CORE EUROPEAN WORKSHOP 1995

Provisional program (as of June 5, 2007)

SESSION 0.1 Thursday 26/10/95
ADVANCES IN EFFICIENCY ANALYSIS
Chair & Discussant: C.A.K LOVELL, University of Georgia

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1. Multiple Comparisons with the Best, with Application to the Efficiency Measurement Problem
   William C.HORACE Peter SCHMIDT
   Michigan State Univ Michigan State Univ.
2. Non Parametric Approaches to Stochastic Frontier Analysis
   Leopold SIMAR Alois KNEIP.
   Inst. of Stat. UCL Louvain Inst. of Stat. UCL Louvain
3. A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data
   G.E. BATTESE Tim.J COELLI
   Univ. New England Univ. New England

SESSION 1.1 Friday 27/10/95 ADVANCES IN PRODUCTIVITY ANALYSIS
Chair & Discussant: Finn FORSUND
University of Oslo

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4. A Quasi-Malmquist Productivity Index
   Emili GRIFELL-TATJÉ C.A.K LOVELL J.T. PASTOR
   Univ. Aut. Barcelona Univ. Georgia Univ. Alicante
5. A New Transitive Productivity Index
   Bert BALK Rikard ALTHIN
   Statistics Netherlands The Swedish Inst. for Health Econ.
6. Estimating Productivity Growth Using Distance and Non-Distance Measures
   Scott E. ATKINSON Christopher CORNWELL
   Univ. Georgia Univ. Georgia
7. DEA, DFA and SFA: A Comparison
   Lennart HJALMARSON Subal KUMBHAKAR Almas HESMATI
   Univ. Gothenburg Univ. Texas Univ. Gothenburg

Reconstruction based on information provided by H. Tulkens.

SESSION 1.2 Friday 27/10/95 PROFIT EFFICIENCY
Chair & Discussant: Lennart HJALMARSSON, University of Gothenburg

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8. Nonparametric Dynamic Efficiency Measurement: A Profit Approach
   Elvira SILVA Spiro STEFANOU
   Pennsylvania St. Univ. Pennsylvania St. Univ.
9. Profit Efficiency of Saving Banks
   Vivas Ann LOZANO
   Univ. Malaga
10. Profit Functions of Technologies with Inefficiency: Some Results and Their Implications
   Subal C. KUMBHAKAR
   Univ. Texas

SESSION 1.3a Friday 27/10/95 SIZE & EFICIENCY
Chair & Discussant: Sverre KITTELSEN, SNF, Oslo

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11. Hospital Mergers and Efficiency
   Harold O. FRIED Suthathip YAISAWARNG
   Union College, Union College
12. Are Inefficient Banks more Likely to Disappear
   David C. WHEELOCK Paul W. WILSON
   Fed. Res. St Louis Univ. Texas
13. Quantity, Quality, and Efficiency for a Partially Super-Additive Cost Function: Connecticut Public Schools Revisited
   Subbash C. RAY Kankana MUKHERJEE
   Univ. Connecticut, Storrs Univ. Connecticut, Storrs

SESSION 1.3b Friday 27/10/95 SENSITIVITY IN NONPARAMETRIC MODELS
Chair & Discussant: Etienne LOUTE
CORE & Université Catholique de Louvain

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14. Effects of excluding the column being scored from the DEA envelopment LP technology matrix
   J.H.DULA B.L.HICKMAN
   Univ. of Mississippi Univ. of Nebraska, Omaha
15. A Statistical Test for Nested Radial DEA Models
   J.T.PASTOR J.L.RUIZ I.SIRVENT
   Univ. Alicante Univ. Alicante Univ. Alicante
16. Application of Facet Analysis to Detect Ill-Conditioning of Selected Data Sets
   Niels C. PETERSEN Ole OLESEN

Odense Univ. Odense Univ.

SESSION 1.4a Friday 27/10/95 EUROPEAN BANKING
Chair & Discussant: Henry TULKENS
CORE & Universite Catholique de Louvain

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17. Efficiency Analysis in Banking Firm: An International Comparison
José Manuel PASTOR Francisco PEREZ Javier QUESADA
Univ. de Valancia IVIE & Univ.Valancia IVIE & Univ.Val.

18. Should Banks Be "Universal"? The Relationship between Economies of Scope and Efficiency in the French Banking Industry
Mohamed CHAFFAI Michel DIETSCH
Univ. of Sfax Univ. R. Schuman Strasbourg

19. Technology and Cost Efficiency in Universal Banking : A "Thick Frontier" Analysis of the German Banking Industry
Günter LANG Pieter WELZEL
Univ. Augsburg Univ. Augsburg

20. DEA and Benchmarks for Nordics Banks
Göran BERGENDAHL
University of Gothenburg

SESSION 1.4b Friday 27/10/95 INCENTIVES & EFFICIENCY
Chair & Discussant: Shawna GROSSKOPF
Southern Illinois University, Carbondale

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21. Regulation towards Efficiency and Yardstick Competition
Pierre WUNSCH
Bureau du Plan

22. Yardstick Competition in a Dynamic Setting
Dag Morten DALEN
University of Oslo

23. Merging DEA and Subjective Performance Evaluation
Jens Leth HOUGAARD
Univ. Copenhagen

SESSION 2.1a Saturday 28/10/95 PUBLIC SECTOR ACTIVITIES
Chair & Discussant: Bruno DE BORGER
UFSIA, Antwerpen

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24. Measuring and Explaining the production and technical Efficiency of Tax Offices
Wim MOESEN Annick PERSOONS
K.U. Leuven K.U. Leuven

25. Museums Efficiency
Odile PAULUS
Univ. R. Schuman

26. Technical Efficiency Measurement and Explanation of French Urban Transit Companies
Kris KERSTENS
UFSIA, Antwerpen

27. Efficiency of State Firms in Bulgarian Industry: Microeconomic Evidence of an Empirical Study
Malinka S. KOPARANOVA
Bulgarian Academy of Sciences

SESSION 2.1b Saturday 28/10/95 METHODOLOGICAL ADVANCES
Chair & Discussant: Philippe VANDEN EECKAUT
CORE & Universite Catholique de Louvain

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28. Scale Efficiency and Scale Elasticity in DEA-Models: A Bootsrapping Approach
Mickael LöTHGREN Magnus TAMBOUR
Stockholm School of Eco. Stockholm School of Eco.

