:</b>	<b>Minviel Jean Joseph, Kristof De Witte</b>
<b>Abstract:</b>	The objective of this paper is to assess the impact of public subsidies on farm technical efficiency in a fully nonparametric framework. To this end, we use robust partial frontier techniques as well as insights from recent developments in nonparametric econometrics. The paper provides one of the first applications of the conditional efficiency setup to examine the subsidy-efficiency nexus. The analysis is conducted using a balanced panel data of 1,584 observations from 396 French farms located in the French region Meuse over the period 2008-2011. The estimates indicate that public subsidies impact negatively farm technical efficiency.
<b>Title:</b>	<b>Productivity Change in North-Rhine Westphalian Dairy Farming 2007-2014: An Application of the Malmquist Index</b>
<b>Paper-ID:</b>	P249
<b>Authors:</b>	<b>Joseph Allendorf</b>
<b>Abstract:</b>	In the next decades Global Agriculture will face several important challenges. Due to a rising world population the demand for agricultural resources will increase especially for food supply as well as for energy production (FAO, 2009; FAOSTAT, 2013). Additionally, in the short term Europe will be challenged by the phasing out of the milk quota in 2015 (European Commission Agriculture and Rural Development, 2010). To assure a sustainable dairy production which at the same time maintains highly competitive, it is essential to keep a high efficiency and productivity level of the given resources. In this context, measuring efficiency gains importance. Therefore, the aim of this study is to determine the productivity growth of dairy farms in North-Rhine Westphalia from 2007 to 2014 and to analyze its components which explain the variations.

**Session 3**

Tuesday 25<sup>th</sup> August, 2015

15:45–17:15

Theory and Modeling; Chair: Jesus T. Pastor Parallel Venue 7: Neuer Senatssitzungssaal	
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Identifying Strong and Weak Congestion in the Presence of Negative Data: A DEA Approach</b> P033 <b>Robabeh Eslami, Mohammad Khoveyni</b></p> <p>One of the concepts of data envelopment analysis (DEA) is congestion. All existing congestion DEA approaches are applicable only to technologies specified by non-negative data whereas in real world, it may exist negative data, too. This fact is the motivation of creating this study. Hence, by assuming decision making units (DMUs) in the presence negative data, we first propose a DEA model to determine candidate DMUs for having congestion and then, a DEA approach is presented to detect congestion status of these DMUs. The advantage of the proposed method is that it is capable of exploring congestion status for DMUs in the presence of negative data while in this situation, the existing congestion methods are incapable of identifying congestion status. This matter is the main drawback of the existing approaches which is removed in this study. Finally, the geometric interpretation of the proposed approach and an empirical application are presented to highlight the purpose of this research.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Efficiency Decomposition in a Two-Stage DEA Model with Stage 1 Output, Intermediate and Stage 2 Input Variables</b> P009 <b>Don U.A. Galagedera, John Watson, I.M. Premachandra, Yao Chen</b></p> <p>The debate on what constitutes a good measure of mutual fund performance continues. We measure performance by considering mutual fund operation as a two-stage process with some output at the first stage not fed into the second stage. We develop a general data envelopment analysis model and decompose overall efficiency of performance into stage 1 and stage 2 efficiency components. An advantage of our model is that we can highlight weaknesses of poor performers and strengths of good performers from two different aspects (operational management and portfolio management) of mutual fund operation. In the case of US mutual fund families, we show evidence that modelling redemption as a stage 1 output variable that is not fed into stage 2 increases discriminatory power of operational management (stage 1) performance.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Using Dynamic DEA to Evaluate the Effectiveness of Machine-building Enterprises of Ukraine</b> P208 <b>Leonid Galchinsky</b></p> <p>To date, the multi-building complex of Ukraine combines over 11,000 enterprises. But decline in investment activity in 2009 in major markets has led to a sharp decrease in exports of machinery. It is obvious, that without significant investments the Ukrainian machine-building industry will not be able to overcome the crisis. This requires substantial upgrading of machine-building enterprises and objective assessment of the effectiveness of the company will be important. This evaluation allows us non-parametric econometric tasks called DEA. Exactly for the machine-building enterprises this assumption reduces the reliability of an efficient estimation. This situation requires an examination of the dynamic model approach that recognizes the inter-temporal relationship between the inputs and the production. The results of calculations according to static model of enterprises activity show, that static model tend to raise the overall inefficiency.</p>
<p><b>Title:</b></p> <p><b>Paper-ID:</b></p> <p><b>Authors:</b></p> <p><b>Abstract:</b></p>	<p><b>Design and Implementation of a Shiny Interactive Web Application by RStudio for Estimating Data Envelopment Analysis Efficiency Measures</b> P059 <b>Juan Aparicio, Jesus T. Pastor, Lidia Ortiz, Vidal Jiménez Fernando, Javier Alcaraz, Juan F. Monge</b></p> <p>In this paper we describe a Shiny interactive Web application by R Studio which is used to estimate technical efficiency through Data Envelopment Analysis (DEA) measures. The Shiny interactive Web application is based on a unified method for computing the scores of a wide family of efficiency measures (Pastor et al., 2012), which greatly reduces the number of the lines of code of the program. Additionally, and in contrast to conventional software, the application allows easily implementing new efficiency measures through a module that could be of interest for theoretical researchers.</p>

## Session 4

Thursday 27<sup>th</sup> August, 2015

09:00–10:30

**Energy and Regulation; Chair: Per Agrell****Parallel Venue 1: SN 19.2**

<b>Title:</b>	<b>Using DEA-MBP to Joint Environmental and Cost Efficiency Analysis in Electricity Generation</b>
<b>Paper-ID:</b>	P222
<b>Authors:</b>	<b>Forough Shadman, Behrouz Arabi, Khalid Abdul Rahim</b>
<b>Abstract:</b>	The first priority and the fastest way to meet sustainable energy requirements is energy efficiency. Heavy fossil fuels used for electricity generation are mainly responsible for sulfur pollutants. DEA-MBP (Data Envelopment Analysis incorporating the Material Balance Principles) is conducted to investigate the integrated allocation of fossil fuels used for steam power plants in micro (DMU) and macro (all-steam utilities) level. The results indicate that by moving to a cost and environmentally efficient point, the mean cost would decrease. It also properly demonstrated that by moving to a cost and environmental efficiency point, the amount of sulfur would reduce. Due to the wide gap between these two efficiency points, it would seem there is still another important variable which was probably did not considered in the first stage. Then, other important explanatory variables re-estimated applying the Ordinary Least Square (OLS).
<b>Title:</b>	<b>Environmental Performance Controlling for Carbon Leakage</b>
<b>Paper-ID:</b>	P230
<b>Authors:</b>	<b>Thomas Grebel, Michael Stützer</b>
<b>Abstract:</b>	The objective of this paper is to investigate the impact of carbon leakage on countries' efficiency scores. Using country input/output tables, we calculate corrected carbon dioxide emissions on the sector level. Efficiency scores will be calculated using different DEA-models. As inputs and outputs we use longitudinal OECD data about European countries. The results show that the correction may lead to a fair redistribution of emission responsibilities according to a consumption-oriented approach. Overall emissions remain largely untouched. However, the enforcement of a leakage-corrected benchmark scheme would function as a contractionary policy for CO <sub>2</sub> net exporters, whereas it would boost net importers.
<b>Title:</b>	<b>Cross-subsidies or Economies of Scope – DEA as a Tool to Assess Cost Allocation and Productivity in Norwegian Electrical Utilities</b>
<b>Paper-ID:</b>	P170
<b>Authors:</b>	<b>Roar Amundsvveen, Hilde Marit Kvile, Tore Langset</b>
<b>Abstract:</b>	Vertical integration has a potential benefit of reduced costs, but the disadvantage is the possible distortions in competitive markets. In this paper we will address these questions by applying Data Envelopment Analysis (DEA) and related methodologies. The starting point in our framework is an analysis of the productivity among the Distribution System Operators (DSOs). This model will be extended to include economies of scope with other services in the value chain like generation, transmission and supply. The analyses above are based on the cost side. In addition we will explore if vertical integration also influence the revenues and the profits of the integrated firm. The results of this study are of general interest in ongoing policy development in Norway. An expert commission has as one out of several proposals suggested legal and functional unbundling for all utilities and not only for the largest as is the situation today.
<b>Title:</b>	<b>Incentive Regulation with Flawed Cost Models: Firm Behaviour and Productivity Losses</b>
<b>Paper-ID:</b>	P217
<b>Authors:</b>	<b>Per Agrell, Emili Grifell-Tatje</b>
<b>Abstract:</b>	Economic regulation, e.g. for energy networks, increasingly use cost models such as frontier analysis (DEA and SFA), average cost (OLS), accounting cost or engineering cost models. In theory, the use of such models in incentive regulation, e.g. revenue-caps, would induce firms to cost-efficiency. However, empirics show cases and periods where regulated firms exhibit endemic inefficiency and falling profitability, seemingly irrationally. We present a small model for firm-level efficiency under a regime with a probability of failure, leading to replacement by a cost-plus model. Theoretical results show that failure risk induces effort-averse firms to adopt inefficiency. Using panel data 2000-2006 from 137 energy networks in Sweden, we show that the behaviour of the firms (failing profitability and efficiency) coincides with the period of a flawed regulation 2003-2006. The work highlights solid cost modelling in regulation and the fallacy of method-neutral incentive regulation.

