ISSN 1691-3078
ISBN 978-9934-8304-1-9

ECONOMIC SCIENCE FOR RURAL DEVELOPMENT

Proceedings of the International Scientific Conference

Rural Business and Finance

1. Rural Business Economics and Administration
2. Finance and Tax

№ 28

"ECONOMIC SCIENCE FOR RURAL DEVELOPMENT"

Proceedings of the
International Scientific Conference

RURAL BUSINESS AND FINANCE

1. Rural Business Economics and Administration
2. Finance And Taxes

№ 28
Jelgava
2012

TIME SCHEDULE OF THE CONFERENCE

Preparation: October 2011 – April 2012
Process: 26-27 April 2012

Agricultural University in Cracow, 2012
Alberta College, 2012
Aleksandras Stulginskis University, 2012
Corvinus University of Budapest, 2012
Council of Latvian Chamber of Commerce and Industry, 2012
Daugavpils University, 2012
Estonian University of Life Sciences, 2012
Fulda University of Applied Sciences, 2012
Institute of Economics and Social Sciences, Estonian University of Life Sciences, 2012
Institute of Economics by Latvian Academy of Sciences, 2012
Institute of Economics, Hungarian Academy of Sciences, 2012
Kaunas University of Technology, 2012
Latvia University of Agriculture, 2012
Latvian Academy of Agricultural and Forestry Sciences, 2012
Latvian Academy of Sciences, 2012
Latvian State Institute of Agrarian Economics, 2012
Lithuanian Institute of Agrarian Economics, 2012
Mendel University in Brno, 2012
Mykolas Romeris University, 2012
Poznan University of Economics, 2012
Professional Association of Project Managers, 2012
Research Institute of Agriculture Machinery, Latvia University of Agriculture, 2012
Research Institute of Biotechnology and Veterinary Medicine "Sigra", 2012
Research Institute of Economics and Business, 2012
State Revenue Service of Latvia, 2012
Rezekne Higher Education Institution, 2012
Riga International School of Economics and Business Administration, 2012
Riga Technical University, 2012
Rural Support Service, 2012
School of Business Administration Turiba, 2012
School of Business and Finance, 2012
Seinäjoki University of Applied Sciences, 2012
Tallinn University Institute of Political Science and Governance, 2012
Tartu University, 2012
University College of Economics and Culture, 2012
University of Latvia, 2012
University of Szczecin, 2012
Ural State Mining University, 2012
Valga County Government, 2012
Ventspils University College, 2012
Vidzeme University of Applied Sciences, 2012
Wageningen University, 2012
Warsaw University of Life Sciences, 2012
West Pomeranian University of Technology in Szczecin, 2012

ISSN 1691-3078
ISBN 978-9934-8304-1-9

Abstracted / Indexed: ISI Web of Knowledge, AGRIS, EBSCO
http://thomsonreuters.com/products_services/science/science_products/a-z/conf_proceedings_citation_index/
http://www.llu.lv/ef/konferences.htm
www.fao.org/agris/
http://search.ebscohost.com/login.aspx?authtype=ip,uid&profile=ehost&defaultdb=lbh

Programme Committee of International Scientific Conference

Professor **Baiba Rivza**	President of the Academy of Agricultural and Forestry Sciences of Latvia; academician of Latvian Academy of Sciences; foreign member of Academy of Agricultural Sciences of Russia; foreign member of Lithuanian Academy of Sciences; foreign member of the Academy Geargophily (Italy), foreign member of the Royal Swedish Academy of Agriculture and Forestry, **Latvia**
Professor **Bartosz Mickiewicz**	West Pomeranian University of Technology in Szczecin, **Poland**
Professor **Vilija Alekneviciene**	Faculty of Economics and Management, Aleksandras Stulginskis University, **Lithuania**
Professor **Irina Pilvere**	Dean of the Faculty of Economics of Latvia University of Agriculture, **Latvia**
Professor **Ingrida Jakusonoka**	Head of the Department of Accounting and Finance of the Faculty of Economics of Latvia University of Agriculture, **Latvia**
Associate professor **Gunita Mazure**	Department of Accounting and Finance of the Faculty of Economics of Latvia University of Agriculture, **Latvia**
Professor **Barbara Freytag-Leyer**	Department of Home Economics, Fulda University of Applied Sciences, **Germany**
Professor **Jacques Viaene**	Faculty of Bioscience Engineering, Department of Agricultural Economics, University of Ghent, **Belgium**
Professor **Bo Öhlmer**	Department of Economics of the Swedish University of Agricultural Sciences, Uppsala, **Sweden**
Professor **Wim J.M. Heijman**	Wageningen University, **the Netherlands**
Professor **Maria Parlinska**	Warsaw University of Life Sciences, **Poland**
Professor **Csaba Forgacs**	Corvinus University of Budapest, **Hungary**
Professor **Aina Dobele**	Department of Entrepreneurship and Management of the Faculty of Economics of Latvia University of Agriculture**, Latvia**
Professor **Liga Mihejeva**	Department of Entrepreneurship and Management of the Faculty of Economics of Latvia University of Agriculture**, Latvia**
Associate professor **Bruna Maria Zolin**	Department of Economic Sciences, University of Venice, **Italy**
Associate professor **Jonas Jasaitis**	Siauliai University, **Lithuania**
Associate professor **Andra Zvirbule-Berzina**	Head of the Department of Entrepreneurship and Management of the Faculty of Economics of Latvia University of Agriculture, **Latvia**
Associate professor **Inguna Leibus**	Department of Accounting and Finance of the Faculty of Economics of Latvia University of Agriculture, **Latvia**
Associate professor **Modrite Pelse**	Head of Department of Economics of the Faculty of Economics of Latvia University of Agriculture, **Latvia**