29. A Mathematical Programming Approach for Measuring Technical Efficiency in a Fuzzy Environment
Konstantinos TRIANTIS Olivier GIROD
Virginia Tech Virginia Tech

30. Bayesian Efficiency Analysis through Individual Effects:
Gary KOOP Jacek OSIEWALSKI Mark F.J.STEEL
Univ. Toronto Ac. of Economics, Krakow Center, Tilburg

31. Recherche des déterminants de l'efficacité par application d'une régression linéaire sur variable d'ordre
B.DERVAUX F.JOUNEAU H. LELEU
CRESGE Univ Cat. Lille CORE Univ. Cat. Louvain CRESGE Un.Cat.Lille

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SESSION 2.2a Saturday 28/10/95 EXTERNALITIES
Chair & Discussant: Bernard THIRY
Université de Liege & CIRIEC

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32. Agriculture's Environmental Externalities Is There a Free Lunch? DEA Evidence for French Agriculture
PIOT I. VERMERSCH D. WEAVER R. D.
INRA, Rennes INRA, Rennes Pennsylvania Univ.

33. DEA Models for the Measurement of Environmental Performance of Firms: Concepts and Empirical Results
Daniel TYTECA
IAG, Louvain-la-Neuve

34. Productivity and Spillover of Local Public Capital
D.BOISSO K.HAYES S.GROSSKOPF
South. Metho. Univ. South.Ill. Univ.

35. Efficiency Analysis in Generation and Distribution of Electric Energy in Spain (1984-1991)
Manuel E. ESCUER Lucia I. G. CEBRIAN
Univ. Zaragoza Univ. Zaragoza, GREMAQ

SESSION 2.2b Saturday 28/10/95 NUMERICAL EXPERIMENTS
Chair & Discussant: Lawrence SEIFORD
University of Massachusetts, Amherst

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36. Numerical Aspects of DEA & FDH Measurement
Philippe VANDEN EECKAUT
CORE Univ. Cat Louvain

37. Numerical Aspects of Fuzzy Analysis
Antreas ATHANASSOPOULOS Konstantinos TRIANTIS
Univ. of Warwick Virginia Tech

38. Numerical Aspects of Bootstrapping
Paul W. WILSON
Univ. Texas

39. Numerical Aspects of Bayesian Efficiency Analysis
Jacek OSIEWALSKI
Ac. of Economics, Krakow

SESSION 2.3 Saturday 28/10/95 INTERNATIONAL PRODUCTIVITY STUDIES
Chair & Discussant: Jacques MAIRESSE
ENSAE-CREST

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40. East Meets West: A comparison of the Productive Performance of Eastern European and Western European Air Carriers
David H. GOOD — Indiana University
Robin C. SICKLES — Rice University

41. Productivity Convergence in OECD Services Industries
Claudine GOUYETTE — CREPP, Univ. Liège
Sergio PERELMAN — CREPP, Univ. Liège

42. Productivity Convergence, Technical Progress and Outward-Oriented Trade Regimes`
Fatma TASKIN
Bilkent University

43. Ownership Structure and Technical Efficiency in Chinese Enterprise
Xiaxuan LIU — Chinese Ac, Beijing
Jinghai ZHENG — Univ. Gothenburg
Arne BIGSTEIN

44. Mesures de la Croissance de la Productivité dans un Cadre d'équilibre général : l'économie du Québec entre 1978 et 1984
Pierre MOHNEN — Univ. Québec, Montréal
Thijs TEN RAA — Tilburg Univ.
Gilles BOURQUE — Univ. Québec

FOURTH EUROPEAN WORKSHOP ON EFFICIENCY AND PRODUCTIVITY ANALYSIS

Louvain la Neuve, October 26 - 28, 1995

BOOK OF ABSTRACTS

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SESSION 0.1 - ADVANCES IN EFFICIENCY ANALYSIS

Chair & Discussant : C.A. Knox LOVELL, University of Georgia

Thursday October 26 - 4:30 - 6:30 p.m.

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1. Multiple Comparisons with the Best, with Application to the Efficiency Measurement Problem

William C. HORRACE, Michigan State University
Peter SCHMIDT, Michigan State University

In this paper we examine a statistical method for performing simultaneous inference on all distances from the "best" called multiple comparisons with the best or simply MCB. While typically applied to controlled experiments, we find that MCB has applications in the economic literature. Specifically, it can be used on stochastic production frontier models for panel data to construct simultaneous confidence intervals for technical inefficiency and to perform inference on maximum efficiency measure, were previously no methods had been suggested.

Additionally, it may suggest consistent point-estimates for technical inefficiency and maximum efficiency with less positive bias than estimators currently exploited in the economics literature. Finally, experiments on these confidence intervals provide insights into the sources of uncertainty in productivity estimation. We use MCB to perform inference and point-estimation on some previously analyzed stochastic frontier data.

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2. Non Parametric Approaches to Stochastic Frontier Analysis

Leopold SIMAR Institut de Statistique and CORE, Université Catholique de Louvain
Alois KNEIP, Institut de Statistique and CORE, Université Catholique de Louvain

The main objective of the paper is to present a general framework for estimating production frontier models with panel data: a sample of firms $i = 1, ..., N$ isobserved on several time periods $t = 1, ..., T$. In this framework, nonparametric stochastic models for the frontier will be analysed. The usual parametric formulations of the literature are viewed as particular cases and the convergence of the obtained estimators in this general framework are investigated. Special attention is devoted to the role of N and of T on the speeds of convergence of the obtained estimators. First, a very general model is investigaated, in this model almost no restriction is imposed on the structure of the model or of the inefficiencies. This model is estimable from a

nonparametric point of view but needs large values of T and of N to obtain reliable estimates of the individual production functions and estimates of the frontier function. Then more specific nonparametric firm effect models are presented. In these cases, only NT must be large to estimate the common production function; but again both large N and T are needed for estimating individual efficiencies and for estimating the frontier. The methods are illustrated through a numerical example with real data.

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3. A Model for Technical Inefficiency Effects in A Stochastic Frontier Production Function for Panel Data

George E. BATTESE, University of New England, Armidale, Australia
Tim J. COELLI,University of New England, Armidale, Australia

A stochastic frontier production function is defined for panel data on firms, in which the non-negative inefficiency effects are assumed to be a function of firm-specific variables and time. The inefficiency effects are assumed to be independently distributed as truncations of normal distributions with constant variance, but with means which are a linear function of observable variables. This panel data model is an extension of recently proposed models for inefficiency effects in stochastic frontiers for cross-sectional data. An empirical application of the model is obtained using up to ten years of data on paddy farmers from an Indian village. The null hypotheses, that the inefficiency effects are not stochastic or do not depend on the farmer-specific variables and time of observation, are rejected for these data.

SESSION 1.1 -ADVANCES IN PRODUCTIVITY ANALYSIS

Chair & Discussant : Finn FORSUND, University of Oslo

Friday October 27 - 9:00 - 10:40 a.m.