# Abstracts

## Session 4

Thursday 27<sup>th</sup> August, 2015

09:00–10:30

**Theory and Modeling; Chair: Konstantinos Triantis**

**Parallel Venue 2: SN 19.3**

<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>On the Interpretation of Farrell Efficiency Measures and the Malmquist Productivity Index</b> P260 <b>Finn Førsund</b> There is a close connection between efficiency and productivity: efficiency can be defined as the relation between observed productivity and a benchmark for a potentially better productivity level that may be obtained. Within the research strand of non-parametric frontier functions the 'ratio' definition of efficiency in Charnes et al. (1978) of weighted outputs on weighted inputs has been seen in this light. However, a productivity interpretation of output weighted with endogenous shadow prices divided by inputs weighted with another set of endogenous shadow prices should not be interpreted as a productivity measure. Reasons are that the measuring unit of the output weights are efficiency score units per output, the weighted sum of the outputs is restricted to be between zero and one, and the sum of the weighted inputs is normalized to unity. An additional anomaly is that some weights may be zero.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Productive Efficiency Measures Using a System-of-equations Two-stage DEA Approach: The Case of Greek Public Hospitals</b> P141 <b>Roxani Karagiannis</b> The paper provides productive efficiency measures, related to technical efficiency, scale efficiency and capacity utilization, for a panel of 112 public hospitals in Greece during the period 2007-2011. We employ a nonparametric model in which productive measures 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 and/or the number of outpatient visits. We use an input orientation model in measuring efficiency as a more appropriate to address questions related to resources savings and effective governance in the public sector that are becoming increasingly popular because of the economic crisis and the implementation of the Memorandum. A system-of-equations two-stage DEA approach is used to explain the simultaneous effect of a number of contextual variables on technical efficiency, scale efficiency and capacity utilization.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Luenberger Productivity Indicator and its Decomposed Components in the Presence of a Change in the Direction of Measurement</b> P188 <b>Mohsen Afsharian, Heinz Ahn</b> The Luenberger productivity indicator applies directional distance functions which allow to specifying in what direction (i.e. direction of measurement) the operating units will be evaluated. In the presence of a change in the direction of measurement, the standard components of the existing Luenberger productivity indicator may provide values which are not compatible with reality. In order to eliminate this pitfall, the so-called bottoms-up approach is used to revisit the definition of the indicator and its components. We start with a list of selected sources of productivity change, namely efficiency change, technical change and direction change, then examine the best possible way of measuring each of the sources and combine them to derive a new measure of productivity change. The proposed indicator will be illustrated by means of an empirical application to a panel of 417 German saving banks over the time period 2006-2012. The example explains how the proposed approach is able to properly measure efficiency change, technical change and direction change. The results also provide conclusive evidence about the effect of the change in direction of measurement on the results of the productivity over time in a centralized management scenario.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>The Implementation of a Complex Adaptive Systems Approach for Productive Efficiency Analysis</b> P110 <b>Konstantinos Triantis, Francis Dougherty, Nathan Ambler</b> We describe the implementation of a complex adaptive productive efficiency method (CAPEM) to a sample of electric power plants. CAPEM is based on a Complex Adaptive Systems (CAS) "flocking" metaphor and Data Envelopment Analysis (DEA). Guided by rules, individual agent DMUs (power plants) 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 in the least possible time. Using a CAS ABM simulation, we find that the flocking rules, taken individually and in combinations, affected the mean technical efficiency of the power plant population and the time to reach the frontier.



## Session 4

Thursday 27<sup>th</sup> August, 2015

09:00–10:30

**Banking and Finance; Chair: Abdel-Latef Anouze**  
**Parallel Venue 3: SN 19.4**

<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>A Three-stage DEA Model to Evaluate the Performance and Explore Preferred Targets for Bank Branches</b> P276 <b>Cong Xu, Jian-Bo Yang, Yu-Wang Chen, Hua-Ying Zhu</b> Although a large number of DEA models have been applied to the banking industry as management monitoring techniques, how to use DEA as a management planning tool is a relative new topic. This paper proposes a three-stage DEA model for bank branches' efficiency evaluation and target setting. The first stage of the model evaluates branches' efficiency. After that, the second stage of the model collects bank head offices' strategies and regulations and transforms them into several DEA constrains. These constrains can identify a narrowed and head office preferred feasible space from existing DEA possibility set. Within the narrowed feasible space, the third stage of the model proposes a stepwise interactive process. Through this interactive process, branch managers can comprehensively and intuitively learn about the efficient frontier and find out their satisfied targets. This paper also illustrates how the three-stage model is applied to the 124 branches of a state-own bank in China.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Technical and Scale Efficiency of Scheduled Banks of Bangladesh in terms of SME Finance Using Data Envelopment Analysis (DEA)</b> P162 <b>Shamim Ara, Hazera Akter</b> This paper has investigated the efficiency of the scheduled banks in Bangladesh in financing Small and Medium Enterprises (SMEs). The nonparametric approach 'Data Envelopment Analysis' has been applied taking the banks' quarterly data from January 2010 to June 2013. The output variables were 'SME finance in service, trading and manufacturing enterprises' and the input variables were total deposits assigned for SME finance, cost of that fund and related salaries expenses. This study reveals that all the banks have overall efficiency 31.69 percent on average which is far below the efficient frontier and very much disappointing for overall economic development. Most of the banks (78 percent) are found having overall efficiency less than 50 percent which would further disrupt the consistent economic development at real world where SCBs are in the most distressed position. The study has important implications in guiding the government policy to progress banks' efficiency.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Interest Rate and Banks' Productivities</b> P142 <b>Shu-Chin Huang, Ching-Yi Chiang</b> An important issue in finance is whether central bank can effectively exercise its interest-rate policy to affect bank performance and therefore improve economic growth. The 2008 financial crisis had triggered a period of low interest rate all over the world till the beginning of 2015. What is the impact of changes in interest rate on bank productivities? The research question is important because banks are not only service producers but also financial intermediaries which can affect other industries' financial opportunities. In this paper, we investigate the relationship by using data of leading commercial banks in Taiwan, Hong Kong, mainland China and OECD countries in 1999–2013. We apply Malmquist total factor productivity index, Random-effect Tobit regression and the System Generalized Method of Moments to show the results. We conclude the contribution of this paper in the productivity analysis literature and the banking and financial literature.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Data Envelopment Analysis and Data Mining for Bank Performance: A Comparative Study</b> P227 <b>Abdel-Latef Anouze, Imad Bou-Hamad</b> The two-stage DEA Models have been progressing since Ray (1991) by considering statistical models other than classical regression. The two stage models have been extensively used in the literature. However, no exhaustive comparison of such models for bank performance has yet been made. On the other hand, previous DEA studies focused on explaining in second stage DEA the role of environmental variables affecting the performance of a bank and did not provide grounds for predicting future performance. This study aims to assess the application of seven statistical and data mining techniques to second stage DEA for bank performance as part of an attempt to produce a powerful model for bank performance with effective predictive ability. The study is based on Middle East and North Africa bank data over a period of 2008-2010. The results of this experiment showed that random forests and bagging techniques outperform other methods in terms of predictive power.