The chief facilitator and project leader – associate professor **Andra Zvirbule-Berzina**

Editorial Board

The Editorial Board of the edition of the International Scientific Conference Proceedings:

Professor Baiba Rivza	Latvia
Professor Irina Pilvere	Latvia
Professor Bartosz Mickiewicz	Poland
Professor Maria Parlinska	Poland
Professor Vilija Alekneviciene	Lithuania
Professor Barbara Freytag-Leyer	Germany
Professor Jacques Viaene	Belgium
Professor Bo Öhlmer	Sweden
Professor Wim J.M. Heijman	the Netherlands
Professor Csaba Forgacs	Hungary
Professor Aina Dobele	Latvia
Associate professor Bruna Maria Zolin	Italy
Associate professor Andra Zvirbule-Berzina	Latvia
Associate professor Gunita Mazure	Latvia

Editor – in-chief	Associate professor **Andra Zvirbule-Berzina**
Responsible compilers of the proceedings:	Associate professor **Gunita Mazure**
	Lecturer **Zanete Gruzina**
Assistants to the responsible compilers:	**Dzesija Zeiferte**
	Agnese Radzele-Sulce

Language editor: **Gunita Mazure**

Layout designer: **Agnese Radzele-Sulce**

Reviewers

Every article included into the Proceedings was subjected to a scientific, including international review.

All reviewers were anonymous for the authors of the articles.

The following **89** reviewers from scientific and academic institutions of **7** countries (Estonia, Finland, Hungary, Latvia, Lithuania, Poland, and the Czech Republic) have written **206** reviews.