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4. A Quasi-Malmquist Productivity Index

Emili GRIFELL-TATJÉ, University Autonoma of Barcelona
C. A. Knox LOVELL, University of Georgia
Jesus T. PASTOR, University of Alicante

The Malmquist productivity index is based on distance functions, which are reciprocals of radial Debreu-Farrell efficiency measures, and which have a number of desirable properties. Linear programming techniques are frequently employed to calculate the efficiency measures. However these techniques can leave slacks, which constitute a non-radial form of inefficiency which is not incorporated into the analysis. Thus a radial efficiency measure overstates true efficiency, and the Malmquist productivity index is adversely affected, although in an unknown direction. This has led us to develop a new non-radial efficiency measure which does incorporate slacks, and which corresponds to Koopmans' definition of efficiency. Replacing distance functions with reciprocals of the non-radial efficiency measures generates what we call a quasi-Malmquist productivity index. This new productivity index possesses the desirable property (which the Malmquist productivity index does not possess) of the inclusion of slacks. We illustrate our Quasi-Malmquist productivity index with an application to productivity change in Spanish banking.

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5. A New Transitive Productivity Index

Bert BALK, Statistics Netherlands
Rikard ALTHIN, The Swedish Institute for Health Economics

The Malmquist productivity index is not transitive. This paper argues that, instead of trying to accomodate this two-period concept to a multi-period setting, it is preferable to look at the measurement of productivity, efficiency and technical change in a multi-period setting from the outset. A new, transitive productivity index is developed with as by-product a measure of the non-neutrality of technical change. The various indices are illustrated on a panel data of swedish pharmacies

6. Estimating Productivity Growth Using Distance and Non-Distance Measures

Scott E. ATKINSON, University of Georgia
Christofer CORNWELL, University of Georgia

Since the pioneering work of Solow (1957), econometric measurement of technical change (TC) and growth in total factor productivity (TFP) has focused on estimation of cost, distance, or production functions, using time to shift these functions. Since distance and production functions have endogenous input quantities as arguments, we derive dual cost functions which allow parameterization of input and output-based distance measures of TFP and TC. We demonstrate that the standard approach, which treats time as an argument of the cost function, does not yield a distance measure of TFP. Using airline panel data and the time dummy variable specification for TFP, the standard (input distance) measure of the average annual increase in quantity-weighted TFP is approximately 0.7 (-0.25) percent, a difference of about one percent. However, aggregation masks greater differences between distance and non-distance measures at the firm level. For our disaggregate models, the standard measures indicate positive growth for all airlines, while the distance measures indicate modest positive growth for three of the four largest airlines and negative growth in TFP (as much as -4 percent) for all small airlines.

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7. DEA, DFA and SFA: A Comparison

Lennart HJALMARSSON, University of Gothenburg
Subal KUMBHAKAR, University of Texas at Austin
Almas HESMATI, University of Gothenburg

In recent years several models have been proposed to estimate time-varying technical inefficiency. These models differ to a great extent in specification and estimation. This paper undertakes a comparison between DEA, deterministic parametric frontiers and stochastic frontiers. The focus is on the temporal pattern of efficiency. The empirical part is based on an unbalanced panel data from the Colombian cement plants over the period 1968-1988. We compare the productive performance of different plants in terms of returns to scale, technical progress and technical efficiency measures.

SESSION 1.2 - PROFIT EFFICIENCY

Chair & Discussant : Lennart HJALMARSSON, University of Gothenburg

Friday October 27 - 11:00 - 12:45 a.m.

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8. Nonparametric Dynamic Efficiency Measurement: A Profit Approach

Elvira SILVA, Pennsylvania State University
Spiro STEFANOU, Pennsylvania State University

Recovering technological information from intertemporal profit maximizing behavior is possible without assuming any parametric functional form for the firm's production technology. A nonparametric dynamic dual profit approach to production analysis is suggested based on a generalization of the nonparametric static dual approach developed by Varian. The theoretical framework developed in this study is applied to evaluate dynamic efficiency.

The dynamic analysis of efficiency can be briefly characterized by two features. Firt, production efficiency is analyzed by taking explicit account of firms continuously engaged in a dynamic investment program and the existence of adjustment costs underlying any investment decisions. Second, dynamic efficiency is evaluated without explicitly or implicitly imposing any parametric functional form on the production technology of the firm. More specifically, dynamic efficiency is analyzed in a nonparametric framework using Data Envelopment Analysis (DEA) and the concept of the dynamic gauge function. Nonparametric measures of technical, allocative and scale efficiency are derived for each firm. Given the sources of inefficiency may be in the allocation of the perfectly variable inputs or in the employment of the quasi-fixed factors, a decomposition of the global measures of technical and allocatie efficiency into individual measures defined in the output-variable input space and output-dynamic factors space is proposed. An empirical application evaluating dynamic efficiency of Pennsylvania dairy operators for the time period 1986-1992 is in progress and results will be incomporated into the final version of the presented paper when available.

9. Profit Efficiency of Spanish Savings Banks

Ana LOZANO-VIVAS University of Malaga

Frontier profit efficiency are examined for Spanish savings banks over 1986-1991, a period in which the Spanish banking industry has seen considerable deregulation.

The effect of deregulation on the cost efficiency of the Spanish savings banks has been investigated earlier. However, cost efficiency is only one part of a two-part response to deregulation. By using profit function we determine both revenue as well as cost effects that follow deregulation. Because the standard profit function model assumes perfectly competitive markets for outputs and inputs, and it is found that financial institutions operate in imperfectly competitive markets, we use an alternative profit function specification reflecting market power in the output market. Profit efficiency is determined using the thick frontier approach, and estimated using both the alternative and standard profit function specification.

Our results using the alternative profit function suggest that profit inefficiency averaged 28 % at Spanish savings banks over 1986-1991 but had a forty percent reduction. The standard profit function, which we believe yields less reliable results, generated greater average inefficiency and showed a smaller decrease over the period.

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10. Profit Functions of Technologies with Inefficiency: Some Results and Their Implications

Subal C. KUMBHAKAR, University of Texas at Austin

This paper derives profit functions of technologies accommodating both technical and allocative inefficiency. It establishes an exact relationship between output technical inefficiency and profit loss therefrom (profit technical inefficiency) using a translog profit function. We show that if the profit function is translog, some popular approaches used in modeling technical and allocative inefficiency are incorrect. In particular, we show that: (i) the models that fail to include technical inefficiency and consider only allocative inefficiency yield biased and inconsistent parameter estimates; (ii) technical inefficiency cannot be modeled simply by appending a non-positive firm-specific term (either random or fixed) in the profit function; (iii) technical and allocative inefficiency depends on allocative inefficiency and vice versa; and (iv) profit shares are affected by both technical and allocative inefficiency.

We develop estimation procedures for both cross-sectional and panel data models. Estimation of the cross-sectional models are based on the distributional assumptions on output technical inefficiency and the stochastic noise components. The estimation method is maximum likelihood. Predictions of firm-specific output and profit technical inefficiency are also considered.

SESSION 1.3a - SIZE & EFFICIENCY

Chair & Discussant : Sverre KITTELSEN, SNF, Oslo

Friday October 27 - 2:00 - 3:40 p.m.