# Abstracts

## Session 4

Thursday 27<sup>th</sup> August, 2015

09:00–10:30

**Transportation; Chair: Subhash Ray**

**Parallel Venue 4: SN 19.7**

<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Evaluation of Railway Traffic Control Efficiency and its Determinants</b> P132 <b>Bart Roets, Johan Christiaens</b> The present paper fills a gap in the literature by examining the efficiency of railway traffic control. In close collaboration with experts from Infrabel, the Belgian railway infrastructure manager, we develop a two-stage benchmarking framework which assesses and explains railway traffic control efficiency. In the first stage, a bootstrapped Data Envelopment Analysis model with a categorical variable assesses efficiency. Second-stage regressions examine the impact of several factors on efficiency. We demonstrate the practical applicability of our approach with a unique and rich 18-month dataset of Infrabel's relay-technology signal boxes. Our findings suggest a significant influence on efficiency of spatial and temporal traffic density, infrastructure complexity, geographical centralisation, team size, and opening times. Finally, this paper offers a methodological contribution, by demonstrating the use of categorical variables in DEA subsample bootstrap algorithms.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Assessing Performance of Czech Public Transport Companies with Two-stage DEA</b> P252 <b>Markéta Matulová</b> We analyze the efficiency and effectiveness of public transport companies in 19 Czech cities by data envelopment analysis using two-stage approach. Two-stage models assume that the first stage of the production process transforms inputs to some intermediate measures, which then are used as inputs to the second stage of the process. These models are often used for unstorable commodities, where the first stage deals with technical efficiency (transforming inputs into outputs) and service effectiveness (how are outputs transformed into consumption) is evaluated in the second stage. The nonstorable feature of transportation service is obvious, the unoccupied seats in the vehicle's past journey cannot be consumed in the future. So in order to capture the overall performance of the transit company it is necessary to treat the commonly used performance indicators such as vehicle kilometers or seat kilometers as an intermediate measure only.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Economic Efficiency of Container Terminals of APEC Countries, 2000-2013: A Measurement with a Dynamic DEA Model</b> P180 <b>Odette Delfin, César L. Navarro-Chávez</b> This research presents measurement of economic efficiency of 40 ports of APEC countries from 2000 to 2013. DEA methodology is used, using as inputs: quay length, employees and cranes and as outputs: port revenues and container volume. For the first year (2000) technical, allocative and economic efficiency is obtained with VRS input orientation, applying bootstrap technique. In the second year (2013), Dynamic DEA model is used and for linking each year it is used an intermediate variable which in this case is port revenue, in the first year it is an output, while for the following year is an input. In 2013, the ports were economically more efficient than in 2000. For 2013, the ports had an average technical efficiency of 77%, allocative efficiency of 68% and economic efficiency of 87%. Whereas, for 2000, have lower values, the average technical efficiency was 63%, the allocative efficiency of 22.9% and the economic efficiency of 33.7%.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Measurement of Non-Radial Efficiency using DEA: A Study of Passenger Bus Undertakings in India</b> P079 <b>Anand Venkatesh, Subhash Ray</b> The widely used Radial Data Envelopment Analysis (DEA) models often result in non Pareto optimal solutions due to presence of slacks at the optimum. Non-radial DEA models facilitate changes in individual inputs or outputs at different rates. We use the input oriented non-radial DEA variant for passenger bus undertakings in India (STUs for each of the twelve years 2002-2013). There has been a marked fall in the labour-related average TE score during the period of study. STUs which are registered as companies have the highest average value of overall technical efficiency while municipal undertakings have the lowest. A noteworthy finding is that Labour related average TE has consistently fallen across all STU types in the sub-period 2008-13 relative to the 2002-07. By and large, peers for inefficient STUs have remained consistent during the past five years implying that STUs which have overall efficiency scores less than one can consider these peer STUs as benchmarks.

**Session 4**Thursday 27<sup>th</sup> August, 2015

09:00–10:30

**Education; Chair: Mehmet Ali Cengiz****Parallel Venue 5: PK 4.1**

<b>Title:</b>	<b>The Performance of Brazilian Students on Standardized Tests of Large-scale Assessments: Administrative and Pedagogical Practices to Improve Educational Policies</b>
<b>Paper-ID:</b>	P213
<b>Authors:</b>	<b>Alexandre Pereira Salgado Junior, Juliana Chiaretti Novi</b>
<b>Abstract:</b>	This article aim to identify practices to improve educational policies and to enhance the performance of Brazilian students is crucial. Firstly, under the quantitative approach, there has been the identification of the schools that were able to translate financial investment efficiently into student performance on large-scale standardized tests through the DEA. Subsequently, the schools considered inefficient were detected according to judgment and convenience among the ones that obtained DEA scores less than to 0.60. The second stage has qualitative, trying to understand the internal processes that lead similar schools have differing performances. At this stage, 26 administrative and pedagogical practices that can contribute to the goal proposed herein were identified. The present work is expected to exert a significant impact on education polity, formulate assertive public policies, administrative practices to upscale education programs and properly adjust resource allocation.
<b>Title:</b>	<b>Network DEA for Measuring Efficiency of National Education System</b>
<b>Paper-ID:</b>	P275
<b>Authors:</b>	<b>Syarifa Hanoum, Sardar M.N. Islam</b>
<b>Abstract:</b>	The objective of this article is to extend data envelopment analysis (DEA) research in public sectors, particularly in efficiency measurement of the educational system at national level. The uniqueness of this study is to modelling the independent but interconnected schools structure in the education production function. To do so, network DEA is taken as an approach. This method is applied to a data set of Indonesia's education network in 33 provinces. The empirical findings reveal 16 provinces were consistently efficient during two periods of study, three provinces were not efficient in the first period but successfully improved themselves to be efficient in the last period. Unfortunately, one province suffered a decrease in efficiency. The first stage of the network, primary school, is discovered as the major source of inefficiency while the last stage, higher education, performed the greatest contribution to efficiency.
<b>Title:</b>	<b>The Efficiency of Tunisian Students' Achievement: A Smooth Bootstrap Data Envelopment Analysis with Non-discretionary Inputs</b>
<b>Paper-ID:</b>	P245
<b>Authors:</b>	<b>Hédi Essid</b>
<b>Abstract:</b>	In this study, we measure the efficiency of a students' achievement in the PISA 2012 study. We use smooth bootstrap data envelopment analysis approach with non-discretionary inputs to estimate and correct the bias and to construct confidence intervals for efficiency measures. In our model, education achievement, the output, is measured by the performance of 15-year-olds on the PISA reading, mathematics and science. We use two categories of inputs measures: variables that are usually under the direct control of the student and non-discretionary that are related to the student's drive and motivation (perseverance and openness for problem solving in the PISA study). The simulation results show that, on average and as a conservative estimate, Tunisian student could have increased their results by 12% using the same resources.
<b>Title:</b>	<b>Academical Efficiency Comparison of Countries via DEA</b>
<b>Paper-ID:</b>	P098
<b>Authors:</b>	<b>Hasan Bal, Ayhan Gölcükcü</b>
<b>Abstract:</b>	The number of academic studies and the H index derived from the citations made to these academic studies per year are the indicator of academic progress not only for an academicians but also for the countries. In this context, Data Envelopment Analysis (DEA) is a relevant tool for the academic comparison of countries. Population which is the source of human capital and GDP per capita which is the indicator of financial support potential could be determined as inputs while the number of studies and H index are output. In our study, 177 countries which have available data segmented according to mean and median of their inputs and compare each other via BCC and CCR models of DEA. Later, an efficient set is evaluated by the efficient countries of each segment and these efficient countries compared each other.