Dzintra Atstaja	Dr.oec., assoc. prof. (School of Business and Finance, Latvia)
Anita Auzina	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Stanislaw Bagienski	Dr.hab., prof. nadz. (Warsaw University of Life Sciences, Poland)
Konstantins Benkovskis	Dr.oec., lecturer (Stockholm School of Economics in Riga, Latvia)
Dainis Berjoza	Dr.ing., assoc. prof. (Latvia University of Agriculture, Latvia)
Veronika Bikse	Dr.oec., prof. (University of Latvia, Latvia)
Ligita Bite	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Vera Boronenko	Dr.oec. (Daugavpils University, Latvia)
Ieva Brence	Dr., assoc. prof. (Latvian Academy of Sciences, Latvia)
Inta Bruna	Dr.oec., prof. (University of Latvia, Latvia)
Veronika Bugina	Dr.oec., prof. (Latvia University of Agriculture, Latvia)
Andrzej Czyzewski	Dr.hab., prof. (Poznan University of Economics, Poland)
Alina Danilowska	Dr.hab., prof. (Warsaw University of Agriculture, Poland)
Rimantas Dapkus	Dr., assoc. prof.(Kaunas University of Technology, Lithuania)
Vija Dislere	Dr.paed., assoc. prof., (Latvia University of Agriculture, Latvia)
Aina Dobele	Dr.oec., prof. (Latvia University of Agriculture, Latvia)
Aija Eglite	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Justyna Franc-Dabrowska	Dr.hab., adjunct prof. (Warsaw University of Life Sciences, Poland)
Ineta Geipele	Dr.oec., prof. (Riga Technical University, Latvia)
Barbara Golebiewska	PhD hab. (Warsaw University of Life Sciences, Poland)
Jaroslaw Golebiewski	Dr.hab. (Warsaw University of Life Sciences, Poland)
Gunta Grinberga-Zalite	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Inguna Gulbe	Dr.oec.(Latvian State Institute of Agrarian Economics, Latvia)
Māra Gulbe	Dr.math., assoc. prof. (University of Latvia, Latvia)
Uldis Ivans	Mg.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Ingrida Jakusonoka	Dr.oec., prof. (Latvia University of Agriculture, Latvia)
Elita Jermolajeva	Dr.oec., assoc. prof. (Daugavpils University, Latvia)
Helma Jirgena	Dr.oec., assoc. prof. (Institute of Economics by Latvian Academy of Sciences, Latvia)
Inara Jurgena	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Janis Kaktins	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Leif Kalev	PhD, assoc. prof. (Tallin University, Estonia)
Laszlo Karpati	Dr., PhD (Budapest Business School, Hungary)
Bogdan Klepacki	Dr.hab., prof. (Warsaw University of Life Sciences, Poland)
Evija Kopeika	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Vulfs Kozlinskis	Dr.habil.oec., prof. (Riga International School of Economics and Business Administration, Latvia)
Zaiga Krisjane	Dr.geogr., prof. (University of Latvia, Latvia)
Gediminas Kuliesis	Dr. (Lithuanian Institute of Agrarian Economics, Lithuania)
Marika Laizane-Jurkane	Dr.sc.pol. (University of Latvia, Latvia)
Olga Lavrinenko	Dr.oec. (Daugavpils University, Latvia)
Inguna Leibus	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Sviesa Leitoniene	Dr., assoc. prof.(Aleksandras Stulginskis University, Lithuania)
Linda Leja	M.Sc. (the Ministry of Environmental Protection and Regional Development, Latvia)

Agita Livina	Dr.oec., assoc. prof.(Vidzeme University of Applied Sciences, Latvia)
Valdemaras Makutenas	Dr., assist. prof.(Aleksandras Stulginskis University, Lithuania)
Gunita Mazure	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Bartosz Mickiewicz	PhD., prof. (West Pomeranian University of Technology in Szczecin, Poland)
Liga Mihejeva	Dr.oec., prof. (Latvia University of Agriculture, Latvia)
Tatjana Muravska	Dr.oec., prof. (University of Latvia, Latvia)
Aina Muska	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Grigorijs Olevskis	Dr.hab.oec., prof. (University of Latvia, Latvia)
Liga Paura	Dr.sc.agr., assoc. prof. (Latvia University of Agriculture, Latvia)
Modrite Pelse	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)
Irina Pilvere	Dr.oec., prof. (Latvia University of Agriculture, Latvia)
Dina Popluga	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Arturs Praulins	Dr.oec. (Latvian State Institute of Agrarian Economics, Latvia)
Agnese Radzele-Sulce	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Viktorija Rankevica	Dr.oec., assoc. prof. (School of Business and Finance, Latvia)
Priit Sander	PhD (Tartu University)
Linda Silina	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Inga Sina	Dr.oec. (University College of Economics and Culture, Latvia)
Timo Sipiläinen	PhD, assist. prof. (University of Helsinki, Finland)
Tomasz Siudek	Dr., assist. prof. (Warsaw University of Life Sciences, Poland)
Peteris Skinkis	Dr.geogr., assoc. prof. (University of Latvia, Latvia)
Teodor Skotarczak	Dr.hab., prof. (West Pomeranian University of Technology in Szczecin, Poland)
Martin Soucek	Ing. Ph.D. (Mendel University in Brno, Czech Republic)
Evelina Spakovica	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Ilze Sproge	Dr.sc.administr., assist. prof. (ISMA Graduate School, Latvia)
Neringa Stonciuviene	Dr., prof.(Aleksandras Stulginskis University, Lithuania)
Evita Straumite	Dr.sc.ing. (Latvia University of Agriculture, Latvia)
Aivars Strautnieks	Dr.oec., assoc. prof. (emeritus) (Latvia University of Agriculture, Latvia)
Voldemars Strikis	Dr.agr., prof. (Latvia University of Agriculture, Latvia)
Romena Sulca	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Tatjana Tambovceva	Dr.oec., assoc. prof. (Riga Technical University, Latvia)
Elga Tilta	Dr.oec. (Institute of Economics by Latvian Academy of Sciences, Latvia)
Ilze Upite	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Vasilijs Ustinovs	Dr.sc.ing. (Research Institute of Agriculture Machinery, Latvia University of Agriculture, Latvia)
Rando Värnik	PhD., prof. (Estonian University of Life Sciences. Estonia)
Dainis Viesturs	Dr.vc.ing. (Research Institute of Agriculture Machinery, Latvia University of Agriculture, Latvia)
Dace Viksne	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Anastasija Vilcina	Dr.oec., prof. (Latvia University of Agriculture, Latvia)
Raina Vira	Dr.paed., assoc. prof.(Riga International School of Economics and Business Administration, Latvia)
Irija Vitola	Dr.oec., prof. (Latvia University of Agriculture, Latvia)
Inesa Voroncuka	Dr.oec., prof. (University of Latvia, Latvia)
Jekaterina Voznuka	Dr.oec., assist. prof. (Baltic International Academy, Latvia)
Bogdan Wawrzyniak	Dr.hab., prof. (University of Technology and Life Sciences in Bydgoszcz, Poland)
Ludwik Wicki	Dr.hab. (Warsaw University of Agriculture, Poland)
Lajos Zoltan Bakucs	Dr. (Hungarian Academy of Sciences, Hungary)
Anda Zvaigzne	Dr.oec., assist. prof. (Latvia University of Agriculture, Latvia)
Andra Zvirbule-Berzina	Dr.oec., assoc. prof. (Latvia University of Agriculture, Latvia)