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11. Hospital Mergers and Efficiency

Harold O. FRIED, Union College, Schenectady, N.Y.
Suthathip YAISAWARNG, Union College, Schenectady, N.Y.

Between 1980 and 1988, there were approximately two hundred hospital mergers. Hospitals may choose to merge to gain market power and/or to lower costs. To the extent that mergers produce gains in efficiency, they contribute to lowering the costs of health care. In evaluating proposals for hospitals to merge, lower cost is an important benefit to consider. However, since efficiency gain is only one of a number of motivations for hospitals to merge, there is no assurance that mergers will produce lower costs. The purpose of this paper is to examine hospital mergers to determine the implications for efficiency and therefore costs.

DEA is used to identify the impact of hospital mergers on productive and scale efficiency. Specifically, Farrell technical efficiencies relative to different returns to scale frontiers are computed. The sample includes pre-merger observations and subsequent observations on the merged unit. For each merger case, pre-merger and post-merger efficiency indices are calculated. The pre-merger index, which represents the predicted efficiency of the merged unit if merger has no effect on efficiency, is compared to the post-merger index to determine the efficiency gain or loss due to merger. Scale efficiency is also computed.

12.Why do Banks Disappear? The Determinants of US Bank Failures and Acquisitions

David C. WHEELOCK, Federal Reserve St Louis
Paul W. WILSON, University of Texas at Austin

This paper examines the determinants of bank failures and acquisitions in the United States during 1984--1993. We estimate competing risks hazard models with time-varying covariates. The hazard models include various financial ratios, environmental variables, and measures of cost and technical inefficiency that reflect management quality. We find that the environmental and financial variables have the expected effect on the estimated instantaneous probability of failure and acquisition. Cost inefficiency greatly increases the probability of being acquired, which may account for its perverse negative impact on the likelihood of failure. Technical inefficiency appears unhelpful for explaining either failures or acquisitions.

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13. Quantity, Quality, and Efficiency for a Partially Super-Additive Cost Function: Connecticut Public Schools Revisited

Subbash C. RAY, University of Connecticut, Storrs
Kankana MUKHERJEE, University of Connecticut, Storrs

The dual cost function is partially super-additive when an output quantity bundle of a given quality can be produced at a lower cost by breaking up the output into a number of smaller bundles of the same quality to be produced by several firms instead of being producing the entire bundle by a single firm. In this paper, we build on Maindiratta's concept of size efficiency and propose a nonparametric method using mixed integer programming to measure cost efficiency allowing for partial super-additivity of the cost function. The procedure allows us to identify those DMUs, which are "too big" to be fully cost efficient as single units and are candidates for decentralization. In such cases, we are also able to determine the optimal number of smaller units that can collectively produce the observed output (quantity and quality) at the least cost. The proposed method is applied to data from Connecticut public shool districts for the years 1980-81 through 1983-84. We find that most of the urban public shood districts (like Hartford, Bridgeport, and Stamford) are cost-efficient as single DMUs; but considerable cost saving could be achieved by breaking them up into a number of smaller districts functioning independently. Somewhat surprisingly, however, even some affluent suburban school districts like Greenwich, Westport, and West Hartford are candidates for break up.

SESSION 1.3b - SENSITIVITY IN NONPARAMETRIC MODELS

Chair & Discussant : Etienne LOUTE, CORE and FUSL, Bruxelles

Friday October 27 - 2:00 - 3:40 p.m.

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14. Effects of excluding the column being scored from the DEA envelopment LP technology matrix

Jose H. DULA, University of Mississipi
Betty L. HICKMAN, University of Nebraska, Omaha

The reformulation of the envelopment linear programs in DEA to score a DMU by excluding the corresponding column vector containing the input and output data from the technology matrix appears natural although it raises several theoretical and computational issues. This idea has been proposed before but not until Andersen and Petersen [1993] is it offered in lieu of the standard approach. However, several issues associated with this proposed modification to standard DEA analysis remain to be formally and comprehensively explored. One such issue is the feasibility of the resultant LPs which, as it turns out, is not guaranteed under this modification with the standard approach; the impact on the problem of pervasive degeneracy in the LPs; and the interpretation of the optimal solutions. This paper formally investigates these issues so as to provide both a firm theoretical basis for the proposed modification to the envelopment LP formulation in the CCR and BCC models in DEA and a thorough analysis of the surrounding issues.

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15. A Statistical Test for Nested DEA Models

Jesus T. PASTOR, University of Alicante
Jose LuisRUIZ, University of Alicante
Inmaculada. SIRVENT, University of Alicante

In this paper we present a method for the comparison of two nested radialDEA models. One of the models can be obtained by adding (removing) a certain number of variables to (from) the other model. We define a new "efficiency contribution measure" which compares the efficiency scores of the two nested models. First, we deal with the one variable case, quantifying the contribution of a variable to the efficiency score within a DEA model specification set and proposing a nonparametric test to state whether the magnitude of this contribution is significant or not from a statistical point of view. Using this method in a sequential way we devise a forward procedure for the addition of variables to a given DEA model. Next, we extend our method to the comparison of any two nested models. In particular,we define a backward procedure in order to simplify a given DEA model and show which variables to remove, if any. Our methodology is also valid for tackling other related problems such as the aggregation or disaggregation of variables or whether scale efficiency is relevant or not in any given experimental setting.

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16. Probabilistic Bounds on the Virtual Multipliers in DEA

Niels C. PETERSEN, Odense University
Ole OLESEN, Odense University

The paper is concerned with an incorporation of probabilistic bounds on the virtual (output) multipliers in DEA. The resulting model involves stochastic programming and is developed within the framework of chance constrained programming theory. The multipliers are bounded by the requirement that the angle between the vector of optimal (output) multipliers and a corresponding stochastic benchmark vector is not allowed to exceed some level, a, to be specified a priori. The ratio between the expected values of any two elements in the stochastic benchmark vector provides a reasonable measure of the rate of substitution between the corresponding outputs. It is assumed that estimates on the first and the second moment of each component in the stochastic benchmark vector are available.

A single chance constraint is sufficient in order to restrict the vector of virtual multipliers to belong to a smooth cone in accordance with the requirement above. The cone is a subset of the non-negative orthant, it is centered around the benchmark vector, and the angle between the stochastic benchmark vector and any vector in the cone will not exceed the level a at some probability level f to be specified a priori. The model relates to the well known cone ratio and AR-models.

SESSION 1.4a - EUROPEAN BANKING

Chair & Discussant : Henry TULKENS, CORE & Université Catholique de Louvain

Friday October 27 - 4:00 - 5:45 p.m.