**Session 4**Thursday 27<sup>th</sup> August, 2015

09:00–10:30

**Environment; Chair: Tomas Balezentis****Parallel Venue 6: PK 4.4**

<b>Title:</b>	<b>Eco-Efficiency Assessment of World-Class Mining Companies</b>
<b>Paper-ID:</b>	P070
<b>Authors:</b>	<b>Renata Oliveira, Ana Camanho, Andreia Zanella</b>
<b>Abstract:</b>	Assessing Eco-efficiency of companies is important to ensure they succeed in creating wealth without compromising the needs of future generations. This work aims to extend the Eco-efficiency concept by including in the assessment new features related to environmental benefits (e.g., the use of renewable resources) and environmental burdens (e.g., dispersions). This concept is implemented using a DEA model with a Directional Distance Function. In the end, we present an application to world-class mining companies, whose results and managerial implications are discussed.
<b>Title:</b>	<b>Regional Opportunity Costs of Environmental Regulations in Turkish Manufacturing Industry</b>
<b>Paper-ID:</b>	P147
<b>Authors:</b>	<b>Yücel Özkara, Mehmet Atak</b>
<b>Abstract:</b>	In developing countries, regional disparities exist and cause structural development problems. Improving manufacturing industry by regional policies can help dealing with these disparities. Efficiency measurement is an essential element for designing regional policies. To this end, using a total-factor DEA model would give specific information to decision makers. Environmental performance index (EPI) is commonly used in literature for evaluating impacts of environmental regulations which may cause a loss of desirable outputs. Opportunity costs (OC) due to these regulations can be assessed by EPI scores. In this study, we use two slack based DEA models to measure regional efficiency of Turkish manufacturing industry between the years 2003-2010 and we calculate the regions' EPI and OC of environmental regulations. It is found that OC differ among regions and average OC per region reaches its highest level in 2006. The relationship between regional development and OC is also investigated.
<b>Title:</b>	<b>Development and Urban Sustainability: An Analysis from Eco-efficiency through DEA</b>
<b>Paper-ID:</b>	P027
<b>Authors:</b>	<b>Clara Pardo, William Alfonso</b>
<b>Abstract:</b>	In the last decades, the majority of cities in developing countries have grown rapidly and increasing environmental problems, which have generated a broad discussion on urban sustainability and development in cities. This research seeks to estimate and evaluate the eco-efficiency in cities of a developing country as Colombia using data envelopment analysis. In this study, indicators related to urban sustainability are used to analysis eco-efficiency. Results indicate differences among cities, where the inefficient cities show a low level of economic development and higher environmental problems. In the second stage, panel data techniques are used to determine factors that influence in the results of eco-efficiency indicating that economic, environmental and social variables have positive and negative effects on ecoefficiency in cities. All these findings are important in the formulation and design of adequate policies in the cities to achieve and strengthen urban sustainability.
<b>Title:</b>	<b>Environmental Performance of Lithuanian Economic Sectors: A DEA Approach</b>
<b>Paper-ID:</b>	P083
<b>Authors:</b>	<b>Tomas Balezentis, Irena Krisciukaitene, Dalia Streimikiene, Alvydas Balezentis</b>
<b>Abstract:</b>	This paper aims to estimate the environmental performance index for Lithuanian economic sectors. The environmental performance index is estimated by employing the data envelopment analysis in the spirit of the Hicks-Moorsteen indices. The present analysis is based on the data from the World Input-Output Database. Specifically, the environmental technology is defined in terms of the value added, carbon emission, labour, capital and energy. The analysed economic sectors were grouped into the four clusters with respect to the mean EPI and its rate of growth. Machinery and manufacturing sectors fell into the best-performing group featuring the highest mean EPI and the highest growth rate. Petroleum production and air transport sectors were those featuring the lowest environmental performance. Therefore, the latter sectors should be given an especial importance when developing strategies for increase in sustainability.

## Session 4

Thursday 27<sup>th</sup> August, 2015

09:00–10:30

Other Applications; Chair: Andreas Kleine Parallel Venue 7: Neuer Senatssitzungssaal	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>How Well is the Museum Performing? A Joint Use of Data Envelopment Analysis (DEA) and Balanced Scorecard (BSC) to Measure the Performance of Museums</b> P075 <b>Antonella Basso, Francesco Casarin, Stefania Funari</b> Measuring performance has become an important issue also in the cultural sector. Recently, the DEA methodology has been used to evaluate the performance of cultural organizations; in particular with regard to museums, first and seminal contributions are those of Mairesse, Vanden Eeckaut (2002), Pignataro (2002), Basso, Funari (2004). In this paper we exploit the potentiality of DEA in measuring the performance of museums by integrating the DEA approach with the balanced scorecard (BSC) tool. To our knowledge, there are so far no attempts to propose a BSC-DEA framework for cultural sector. We first compute a DEA efficiency measure for each of the perspectives of the BSC, according to a suitable BSC scheme which we will propose for museums. Subsequently, through an opportune aggregation of the previously computed measures, a further DEA model will provide a global performance index for museums. An application to the museums of the city of Venice will be finally illustrated.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Global Public Spending Efficiency in Tuscan Municipalities</b> P129 <b>Giovanna D'Inverno, Laura Carosi, Letizia Ravagli</b> In this paper, a Data Envelopment Analysis is performed to study the efficiency of Tuscan municipalities' public expenditure. Differently from other contributions, the global efficiency score of each municipality is computed by introducing a new indicator: for five strategic functions of Tuscan municipalities, a non-aggregate analysis is first run and then a composite indicator is proposed to analyze the overall expenditure composition of each municipality and to evaluate the global spending efficiency. As the municipal size has been one of the most discussed issues in the political debate, this study aims at investigating whether the efficiency of public expenditure is really affected by the municipal dimension. The choice of the Tuscan framework is linked to this topical feature and it has been motivated by the activity of Tuscan legislator; institutional and administrative reforms are nowadays under consideration to overcome inefficiency in the municipalities' expenditure.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Performance Evaluation of the Public Employment Services in Finland</b> P131 <b>Juha Eskelinen, Abolfazl Keshvari</b> The public employment services play an important role in the job market by matching job seekers and job vacancies, and also empowering job seekers to gain employability skills. The unemployment rate in Finland has increased since the financial crisis of 2008. Efficient use of available resources of the public employment services is critical for the Ministry of Employment and the Economy. In this study, we work together with the Ministry to develop a model to evaluate the productive efficiency of the regional public employment agencies. This model is applied to evaluate the performance of the agencies in 2014 and the performance development over recent years. We employ data envelopment analysis as a non-parametric frontier estimator. Directional distance function is used to assess the contributions of agencies to the objectives of the government. Results show clear performance differences between the regions and improvement opportunities for the regional public employment agencies.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Dynamic Efficiency Evaluation of German Public Multidisciplinary Theatres by RC-DEA Model</b> P202 <b>Andreas Kleine, Steffen Hoffmann</b> Due to strategic objectives multidisciplinary theatres offer dramas as well as music and dance events. If we measure efficiency of these theatres by DEA it is inappropriate to neglect a discipline when efficiency bases on it. Hence, the efficiency structure has to be observed. Moreover some of these theatres operate under specific conditions which require a categorization. As decision makers are interested in efficiency changes over time we introduce a so called dynamic RC-DEA model that incorporates all these requirements. The RC-DEA is based on an application-oriented implementation of weight restrictions in the multiplier model. A hierarchically categorical DEA is embedded in combination with a Window Analysis. In contrast to this well-known dynamic approach we recommend a modified measure for a window. The use of the RC-DEA model is illustrated by an empirical example of 31 German public multidisciplinary theatres.