Foreword

Every year the Faculty of Economics, Latvia University of Agriculture holds the international scientific conference "Economic Science for Rural Development" and publishes internationally reviewed papers of scientific researches, which are presented at the conference. **This year the conference is organised for the 13th year running and all the papers are published in English.** Selected papers from the Proceedings are included into *ISI Web of Knowledge* database and the Faculty of Economics has applied also to Scopus database for including the Proceedings into this database.

Researchers from various European countries representing not only the science of economics in the diversity of its sub-branches have contributed to the conference this year; they have expanded their studies engaging colleagues from social and other sciences, thus confirming inter-disciplinary and multi-dimensional development of the contemporary science. The conference is dedicated to topical themes of rural development; hence, the research results are published in three successive volumes (No. 27, 28, and 29). The first volume of scientific conference proceedings was published in 2000.

Professors, doctors of science, associate professors, assistant professors, PhD students, and other researchers from the following higher education, research institutions, and professional organisations participate at the International Scientific Conference held on April 26-27, 2012 and present their results of scientific research:

Agricultural University in Cracow
Alberta College
Aleksandras Stulginskis University
Corvinus University of Budapest
Council of Latvian Chamber of Commerce and Industry
Daugavpils University
Estonian University of Life Sciences
Fulda University of Applied Sciences
Institute of Economics and Social Sciences, Estonian University of Life Sciences
Institute of Economics by Latvian Academy of Sciences
Institute of Economics, Hungarian Academy of Sciences
Kaunas University of Technology
Latvia University of Agriculture
Latvian Academy of Agricultural and Forestry Sciences
Latvian Academy of Sciences
Latvian State Institute of Agrarian Economics
Lithuanian Institute of Agrarian Economics
Mendel University in Brno
Mykolas Romeris University
Poznan University of Economics
Professional Association of Project Managers
Research Institute of Agriculture Machinery, Latvia University of Agriculture
Research Institute of Biotechnology and Veterinary Medicine "Sigra"
Research Institute of Economics and Business
State Revenue Service of Latvia
Rezekne Higher Education Institution
Riga International School of Economics and Business Administration
Riga Technical University
Rural Support Service
School of Business Administration Turiba
School of Business and Finance
Seinäjoki University of Applied Sciences
Tallinn University Institute of Political Science and Governance
Tartu University
University College of Economics and Culture

University of Latvia
University of Szczecin
Ural State Mining University
Valga County Government
Ventspils University College
Vidzeme University of Applied Sciences
Wageningen University
Warsaw University of Life Sciences
West Pomeranian University of Technology in Szczecin

The following topical themes have been chosen for the conference:
— Production and co-operation in primary and secondary agriculture
— Integrated and sustainable development
— Finance and tax
— Rural business economics and administration
— Resources and sustainable consumption

The comprehensive reviewing of submitted scientific articles has been performed on international and inter-university level to ensure that only high-level scientific and methodological research results, meeting the requirements of international standards, are presented at the conference. Every submitted manuscript has been reviewed by one reviewer from the author's native country or university, while the other reviewer came from another country or university. The third reviewer was chosen in the case of conflicting reviews. All reviewers were anonymous for the authors of the articles. Every author received the reviewers' objections or recommendations. After receiving the improved (final) version of the manuscript and the author's comments, the Editorial Board of the conference evaluated each article.
All the papers of the international scientific conference "Economic Science for Rural Development" are arranged into the three following thematic volumes:

No. 27 Integrated and Sustainable Development

No. 28 Rural Business and Finance
Rural Business Economics and Administration
Finance and Tax

No. 29 Resources and Cooperation
Resources and Sustainable Consumption
Production and Cooperation in Primary and Secondary Agriculture

The publishing of the Proceedings before the conference will promote exchange of opinions, discussions, and collaboration of economic scientists on the international level. The research results included into the Proceedings are available worldwide to any stakeholder.