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17. Efficiency Analysis in Banking Firm: An International Comparison

José Manuel PASTOR, University of Valencia
Francisco PEREZ, IVIE & University of Valencia
Javier QUESADA, IVIE & University of Valencia

The intensive process of financial European integration, together with the profound transformation and deregulation that has taken place in the Spanish Banking System (SBS) justified the evaluation of its efficiency in comparison with that of other banking systems. In fact, as a consequence of the deregulation process and the continuous liberalization the SBS has become a much more competitive market. In this context, in recent years, efficiency analysis of financial institutions has received increasing attention from specialists. The aim of this study is to analyze productivity, efficiency and differences in technology of several banking systems. Using a non parametric approach together with Malmquist index. We carry out comparisons of efficiency, productivity and differences in technology between different European banking systems including the US for the year 1992. We find quite different values of the efficiency parameters for different countries. France, Spain and Belgium appear as the countries with the most efficient banking systems, whereas UK, Austria and Germany show the lowest efficiency levels. We have found some evidence of scale inefficiencies in the Austrian, German and US banking systems and almost no trace of scale inefficiency in France and UK.

Banking systems can be classified by productivity into two groups: Austria, Italy, Germany and Belgium belong to the most productive one, and USA, UK, France and Spain to the less productive one. Decomposing the Malmquist productivity index into the two components of catching up and distance to the frontier we find banking systems with very different combinations of both factors. Some countries (Spain, France) have banking systems showing, simultaneously, a relatively high efficiency and a relatively low level of technology, whereas other countries (Austria, Germany) combine a very productive technology with a low level of efficiency.

Finally, for a subsample of banks belonging to the same group of countries, using real as opposed to nominal quantities of labor, we introduce corrections on efficiency measures introducing the services provided to customers by the branch network and the degree of solvency determined by the capital ratio. Once we take into consideration these other features in computing efficiency, we find significant changes in the ranking of particular banks by efficiency. In particular, Spanish banks perform better when branch services are introduced in the analysis.

18. Should Banks Be "Universal" ? The Relationship Between Economies of Scope and Efficiency in the French Banking Industry

Mohamed CHAFFAI, University of Sfax
Michel DIETSCH, Université Robert Schuman, Strasbourg

The objective of this paper is to verify the existence of a positive relationship between efficiency and economies of scope in the banking industry. There are a lot of papers devoted to the estimation of economies of scope in the US-banking industry (see Berger, Hunter and Timme (1993) for a survey on this subject). However, the results of these papers are not entirely convincing for two reasons. First, the methods of estimation used usually (translog function) are based on functional forms that are not appropriate in the neighbourhood of zero output. Second, the estimations of economies of scope are only based on data of multiproductbanks which produce a diversified set of outputs (Ferrier and Lovell (1990), Berger and Humphrey (1990), Ferrier and Ali (1993)). Therefore, because of the lack of specialized banks in the samples used, it is not possible to generalize the measure of costs when some outputs are not produced. The cost function has to be extrapolated in some neighbour of the output space for which there is no data.

One peculiarity of the French banking industry is that there exist universal and specialized banks operating in the same markets. The universal banks are allowed to produce all types of products (deposits, loans, investment securities, ...). On the contrary, the specialized banks are not allowed to produce deposits. The majority of these institutions produce different kinds of loans (loans for housing, consumption loans, equipment loans and other types of commercial loans). We restrict our analysis to these types of specialized institutions in the production of loans. The market share of these instutions in loan markets is significant. In this paper, using data of these two categories, we can solve the second problem we mention above. The first originality of this paper comes from the extraction of information that this data basis permits.

Moreover, even if the idea of a positive relationship is frequently evocated, there is no real estimation of this link in papers devoted to the estimation of economies of scope. Many factors could be at the origin of this relationship. Due to the new conditions of competition, the banks have been constrained to reduce costs dramatically, in order to maintain competitiveness. The possibility to extract important cost savings from diversification of products can be used by banks to reduce their costs. First, diversification helps to spread fixed costs in case of excess capacity. Second, reduction of informations costs could be obtained from the sales of differents products to the same customers. Third, diversification reduces also the rissk. In total, we expect a positive relationship between economies of scope and efficiency.

In this paper, we consider the relationship between efficiency and economies of scope in the French banking industry over the 1988-1992 period. We estimate an hybrid translog cost frontier. The paper is organized as follows. In section 2, we present the methods used for the estimation of economies of scope for multiproduct technologies. Section 3 presents the data and show the results of estimations of economies of scope in the French banking industry. Finally, the relationship between economies of scope and efficiency is given in section 4.

19. Technology and Cost Efficiency in Universal Banking : A "Thick Frontier" Analysis of the German Banking Industry

Günter LANG, University of Augsburg
Pieter WELZEL, University of Augsburg

Using 1992 data of 1490 banks covering about 40% of German banking, we specify a multi-product translog cost function and follow the "thick frontier"-approach to control for cost inefficiency when evaluating thetechnology of banking. Scale economies are found to exist up to a size of about 5 billion DM of taotal assets, with diseconomies being caused by non-operating costs. There is hardly any evidence of economies of scope. Compared to cost inefficiency external factors play a surprisingly strong role in explaining cost differences between high-cost and low-cost banks. Smaller banks turn out to be more responsive to input prices.

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20. DEA and Benchmarks for Nordics Banks

Göran BERGENDAHL, University of Gothenburg

In this paper an analysis is made of the efficiency in the operation of a set of large Nordic banks during the two years 1992 and 1993. The method that is used may be called a window analysis of Data Envelopment Analysis (DEA). The inputs are given in terms of the cost of personnel, the cost of material and the expected cost of credit losses. Output concerns lending, deposits and net revenues (interest margins and non-interest income).

The data covers 48 banks. Fourteen banks are from Denmark, thirteen from Finland, twelve from Norway and nine from Sweden. For each of these banks, the DEA method is used to form a "reference bank", which is a convex combination of the best competing banks (those at the efficiency frontier). The three inputs and the three outputs of the reference bank will be used as benchmarks. That procedure implies that one cannot say that one single bank dominates another. The statement to be made is that a single bank is dominated by its corresponding reference bank.

The preliminary results show that 4-7 banks were situated at the frontier those two years. Then benchmarks from the references banks are slightly different dependent on which "window" that is used, 1992, 1993 or 1992 + 1993.

SESSION 1.4b - INCENTIVES & EFFICIENCY

Chair & Discussant : Shawna GROSSKOPF, Southern Illinois University, Carbondale

Friday October 27 - 4:00 - 5:45 p.m.

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21. Peer Comparison, Regulation and Replicability

Pierre WUNSCH, Bureau du Plan, Bruxelles

The paper investigates the use of peer comparison in a regulatory framework in which the principal only knows that past production plans are replicable. The model is a simple negotiation process with moral hazard and adverse selection in a non-Bayesian setting. Results are ambiguous when information on only one firm is available but are appealing when based on a cross-section of firms. Informational rents are nil for identical firms after period 1 and an example shows that they are likely to increase only slowly as agents become dissimilar in input prices or demand conditions.