**Session 5**Thursday 27<sup>th</sup> August, 2015

13:30–15:00

**Other Applications; Chair: Hasan Bal****Parallel Venue 1: SN 19.2**

<b>Title:</b>	<b>Examining the Efficiency of MGNREGS in North Eastern States of India using the Data Envelopment Analysis Approach</b>
<b>Paper-ID:</b>	P255
<b>Authors:</b>	<b>Indraneel Bhowmik, Pritam Bose</b>
<b>Abstract:</b>	The world's largest employment generation programme, Mahatma Gandhi National Rural Employment Generation Scheme (MGNREGS) operational in India involves about Rs. 35000 crores (5 Billion US dollars) annually. The scheme provides 100 days of employment to the rural households for creation of sustainable assets on demand. However, there are wide variations in the implementation of the programme in the states. The North Eastern Region (NER) of India characterised by infrastructure bottlenecks, low industrialisation, and chronic unemployment has much higher dependence on Government sector activities, thereby increasing the importance of the scheme for the region. The present paper tries to examine the functional efficiency of the scheme based on multiple output indicators like average person-days generated per household, proportions of households with 100 days of employment, work completion rate, utilisation of funds, etc as available in official statistics.
<b>Title:</b>	<b>Rational Inefficiency, Adjustment Costs and Sequential Technologies</b>
<b>Paper-ID:</b>	P063
<b>Authors:</b>	<b>Benjamin Hampf</b>
<b>Abstract:</b>	We propose a novel methodology to estimate the rational inefficiency of firms in the presence of adjustment costs. Based on the assumption that at each point in time the firms have knowledge about their own production structure in all previous periods we are able to decompose the cost efficiency of a firm into rational and residual economic inefficiency. Using the methodology proposed by Bogetoft et al. (2006) we are furthermore able to decompose the rational inefficiency into technical and allocative components. We apply our model to an analysis of cost efficiency of power plants in the United States covering the years 1994-2009. Our results show that significant cost inefficiencies exist but approximately 25% of the identified cost reductions can be attributed to rational inefficiencies. Moreover, we find that while technical inefficiency is largely caused by rational inefficiency, the allocative inefficiency cannot be explained by rational behavior of the plants.
<b>Title:</b>	<b>Transforming towards Smart Government in Dubai: An Efficiency Analysis</b>
<b>Paper-ID:</b>	P001
<b>Authors:</b>	<b>Hazza Alnuaimi, Ozren Despic, Ali Emrouznejad</b>
<b>Abstract:</b>	Government websites in Dubai have been an integral element throughout all previous stages of transformation as well as the current smart-transformation that needs to be studied and evaluated. This ultimately leads to the assessment of websites, which are a vital element for transforming towards Smart Government considering Dubai Government entities' website case study. This will include investigating and methodically studying all the identified tools and methods in line with the most relevant theoretical and practical properties applied in similar environments. In addition, a new and promising method known as GDEA will be investigated which will provide a new set of properties that may not be found in existing methods.
<b>Title:</b>	<b>Unbiased Efficiency Estimators: A Bayesian DEA Approach</b>
<b>Paper-ID:</b>	P118
<b>Authors:</b>	<b>Haktan Sarikaya, Panagiotis Zervopoulos, Francisco Vargas Serrano</b>
<b>Abstract:</b>	This work emphasizes the sensitivity of DEA efficiency estimators in sampling variations of the production frontier and dimensionality of the production set. It is proven that only asymptotically DEA yields unbiased efficiency estimators and that DEA estimators are upward biased for a finite sample. DEA bootstrap methods enhance the statistical properties of DEA estimators. However, major limitations, such as the asymptotic justification of the bootstrap technique and the overlapping confidence intervals of greatly diverse bootstrapped efficiency estimators, are still present. A Bayesian DEA method presented in this study yields unbiased efficiency estimators for every sample size. This new method overcomes the limitations of DEA bootstrap methods. Unlike a recent Bayesian DEA study, the new method does not use simulation techniques to derive the posterior distribution but assumes a posterior beta distribution, which achieves the best fit to DEA efficiency estimators.

**Session 5**Thursday 27<sup>th</sup> August, 2015

13:30–15:00

**Theory and Modeling; Chair: Kristiaan Kerstens****Parallel Venue 2: SN 19.3**

<b>Title:</b>	<b>How to Deal with Number of Decision Making Units and Variables in Data Envelopment Analysis</b>
<b>Paper-ID:</b>	P043
<b>Authors:</b>	<b>Dariush Khezrimotlagh</b>
<b>Abstract:</b>	Sufficient numbers of Decision Making Units (DMUs) in comparison with the number of input and output variables has been a concern of using Data Envelopment Analysis (DEA) in the last three decades. There are several studies in the literature of DEA which have tried to handle this issue by providing additional procedures to increase the number of DMUs, decreasing the number of variables or finding a relationship between the number of DMUs and variables. However, there are no concerns about the number of DMUs in comparison with the number of variables while Kourosh and Arash Method (KAM) is applied. A geometric reason is provided to depict the validity of the method without any extra conditions or additional methodologies. The technique is quite simple with no computational complexities of current methodologies even if the number of DMUs is less than the number of variables. A real-life numerical example of 32 DMUs with 45 variables demonstrates the advantages of the proposed technique.
<b>Title:</b>	<b>Support of Efficient Resource Allocation of Technological Processes by a Heuristic Solution and Agent Technology</b>
<b>Paper-ID:</b>	P049
<b>Authors:</b>	<b>Ágnes Werner-Stark, Tibor Dulai, Gyula Ábrahám</b>
<b>Abstract:</b>	The paper presents a heuristic solution, which can help in resource allocation of technological processes. The novelty is provided by the definition of a possible combination of the primary and secondary scheduling criteria and a limit value which is determined by taking into account these criteria. The data which describe the process models and their belonging resource definitions as well as the data from concrete process running are stored in a database that we have designed and implemented. The mined information from the event logs are used to increase the efficiency of the method. We applied the agent technology for the development of the system and for the implementation of more efficient operation. All functions appear in the system are represented by an own agent. Using heuristic solution and agent technology we could achieve better result in time and costs than without the use of our method.
<b>Title:</b>	<b>Virtual-Gap Measurement based Model to Assess Two-stage DEA with Shared Inputs and Shared Outputs</b>
<b>Paper-ID:</b>	P271
<b>Authors:</b>	<b>Fuh-Hwa Liu, Jun-Yan Lee</b>
<b>Abstract:</b>	Two-stage DEA have a set of inputs to the first stage, a set of outputs from the second stage and a set of intermediate measures between the two stages. This research considers a special two-stage DEA that there are additional inputs shared by the two stages and additional outputs of the first stage shared by the second stage with bounded probabilities. We constructed a two-phase procedure that is based on Virtual-Gap Measurement (VGM) model to obtain the slacks and weights of the inputs, outputs, shared inputs, shared outputs and intermediate measurements of the two stages. Phase-one is a mixed binary integer programming to partition the intermediate measures into 'as-inputs' and 'as-output' indices respect to the entire system so that the best-practice efficiency would be identified. Phase-two is to obtain the final solutions and the aggregates efficiency of the decision-making unit (DMU) against the set of peer DMUs. Its efficiencies at the first and second stages also computed.
<b>Title:</b>	<b>Frontier Metatechnologies and Convexity: A Restatement</b>
<b>Paper-ID:</b>	P223
<b>Authors:</b>	<b>Kristiaan Kerstens, Christopher O'Donnell, Ignace Van de Woestyne</b>
<b>Abstract:</b>	This contribution reconsiders the construction of metafrontiers based on underlying group frontiers using non-parametric technology specifications. We argue that the large majority of articles applying this popular methodology in fact assesses efficiency measures relative to a potentially poor approximation of the metafrontier. We develop a refined methodology for non-parametric specifications of technology yielding a proper non-convex metafrontier. Furthermore, this methodology is empirically applied on a secondary data set to verify the estimation of metatechnology ratios (as defined in O'Donnell, Rao, and Battese, 2008) as well as to illustrate the potential bias of using the currently established methods.