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22. Yardstick Competition and Investment Incentives

Dag Morten DALEN, University of Oslo

This paper analyzes how firms' investment-incentives are influenced by yardstick competition in a situation in which the regulator is unable to commit to the regulatory contract before firms invest. Despite its rent-extracting property, yardstick competition does not necessarily cause reduced investment. If investment is industry-specific, incentives to invest are lowered compared to an individual regulation regime. However, assuming firm-specific investment, yardstick competition is shown to increase incentives for investment. In this case, therefore, yardstick competition both reduces regulator's informational problem ex post and strenghtens investment incentives ex ante. When linking yardstick competition to deregulation of monopolistic markets, a market-sharing effect arises which works to reduce firms' investment incentives. Competition is then shown to have a possible advers effect on firm-specific investment.

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23 Merging DEA and Subjective Performance Evaluation

Jens Leth HOUGAARD, University of Copenhagen

This paper tries to merge DEA with subjective performance evaluation. It is shown how the efficiency interval resulting from DEA, as a consequence of different technological assumptions about returns to scale, and the subjective efficiency interval, as conceived by the decision maker, can be represented as one performance statement; a fuzzy interval. Moreover, it is shown how these fuzzy intervals can be ranked according to a certain performance index.

SESSION 2.1a - PUBLIC SECTOR ACTIVITIES

Chair & Discussant : Bruno DE BORGER, UFSIA, Antwerpen

Saturday October 28 - 9:00 - 10:40 a.m.

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24. Measuring and Explaining the Production and Technical Effciency of Tax Offices

Wim MOESEN, K.U. Leuven
Annick PERSOONS, K.U. Leuven

This paper measures and explains the productive efficiency of tax administrations. Technical efficiency is evaluated using the non-parametric Free Disposal Hull (FDH) method and Data Envelopment Analysis (DEA). We first calculate efficiency measures for 289 regional tax offices responsible for the personal income tax in Belgium. Next, we explain the differences in efficiency in terms of variables related to managerial and organizational characteristics of the tax offices.

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25. Museums Efficiency

Odile PAULUS, Université Robert Schuman, Strasbourg

Museums activities are often not controlled and funds providers may search for ways to improve their evaluation process. This paper proposes an evaluation of museum efficiency based on the estimation of a production frontier.

The first section deals with the problem of definition and measurement of museum output. It is distinguished between the offered services and the received services and between the passive and active museum services. For the estimation the number of visitors is used as a measurement for the active and received services.

The second section presents the data and the estimation results. The databases are on French and German museums. We estimate a Data Envelopment Analysis and a parametric production frontier by corrected ordinary least squares. We study the sensitivity of the efficiency scores due to the integration of several variables and to the changes in the estimation techniques. In a second stage analysis, we try to explain the efficiency scores. It seems that part of the efficiency can be explained by the museum attractiveness and by the involvement of volunteers.

26. Technical Efficiency Measurement and Explanation of French Urban Transit Companies

Kris KERSTENS, UFSIA - SESO, Antwerpen

The performance of a sample of French urban transit companies is evaluated using a broad selection of nonparametric reference technologies for two specifications of the production process. In particular, the variable returns to scale Data Envelopment Analysis (DEA) models with either strong or weak disposability in both inputs and outputs, and the Free Disposal Hull (FDH) are applied. An extensive comparison of the resulting radial output efficiency measures yields the following major conclusions.

First, the location of the efficiency distributions differs substantially depending on the methodology and especially on the output specification considered. The latter differences vanish if the impact of outliers is eliminated. Their rankings are less divergent.

Second, imposing convexity results in a serious decrease of the number of efficient observations in a strongly disposable DEA model relative to FDH, and convexity has a stronger influence on the efficient-inefficient dichotomy than allowing for congestion by means of a weakly disposable DEA model.

Third, the efficiency distributions are explained using a Tobit model. The findings corroborate results reported elsewhere: the relevance of ownership, the use of incentives in contracting, the harmful impact of subsidies, etc. A novelty in the urban transit context is the indirect monitoring effect of the French transportation tax.

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27. Efficiency of State Firms in Bulgarian Industry: Microeconomic Evidence of an Empirical Study

Malinka S. KOPARANOVA, Bulgarian Academy of Sciences, Sofia

The paper analyses the inside of the industrial structure in Bulgaria by measuring empirically microeconomic effects of technical efficiency, i.e. firms impacts. As comparative advantages of industries are different we look for the specificity of firms when using labour and capital in the transitional process. We analyse enterprise adjustment by measuring to what extent it is related to the firms' characteristics, or to sector specificity. We do this by evaluating firms' effects applying stochastic frontier production function with time-varying parameters to allow for changes in sectors levels in 1994, i.e. the forth year of the reform. Models for firm effects are specified and tested for different hypothesis of firms impacts on. The technical efficiency of each of the firms, included in the research is predicted. The average level of technical efficiency is also evaluated for each of the industrial sectors. We address the questions about heterogeneity of 2 171 firms as the results obviously lead to this kind of industries for the first and second quarter of 1994. We conclude by grouping the industries according to the firms effects. The analysis of the industrial structure based on the empirical estimations of the firms' technical efficiency is extended by looking at some indicators for firms behaviour and financial situation: profitability and financial viability.

SESSION 2.1b - METHODOLOGICAL ADVANCES

Chair & Discussant : Philippe VANDEN EECKAUT,
CORE & Université Catholique de Louvain

Saturday October 28 - 9:00 - 10:40 a.m.

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28. Scale Efficiency and Scale Elasticity in DEA-Models: A Bootstrapping Approach

Mickael LöTHGREN, Stockholm School of Economics
Magnus TAMBOUR, Stockholm School of Economics

This paper presents measures of scale efficiency and scale elasticity for multiple-input multiple-output production technologies. The scale measures are defined in terms of the inverse (output) distance functions. The Data Envelopment Analysis (DEA)-method is a non-parametric non-statistical method that gives estimates of the distance functions. Since the DEA-method is inherently deterministic, no measures of uncertainty in the obtained scale efficiency and scale elasticity measures are provided. The bootstrap offers a possibility to reconstruct the sampling distributions of the scale measures and allows construction of confidence intervals/statistical hypotheses testing of the scale efficiencies and elasticities. Empirical evidence from (public) eye-care departments in Sweden is presented.

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29. A Mathematical Programming Approach for Measuring Technical Efficiency in a Fuzzy Environment

Konstantinos TRIANTIS, Virginia Tech, Falls Church, VA
Olivier GIROD, Virginia Tech, Falls Church, VA

Conventional data envelopment analysis (DEA) assumes input and output measures are known precisely. When input and output are not deterministic, the decision maker may choose among three options. The first option consists in applying stochastic DEA models. The second option involves traditional post-optimization techniques, like sensitivity analysis. The third option, is based on fuzzy set theory. Sengupta (1992) was the first researcher to propose fuzzy decision making principles in data envolopment analysis. Sengupta's (1992) fuzzy DEA model introduces vagueness not in the input and output measures but in the relationships they are bound to satisfy. The present paper investigates an alternative framework that can be implemented when fuzziness is directly introduced in the input and output measures. The framework merges DEA with the general fuzzy linear programming formulation developed by Carlsson and Korhonen (1986), and is particularly well suited to problems where the analyst has the capacity of specifying the lower and upper bounds of the input and output measures. Additionally, within this context, the concept of a fuzzy Free Disposal Hull (FDH) is explored.

30. Bayesian Efficiency Analysis Through Individual Effects: Hospital Cost Frontiers

Gary KOOP, University of Toronto
Jacek OSIEWALSKI, Academy of Economics, Krakow
Mark STEEL, CentER, Tilburg University

This paper develops Bayesian tools for making inferences about firm-specific inefficiencies in panel data models. We begin by establishing a Bayesian setting in which fixed and random effects models are defined. What distinguishes these classes of models is the marginal prior independence of the effects. We show how such models can be analyzed using Monte Carlo integration or Gibbs sampling. These techniques are applied to a panel of U.S. hospitals. Our empirical findings illustrate the different characteristics of both types of models, as well as the influence of the particular priors used on the firm effects.

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31. Rank Regression for Explaining Efficiency

Benoît DERVAUX, CRESGE, Université Catholique de Lille
Frédéric JOUNEAU, CORE, Université Catholique de Louvain
Hervé LELEU, CRESGE, Université Catholique de Lille

In the recent years, an increasing numbeer of research works have attempted to measure the efficiency of economic decision-making unitss, and to identify its determining factors. From a theoretical standpoint, efficiency measurement is linked to the selection of the assumptions which underlay the building of the production set (returrn to scale, free disposability of inputs and outputs, convexity) as well as the definition of the measure itself (Debreu-Farrell's radial measure or non radial measures of Färe, Färe-Lovell or Zieschang). From an empirical standpoint, the specification of the production function (selection and aggregation level of inputs and outputs) and the estimation method (parametrical vs non parametrical, stochastic vs deterministic) also have a bearing on efficiency measurement. On the basis of empirical literature, it seems that the distribution of the estimated efficiency scores is highly sensitive to these different methodological choices and give rise to difficulties in the search for efficiency determinantss or in the use of these indexes with a view to the development of economic policies. At the opposite, the ranking of observations on the basis of their efficiency produces relatively stable results,, when compared to the different approaches. In this communication, we propose an original rank regression methodology in order to identify the factors of efficiency.

Quite vaguely, the problem is to estimate the "influence" of observed exogenouss variables on the ranking of each observation. Since the underlying criterion applied for the classification is unobserved, we adopt aa classical latent variable model. The estimation of the model is based on a Bayesian approach. After defining a prior distribution for the parameters to be estimated, we simulate, with the use of Gibbs' sampling procedure, the values of the latent variable while maintaining the rank status of each observation. These simulations make it posssible to estimate by OLS posterior distribution moments and to simulate values for the parameters of interest. The repetition of simulations enables to obtain an average estimation of the parameters.

SESSION 2.2a - EXTERNALITIES

Chair & Discussant : Bernard THIRY, Université de Liège & CIRIEC

Saturday October 28 - 11:00 - 12:45 a.m.

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32. Agriculture's Environmental Externalities Is There a Free Lunch ? DEA Evidence for French Agriculture

Isabelle PIOT, INRA, Rennes
Dominique VERMERSCH, INRA, Rennes
Robert D. WEAVER, Pennsylvania State University

The existence of technical inefficiency offers the opportunity for a "free lunch" not typically consistent with neoclassical theory. Within the context of management of external effects of production processes, when external effects are related to the use of particular inputs, elimination of technical efficiency through reduction of input use represents a means of reducing external impacts. An important example is found in agriculture where substantial environmental impacts are generated by particular inputs. Within this context, this paper considers the usefulness of Data Envelopment Analysis for estimation of potential input reductions and assessment of potential reductions of environmental impacts of agricultural inputs. An application for French cereal production provides estimates that indicate that substantial potential exists for reduction of input use and environmental impacts.

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33. DEA Models for the Measurement of Environmental Performance of Firms: Concepts and Empirical Results

Daniel TYTECA, IAG, Université Catholique de Louvain

I use DEA to define standardised, aggregate environmental performance indicators for firms. The best practice frontier obtained with DEA corresponds to decision making units showing the best environmental behaviour. Results are obtained with data from U.S. fossil fuel-fired electric utilities, starting from four alternative models, among which three DEA models that differ in the way they account for undesirable outputs (pollutants) and resources used as inputs. The results indicate considerable discrepancies in the rankings obtained by the four models. Rather than contradictory, these results are interpreted as giving different, complementary kinds of information, that should all be taken into account by public deciders.

34. Productivity and Spillovers of Local Public Capital

Dale BOISSO, Southern Methodist University, Dallas
Kathy HAYES, Southern Methodist University, Dallas
Shawna GROSSKOPF, Southern Illinois University, Carbondale

The purpose of this paper is to provide further evidence concerning the role of public sector infrastructure in productivity growth. Our approach differs from earlier work in that we include public sector infrastructure as a direct input as well as including a proxy for the external effects of public sector infrastructure in neighboring areas in the construction of our productivity index. Our index differs from those used in the existing literature as well; we use a Malmquist productivity index which allows us to decompose productivity change into efficiency change and technical change components. We apply this technique to data originally collected by Munnel (1994) for a panel of 48 states in the U.S. over the 1970-1986 period.

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35. Efficiency Analysis in Generation and Distribution of Electric Energy in Spain (1984-1991)

Manuel E. ESCUER, University of Zaragoza
Lucia I. G. CEBRIAN, University of Zaragoza & GREMAQ, Toulouse

Productive efficiency analysis in a regulated sector aims at understanding whether the abnormal returns of a regulated firm are due to a wrong regulatory schema or to a reduction of firm's costs.

Productive efficiency can be calculated by means of input productivity indices, cost and production functions and frontier methods.

In this paper the frontier method suggested by Farrell (1957) is applied to productive efficiency anlysis in the Spanish electric utilities. Generation and distribution activities are studied separately. In order to work with homogeneous units, we also distinguish different generation technologies: hydraulic, thermic (coal and fuel-gas) and nuclear. The data cover the periods between 1984 and 1991.

We use deterministic non-parametric frontiers and we study technical efficiency and two of its components: purely technical efficiency and scale efficiency.

Our main results show that as regards thermic generation, firms owning coal stations are the most efficient; nuclear stations as well as firms operating in the distribution branch show also quite high efficiency standards. We use these results to evaluate the recent decisions intended to reorganize the whole sector.

SESSION 2.2b - NUMERICAL EXPERIMENTS

Chair & Discussant : Lawrence SEIFORD, University of Massachussetts, Amherst

Saturday October 28 - 11:00 - 12:45 a.m.