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13:30–15:00

**Banking and Finance; Chair: Hirofumi Fukuyama****Parallel Venue 3: SN 19.4**

<b>Title:</b>	<b>Measuring the Mutual Fund Performance in Data Envelopment Analysis</b>
<b>Paper-ID:</b>	P278
<b>Authors:</b>	<b>Haochen Guo</b>
<b>Abstract:</b>	This paper presents using Data Envelopment Analysis (DEA) to evaluate the performance and efficiency of mutual funds. The proposed DEA integrated risk assessment and ranking method for mutual fund investment. Even there are many advantages for mutual fund investment also exits opposite point of view. Like fees, less control over timing of recognition of gain, less predictable income, no opportunity to customize and so on. Hence, the evaluation of the performance of mutual funds by DEA ranking is eventful for both invest and investor of financial institutions, banking and investment institutions. DEA is one nonparametric approach which paper applies in return risk ratios as measurement of decision making units (DMUs) for mutual fund ranking. The example of discusses result presents the performance and efficiency of selected mutual fund investment in financial markets.
<b>Title:</b>	<b>Decision-oriented Performance Measurement Framework: An Emphasis on Rationality</b>
<b>Paper-ID:</b>	P121
<b>Authors:</b>	<b>Minh Hanh Le, Heinz Ahn</b>
<b>Abstract:</b>	The Decision-oriented performance measurement framework is proposed to derive criteria for assessing how organizations perform their actual goals against the expected values, given motivational and cognitive constraints. The framework design is oriented toward rationality concepts of decision making. The expected values are determined from the fundamental values of both primary and secondary stakeholders. The actual goals are specified through the strategies and behavior models of organizations. The respective correspondence is quantified via a set of rationality objectives which are modeled as value functions of input and output factors. The developed criteria are suitable for efficiency measurement models like Data Envelopment Analysis (DEA). Our study also illustrates an application of the framework which presents a solution to the on-going debate over the treatment of deposits in DEA models for measuring bank efficiency.
<b>Title:</b>	<b>Measurement of Banking Efficiency in Visegrad Countries: A DEA Window Analysis</b>
<b>Paper-ID:</b>	P144
<b>Authors:</b>	<b>Iveta Paleckova</b>
<b>Abstract:</b>	The aim of the paper is to apply the Data Envelopment Analysis (DEA) window analysis on commercial banks of the group of Visegrad countries (Czech Republic, Hungary, Poland and Slovakia) and to examine the banking efficiency of Visegrad countries' banking sectors during the period 2009-2013. We use the DEA window analysis based on an input oriented model to measure banking efficiency. There is a lack of studies in Visegrad countries examining banking efficiency using the Window DEA, which creates an opportunity for this research. The obtained results allow for an analyses of trends of the overall banking sector efficiency. The technical efficiency is analysed sequentially with a certain window width using a panel data of the commercial domestic banks. The result of the paper is that the average efficiency was decreasing during the period 2009-2013. The Hungarian commercial banks were the most efficient and the Slovak banking industry was the last efficient in both models.
<b>Title:</b>	<b>Metatechnology, Group Technologies and Nonconvexity: An Application to Japanese Banking</b>
<b>Paper-ID:</b>	P259
<b>Authors:</b>	<b>Hirofumi Fukuyama</b>
<b>Abstract:</b>	In this paper we employ the notion of metatechnology or metafrontier to assess the efficiency of Japanese banks focusing on local banking which serves individual and local business customers. These banks are classified into two groups based on their organizational types. The first group consists of commercial Regional banks, and the second comprises cooperative Shinkin banks. We introduce a metatechnology framework to examine technology gaps of innovation efficiency based on the different organizational forms and production structures.



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13:30–15:00

**Transportation and Public Sector; Chair: Ana Camanho****Parallel Venue 4: SN 19.7**

<b>Title:</b>	<b>Public Sector Contribution to Competitiveness</b>
<b>Paper-ID:</b>	P143
<b>Authors:</b>	<b>Giuliano Resce, Vincenzo Patrizii</b>
<b>Abstract:</b>	Conventional measures of competitiveness in terms of final prices shed little light on how those prices are affected by public expenditure. By taking productivity as a common factor to any index of competitiveness we propose to assess Italian Public Sector contribution by its productivity in public services provision. Integration of Data Envelopment Analysis with Principal Component Analysis provides a consistent methodology to face the problem of high dimensions, intrinsic to the multidimensional nature of public services provision and objectives. Results show a large territorial variability in Public Sector productivity and a significant differentiation in terms of both layers of government and type of services. This provides evidence to identify areas, services and tiers of government lacking efficiency and constituting a potential obstacle for growth.
<b>Title:</b>	<b>Evaluation of Efficiency and Effectiveness of Public Transport Sector of India Using DEA Approach</b>
<b>Paper-ID:</b>	P146
<b>Authors:</b>	<b>Shivi Agarwal</b>
<b>Abstract:</b>	The efficiency and effectiveness are two important issues related to the productive analysis of any public sector so this study makes an attempt to provide an overview of the general status of the public transport sector of India in terms of their productive analysis. The paper evaluates the efficiency and effectiveness of public transport sector of India using Data Envelopment Analysis (DEA) approach. Data have been collected for 34 State Transport Undertakings (STUs) for the year 2012-2013. This study uses three different DEA models with the same set of inputs but with different outputs. Fleet size, Total staff and Fuel consumption are considered as inputs. Bus Utilization (BU) is considered as output for efficiency model, passenger kilometers (PassKm) is used as a measure of output in effectiveness model. For the relationship between efficiency and effectiveness, third DEA model is used with both BU and PassKm as output variables.
<b>Title:</b>	<b>Industry Restructuring: An Analysis of Potential Horizontal Mergers among European Automobile Plants</b>
<b>Paper-ID:</b>	P246
<b>Authors:</b>	<b>Jonathan Calleja-Blanco, Emili Grifell-Tatjé</b>
<b>Abstract:</b>	The purpose of this paper is to analyze the potential gains obtained from mergers in the European automobile industry, at plant level. This paper also aims at examining whether overall industry performance can be improved by restructuring in the sector. The methodology used in this study was firstly proposed by Bogetoft and Wang (2005), based on non-parametric techniques, which allows for the examination of potential gains obtained through horizontal mergers. These are further decomposed into technical efficiency, scale and harmony effects. Technical efficiency captures individual improvements that can be obtained independently, before merging, by adapting to best practices. In contrast, size and harmony effects show full-scale merger gains. The study concludes discussing potential plausible strategies for restructuring the European automobile industry.
<b>Title:</b>	<b>A New Index to Assess Productivity Change Over Time Using Directional Distance Functions</b>
<b>Paper-ID:</b>	P071
<b>Authors:</b>	<b>Ana Camanho, Andreia Zanella, Teresa Dias</b>
<b>Abstract:</b>	This paper proposes a ratio-based productivity index to estimate productivity change using directional distance functions. The new index generalizes the Malmquist-Luenberger (ML) index, as it can account for simultaneous adjustments to inputs, desirable outputs and undesirable outputs. The ML index is derived from an output-oriented Malmquist index using the relationship between the directional distance function and the Shephard output distance function. We demonstrate that in assessments involving simultaneous input reductions and output increases, the input-oriented or the output-oriented versions of the Malmquist index could equally be used to estimate productivity change. In order to avoid an arbitrary choice of the orientation, it is proposed a new Directional Malmquist index, which is constructed using the geometric mean of the two indices. An empirical example, focusing on productivity change of the European Commercial Transport Industry, is used to illustrate the new index.

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**Education; Chair: Sahand Daneshvar****Parallel Venue 5: PK 4.1**

<b>Title:</b>	<b>Efficiency of Public Educational Expenditure in China</b>
<b>Paper-ID:</b>	P041
<b>Authors:</b>	<b>Zhiqian Yu</b>
<b>Abstract:</b>	The study investigates the efficiency of local public educational expenditure of 31 provinces in China during 2005-2010, using the Slack-based Measurement (SBM) directional distance function. The results show that public educational expenditure is the most efficient in eastern China, followed by middle and western areas. The inefficiency can be explained mostly by the number of master graduates, while the impacts of the number of undergraduates and graduates from secondary school are also significant. Additionally, bootstrap method is applied to explore the contextual factors influencing the efficiency. The results suggest that economic development and urbanization process increase the efficiency, while the state-owned industry obstructs the development.
<b>Title:</b>	<b>Measuring Inefficiency in Vietnamese Private Universities: An Application of the Bootstrap Directional Distance Approach</b>
<b>Paper-ID:</b>	P074
<b>Authors:</b>	<b>Renato Villano, Carolyn D.T.T. Tran</b>
<b>Abstract:</b>	In this paper, we evaluate the performance of private universities in Vietnam. Using data collected from 2011/12 to 2013/14, we employ an integrated DEA-based bootstrap directional distance approach to measure the inefficiencies of universities in the sector. This approach allows us to account for quasi-fixed inputs, assess the statistical precision of the estimators and construct confidence intervals of inefficiency estimates. Results from the application of this approach show a large variation in the level of efficiencies of private universities within and between academic years. Metropolitan private universities also performed better relative to those that are located outside the main cities. Our empirical findings also demonstrate the importance of a DEA-based framework for measuring the performance of higher education institutions; thereby, providing more insights to educational leaders and policy makers in assessing the role of each sector in the national higher education system.
<b>Title:</b>	<b>Efficiency Measure of British Universities with PROMETHEE Efficiency Analysis</b>
<b>Paper-ID:</b>	P037
<b>Authors:</b>	<b>Alessio Ishizaka, Bertrand Mareschal</b>
<b>Abstract:</b>	Several problem formulations exist in multi-criteria decision analysis (MCDA): choice, sorting, ranking, description, elimination. PROMETHEE has been adapted to solve most of them. In this paper, we introduce a new adaption of PROMETHEE for efficiency ranking where output and input criteria are compared. The PROMETHEE Efficiency Analysis inherits the advantages of PROMETHEE: it does not require any normalisation of the data, it uses a partial compensatory approach, preference functions and weights are associated to the criteria and it can handle criteria with a zero score. The method has been implemented in the Visual PROMETHEE software, where graphical displays facilitate the analysis. In particular, the frontier analysis and the peers (benchmarks) can be easily identified. To illustrate the method, an efficiency analysis of British universities is presented. It can be seen that high positioned universities in the preference ranking can be inefficient and vice versa.
<b>Title:</b>	<b>Computing the Malmquist Index Using Data Envelopment Analysis as an Improvement Measure for Educational Purposes</b>
<b>Paper-ID:</b>	P022
<b>Authors:</b>	<b>Sahand Daneshvar, Gokhan Izbirak, Adamu Musa Binyuy</b>
<b>Abstract:</b>	In this paper we compute the Malmquist Index (MI) using Data Envelopment Analysis (DEA) considering some criteria from the Accreditation Board for Engineering and Technology (ABET) that is student outcomes as an improvement measure for educational purposes. As DEA measures the efficiencies of the student's performance using a defined set of inputs and outputs, "Malmquist index" conflate the efficiencies with other factors such as surveys (relating instructors and students) to compute an index for a course or program which can be compared to unity. Based on this, an educational Malmquist index is defined called Malmquist Educational Index (MEI), to evaluate Student Outcomes, performance and monitor continuous improvement of educational programs. A case study is used, with real data from the Department of Industrial Engineering, Eastern Mediterranean University, which show clearly the ability of MEI as a direct method for productivity evaluation of ABET accredited program.

# Abstracts

## Session 5

Thursday 27<sup>th</sup> August, 2015

13:30–15:00

Theory and Modeling; Chair: Victor Podinovski Parallel Venue 6: PK 4.4	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Symmetric Error Structure in Stochastic DEA</b> P062 <b>Mohammad Hassan Behzadi, Mahnaz Mirbolouki</b> Stochastic programming is an approach for modeling and solving optimization problem that include uncertain data. Chance constrained programming is one of the most important methods of stochastic programming. In many real world data envelopment analysis (DEA) models, exact amount of data cannot be determined. Therefore several researchers proposed methods to evaluate stochastic efficiency of units with random inputs and/or outputs. Most of these methods are nonlinear. In this paper by introducing symmetric error structure for random variables, a linear form of stochastic CCR is provided.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Estimating Right- and Left-hand Returns to Scale in the Presence of Undesirable Factors: A DEA Approach</b> P032 <b>Mohammad Khoveyni, Robabeh Eslami</b> This study specifies right- and left-hand RTS of strong efficient DMUs with desirable and undesirable data in DEA. All of the existing RTS methods are capable of determining RTS only for desirable data while in real world, both desirable and undesirable data may be present. This fact is the motivation of creating this research. Hence, an input-output oriented model is first proposed to identify strong efficient DMUs and then, right- and left-hand RTS of these DMUs are estimated by introducing two new non-radial models. One of the benefits of our proposed method is that it is able to determine strong efficient DMUs, and the second one is that it is capable of estimating right- and left-hand RTS of these DMUs in the presence of undesirable data while in this situation, the existing RTS methods are incapable of identifying RTS. This matter is the main drawback of the existing methods which is removed in this study. Finally, a case study is presented to highlight the proposed method.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>An Improved DEA-SVR Method for Predicting Efficiency of Large DMUs</b> P207 <b>Mohammadreza Farahmand, Mohammad Ishak Desa, Ali Emrouznejad, Mehrbakhsh Nilashi</b> Data Envelopment Analysis (DEA) is computationally intensive. As was demonstrated in previous methods, for large Decision Making Units (DMUs) set, DEA needs huge computer resources in terms of memory and CPU time. In this regard, in a new combined method proposed using DEA and SVR (DEA-SVR) for efficiency evaluation of large DMUs to solve some drawbacks which include uncontrolled convergence, non-generalization. However, in this paper, we develop DEA-SVR method based on two new normalization functions and other kernel functions in SVR. In addition, we show selecting parameters of $\epsilon$ -SVR or $\nu$ -SVR are very important in improvement of DEA-SVR method. As a result, selecting the suitable kernel function, normalization function, SVR models and their parameters can play important role in achieving noticeable results for improving accuracy and computation time. Finally, experimental results demonstrated that the proposed method outperforms the earlier developed DEA-SVR method.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Improving Weight Dispersion and Discrimination Power in DEA Model Using Fuzzy Concept</b> P051 <b>Mohammadreza Ghasemi, Joshua Ignatius</b> This study proposes a fuzzy concept framework to extend the data envelopment analysis (DEA) model in the aspects of discrimination power and weight dispersion. Fuzzy numbers are used to define a triangular fuzzy number associated with the output weights in the model by providing the upper bounds of the output weights for all DMUs. The upper bound for each output weight is considered as a fuzzy set and is further transformed into a fuzzy number. Then the constraints of fuzzy restrictions on the output weights are defined. By adding these constraints into the DEA model instead of the non-negative constraints, the DEA with fuzzy restrictions on the output weights will be named as DEA-FWeR model. The validity of the proposed model has been tested and its usefulness has been illustrated using an established numerical example.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Combining the Assumptions of VRS and CRS in One DEA Model: An Application to Schools</b> P103 <b>Victor Podinovski</b> We consider an application of DEA to the assessment of performance of schools. In this application we assume that some students (output) exhibit CRS with respect to teachers (input). However, the academic performance of students on exit (output) and entry (input) cannot be assumed to exhibit CRS and is modelled by the VRS assumption. A suitable model for this context is the hybrid returns-to-scale model. The HRS model combines the assumption of CRS with respect to a subset of inputs and outputs, while retaining VRS with respect to the remaining measures. We discuss the assumptions of HRS in detail, explain the structure of the model and comment on computational results.