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36. Numerical Aspects of DEA & FDH Measurement

Philippe VANDEN EECKAUT, CORE, Université Catholique de Louvain

Two aspects should be taken into consideration when dealing with the computational issues associated with non-parametric techniques. First, new techniques like for instance bootstraping are extremely demanding in term of computational burden. Therefore, we need to consider carefully the optimization of the computation of DEA and FDH. A survey of the traditional and new techniques is commented. A method based on the notion of "extended dominance" is proposed. This technique uses the notion of free disposal, return to scale and convexity in order to provide a more efficient computation and a more detailled caracterization of the efficiency of each units. An illustration based on bank branches in Belgium is provided. Second, the lack of numerical precision of the results may lead mistaken interpretation of efficiency measurement. An example based on the misuse of explanatory variables in a study of US urban transport is proposed.

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37. Computational Issues of Fuzzy Methods

Antreas ATHANASSOPOULOS, University of Warwick
Konstantinos TRIANTIS, Virginia Tech, Falls Church, VA

The computational issues related to two fuzzy approaches used to evaluate efficiency performance are presented. First, the fuzzy K-means clustering approach has been used to evaluate the technical efficiency performance of manufacturing facilities and the determinants of cost efficiency of local authorities. The primary computational factors that need to be considered are: the selection of the initial clustering procedure, the selection of the density parameter, the determination of the appropriate number of clusters, the variation of the fuzzy parameter, and the graphical presentation of the results. Second, a fuzzy DEA approach is currently being used to evaluate the performance of a production process. The primary computational issues that need to be considered are: the optimization platform to be used, the variation of the membership function, the graphical representation of the results.

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38. Numerical Aspects of Bootstraping
Paul W. WILSON, University of Texas

no abstract available

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39 Numerical Aspects of Bayesian Efficiency Analysis
Jacek OSIEWALSKI, Academy of Economics, Krakow
Mark STEEL, CentER, Tilburg University

no abstract available

SESSION 2.3 - INTERNATIONAL PRODUCTIVITY STUDIES

Chair & Discussant : Jacques MAIRESSE, ENSAE-CREST

Saturday October 28 - 2:00 - 4:15 p.m.

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40. East Meets West: A comparison of the Productive Performance of Eastern European and Western European Air Carriers

David H. GOOD, Indiana University, Bloomington
Robin C. SICKLES, Rice University, Houston

In this paper we examine the productivity performance of a group of four Eastern European carriers and compare it to fourteen of their Western European competitors during the period 1977-1990. We first model the multiple output/multiple input technology with a stochastic distance frontier using recently developed semiparametric efficient methods. The endogeneity of multiple outputs is addressed in part by introducing multivariate kernel estimators for the joint distribution of the multiple outputs and potentially correlated firm random effects. We augment estimates from our semiparametric stochastic distance function with nonparametric and deterministic distance function methods using programming techniques as well as with extended dynamic decomposition methods introduced by Fare et al. (1985, 1992, 1993). We find significant relative slack in the Eastern European carriers which appears to be due to a divergence in efficiency change rather than in technical change.

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41. Productivity Convergence in OECD Services Industries

Claudine GOUYETTE, CREPP, Université de Liège
Sergio PERELMAN, CREPP, Université de Liège

The objective of this paper is threefold. First, estimating the productivity performances realized by a sample of thirteen OECD countries in two specific sectors, services and manufacturing, over the 1970-1987 period. Second, discussing and comparing the productivity indicators computed under two alternative approaches, namely the frontier analysis and the index numbers method. Third, testing for the existence of a convergence process in both industries, devoting a particular attention to the catching-up process and to the interaction between productivity growth and changes in capital/labor intensities. Our main results suggest that, contrary to what is observed for the manufacturing sector and in spite of very low growth rates, productivity levels seem to have converged in the service sector. Moreover, new investments in capital appear to have an unexpected depressive effect on growth rates in the service industries, contrary to what occurs in manufacturing activities.

42. Productivity Convergence, Technical Progress and Outward-Oriented Trade Regimes

Fatma TASKIN, Bilkent University, Ankara

Dynamic effect of international trade on growth have receive increased interest in the recent years. Even though there are extensive amount of empirical evidence for the positive impact of trade on growth rate of countries, the debate on economic convergence and the role of trade is far from being settled. The importance of political and economic policies adopted by the Less Developed Countries as the determining factor of convergence have been emphasized. This study empirically investigates the issue of productivity convergence, using a nonparametric method to compute Malmquist productivity index for the period 1975-1990, in a sample of countries which includes both LDC and DC. The nice property of this approach is that it is possible to decompose the productivity change into the components of technical chagne and efficiency change. It is demonstrated that the less developed countries have higher rates of diffusion which is negatively related to their initial per capita income levels. The impirical findings also point out that the less developed countries which implemented trade liberalization policies and increased their openness were the ones that achieved greatest improvement in their productivity.

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43. Ownership Structure and Technical Efficiency in Chinese Enterprises

Xiaoxuan LIU, Chinese Academy of Social Sciences
Jinghai ZHENG, University of Gothenburg
Arne BIGSTEN, University of Gothenburg

The coexistence of state, collective and township-village enterprises in China has lasted for more than a decade. Recently, the rapid development of township-village enterprises and their outstanding performance has attracted much public attention, while the state enterprises are undergoing further ownership reforms. This study, based on samples or more than 1,500 Chinese enterprises during 1986-1990, investigates structure differences and differences in technical efficiency among three prevailing ownership groups in China's industry. Structure analysis was performed to demonstrate the differences between state, collective and twonship-village enterprises. A translog production function was specified in estimating the structure of production for the Chinese enterprises. Significant differences were found with respect to returns to scale and elasticity of substitution across the ownership groups. The findings from estimations of stochastic frontier production function models showed mixed results in terms of technical efficency, while the results from estimations of production functions with dummy variables suggested that the township and village enterprises were the most efficient ownership group in China.

44. Total Factor Productivity Growth Measurements in a General Equilibrium Framework: the Quebec Economy between 1978 and 1984

Pierre MOHNEN, University of Québec, Montréal
Thijs TEN RAA, Tilburg University
Gilles BOURQUE, University of Québec, Montréal

We propose a new measure of total factor productivity (TFP) growth in a general equilibrium setting. It measures by how much the efficiency frontier moves outwards given the availability of primary resources, the technology and the structures of net imports and domestic final demand. All domestic prices are endogenous in this model.

We apply this new measure to the Québec economy between 1978 and 1984. We find negative TFP growth rates in most of the manufacturing industries and positive and relatively big growth rates in the service sectors. When comparing our measure to the traditional measure, only a few sectors display substantial differences in TFP growth, but enough to render the aggregate TFP growth higher with our measure. The frontier moves ouwards at a higher pace than suggested by the observed input and output changes.

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