## Session 5

Thursday 27<sup>th</sup> August, 2015

13:30–15:00

**Other Applications; Chair: Adel Hatami-Marbini  
Parallel Venue 7: Neuer Senatssitzungssaal**

<p><b>Title:</b> Performance Evaluation of India States in terms of Socio-economic Indicators  <b>Paper-ID:</b> P203  <b>Authors:</b> Chiranjib Neogi, Labanya Pal  <b>Abstract:</b> Some socio-economic indicators can be identified as services produced by regional government using some inputs. DEA has been proposed as a method for measuring relative efficiencies of regional governments as DMUs. The differences in the capacity of utilization of grants and revenue by the states are probably most important for explaining the disparities among the states that develop successfully and those that do not. The government objective is to go for a more egalitarian society, coupled with balanced development of different regions. In this paper we have run a DEA using some services as output produced by some inputs by different state governments in India. We then try to decompose the TFP into some components. Finally we have tried to get some idea about the factors responsible for the variation of efficiencies of the state governments.</p>
<p><b>Title:</b> Does it Make a Difference? The Development of a Performance Appraisal Based on DEA and Employee's Responses to it  <b>Paper-ID:</b> P204  <b>Authors:</b> Manuela Koch-Rogge, Georg Westermann  <b>Abstract:</b> A crucial part in strategy management is the strategy implementation. In order to permeate the whole organization, the strategy implementation comprises the cascading of the company's strategic objectives into sub-targets. An important requirement to obtain a solid basis for determining achievable, but challenging performance targets to measure employee's performance properly. In practice, there are many obstacles to the development of an appropriate performance appraisal (PA). Performance appraisals therefore are often experienced as "unfair". Throughout our presentation we will outline the standards for "good" performance measures and propose the DEA as a method for a PA on individual level. Using the example of a German cooperative bank, we apply a multi-stage DEA approach to measure employee performance and report on the results and employees' response to it. Subsequently it is illustrated how strategies on both individual and company level may be derived.</p>
<p><b>Title:</b> The Environmental Cost of Human Development: A Data Envelopment Analysis Approach  <b>Paper-ID:</b> P242  <b>Authors:</b> Soulef Khalfallah  <b>Abstract:</b> The Human Development Index is considered as the principal measure of countries' development. Nevertheless, not enough attention has been given to how this development was achieved. This paper suggests a measure of the efficiency of human development through an example of 59 developed countries by considering both inputs to human development and its outputs. The inputs considered in this paper are spending on health and on education, and natural resources depreciation. The outputs are the traditional human development components. Out of this context, three DEA models are compared. In the first model, CO<sub>2</sub> emissions are considered as an input to human development. In the second model, CO<sub>2</sub> emissions are considered as an undesirable output. The third model ignores CO<sub>2</sub> emissions. Based on the generated results, we propose a classification of countries into seven categories.</p>
<p><b>Title:</b> Performance Evaluation of R&amp;D Firms for Generating Insights into Innovation Systems  <b>Paper-ID:</b> P261  <b>Authors:</b> Pegah Khoshnevis, Peter Teirlinck, Adel Hatami-Marbini  <b>Abstract:</b> Due to the speed of technology change and market development, R&amp;D active firms that are viewed as an important and effective anchor of facilitating future product development and economic growth, although R&amp;D is not often aimed to generate immediate profit. Prior studies have shown that there is no positive linear correlation between the total R&amp;D investment and the R&amp;D growth while it is crucial for policy makers to ensure the performance of (supported) R&amp;D firms in disseminating innovations. We evaluate the performance of Belgian R&amp;D active firms. We therefore use data envelopment analysis (DEA) to gauge the multi-dimensional performance of R&amp;D firms in Belgium. Such research sets out to create a classification of firms with regard to the linkage between R&amp;D and firm performance.</p>

## E-slide Session

Other Applications	
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Evaluating Iran SME's R&amp;D Efficiency Provinces using DEA</b> P210 <b>Mohammadreza Rasol Roveicy, Mehdi Sheikhzadehmarand, Morteza Rasol Roveicy</b> This paper compares research and development (R&D) efficiency across Iran provinces in the field of SME's R&D of Iran based on various output-oriented R&D efficiency indices that are developed by the data envelopment analysis approach. Resources regarding SME's R&D in Iran are distributed uneven. Therefore it important to know this level dispersion somewhat by using a methodology known as Data Envelopment Analysis to plan better for the usage of suitable resources among different provinces efficiently in the country since the resources are limited. The emergence of some of the provinces on the efficiency frontier indicates that these provinces can also serve as benchmarks for their efficient use of R&D resources. The inefficiency in the R&D resource usage highlighted by this study indicates the underlying potential that can be tapped for the development and growth of Iran provinces. This study would be helpful in understanding the drawbacks Iranian National Innovation System.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>X-Efficiency of Indian Commercial Banks and Their Determinants of Service Quality: A Study of Post Global Financial Crisis</b> P112 <b>Gagandeep Sharma, Divya Sharma</b> The Indian banking system is an important component of the economy and its sustainability is essential to attain economic growth. In the present scenario, the Indian banking system needs to be flexible and competitive. For the banks to be efficient and survive in the system, having larger customer satisfaction base is now a necessary condition. In 2007 Global banking sector was severely affected by financial crisis and the economies took time to recover from this crisis. Therefore, it was felt important to study efficiency after this crisis. X-efficiency is an economic term that gives the ways by which a firm is utilizing its resources and labour to produce results. An attempt has been made to study the X-efficiency of Indian commercial banks for the post financial crisis period i.e. 2007-14 using Data Envelopment Analysis method and also identifying important determinants of service quality of efficient banks by applying factor analysis.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Demand and Supply Evaluation of Urban Facilities Needed for Management of Tehran after an Earthquake: A DEA Approach</b> P272 <b>Mohammad Taleai, Amir Hosein Rahnama</b> Optimal distribution of urban emergency facilities is one of the important issues for management of the crisis caused by an earthquake. In this paper, with modeling of the supply and demand for emergency facilities, balanced spatial distribution of emergency facilities is evaluated using DEA and spatial analysis. Two scenarios are developed for day and night and lack of supply or excess demand in every region of the Tehran is calculated. The results provide useful information for decision makers regarding the regions have a shortage on the emergency facilities. The results of using CCR method of DEA indicate that in the day scenario, regions 9, 10 and 22 and in the night scenario regions 10, 16 and 19 have good balance between supply and demand of the facilities. The results of using BCC method of DEA indicate same result in the day scenario and in the night scenario regions 19, 4 and 16 have good situation.
<b>Title:</b> <b>Paper-ID:</b> <b>Authors:</b> <b>Abstract:</b>	<b>Technical Efficiency and Potential Productivity Gains of Cereal Farms in Iran</b> P024 <b>Mohammad Ali Nasser Jahromi, Erfaneh Rasekh Jahromi, Jalil Kodaparast, Atthar Rasekh Jahromi, Reza Nasser Jahromi</b> The method of DEA to measure technical efficiency (pure technical efficiency and scale) grain operators in Iran. The observed improvement is due to the increase in pure technical efficiency (management), including training, equipment, and the quality of human resources. We use a non parametric approach in an intertemporal framework (3 years) to estimate technical inefficiency and scale grain farms. Measured inefficiencies are interpreted as potential productivity gains, translated here as increased cereal yields per hectare. The total absorption of the technical inefficiency and lead to an 11% increase in crop yields and thus increase the food security of our country.



*Hofbrauhaus Wolters*