The abstracts of the conference proceedings provided in English are submitted to the international databases:

Web of Knowledge, which is a unified platform, that integrates all data and search terms. It provides access to the world's leading citation databases, including powerful cited reference searching, the Analyse Tool, over 100 years of comprehensive backfile and citation data. *Web of Knowledge* also delivers access to conference proceedings, patents, websites, and chemical structures, compounds and reactions. While other databases simply aggregate data, *Web of Science* information is carefully evaluated and selected. This time-tested approach helps conserve an institution's resources and researchers' time by delivering access to the most relevant resources. *Web of Science* offers a true cited reference index, which is still the best tool for discovery and the only method of retrieving accurate citation counts.

AGRIS - International Information System for the Agricultural Sciences and Technology set up by the Food and Agriculture Organisation of the United Nations (FAO UN), and especially to the databases containing full research texts set up by the academic higher education institutions.

EBSCO Academic Search Complete is the world's most valuable and comprehensive scholarly, multi-disciplinary full-text database with more than 8,500 full-text periodicals, including more than 7,300 peer-reviewed journals.

CABI PUBLISHING CAB ABSTRACTS database. *CAB Abstracts* gives researchers instant access to over 6.3 million records from 1973 onwards, with over 300,000 abstracts added each year. Its coverage of the applied life sciences includes agriculture, environment, veterinary sciences, applied economics, food science, and nutrition. **CAB Abstracts** is a comprehensive bibliographic database that covers worldwide literature from all areas of agriculture and related applied and life sciences. Published by CAB International, a division of CAB International, CABA is the world's most comprehensive database in its field containing 5 million entries of which 95% are supported by abstracts. Starting from 2009, part of entries is available as full-text periodicals.

The Conference Committee and editorial Board are open to comments and recommendations for the development of future conference proceedings and organisation of international scientific conferences.

We would like to thank all the authors, reviewers, members of the Programme Committee and the Editorial Board as well as supporting staff for their contribution organising the conference.

On behalf of the conference organisers
Andra Zvirbule-Berzina
Associate professor of Faculty of Economics
Latvia University of Agriculture

Content

1. Rural Business Economics and Administration

2. Finance and Taxes

"ECONOMIC SCIENCE FOR RURAL DEVELOPMENT"

Proceedings of the
International Scientific Conference

RURAL BUSINESS AND FINANCE

1. Rural Business Economics and Administration

Farming Efficiency Across the EU Member States and Farming Types: Frontier Benchmarking

Tomas Balezentis[1]; **Irena Krisciukaitiene**, Dr.
Lithuanian Institute of Agrarian Economics
Alvydas Balezentis, prof. Dr.
Mykolas Romeris University

Abstract. Most of the Central and East European countries are still peculiar with relatively low efficiency and productivity of agriculture. This paper analyses farming efficiency in the selected European Union Member States during 2009. The aim of this study was to apply the benchmarking method and thus reveal the competitive advantages of the Lithuanian agricultural sector by comparing efficiency of different farming types. The data envelopment analysis was employed for the analysis. The results of analysis showed that for Lithuania, the most prospective farming types in terms of international competitiveness were those related to animal farming, namely, dairying (milk) and mixed farming.
Key words: efficiency, productivity, farming types, European Union, data envelopment analysis.
JEL code: C14, C61, Q13.

Introduction

The effective decision-making aimed at sustainable change requires appropriate benchmarking practices. More specifically, the sustainable change can be fostered through benchmarking-based comparative analysis, which enables to identify the best practices and thus, improve the situation. As Jack and Boone (2009) reported with reference to Bogan and English (1994), benchmarking could (i) create motivation for change; (ii) provide a vision for what an organisation can look like after change; (iii) provide data, evidence, and success stories for inspiring change; (iv) identify best practices for how to manage change; and (v) create a baseline or yardstick by which to evaluate the impact of earlier changes. Moreover, a steady growth in productivity and efficiency leads to non-inflationary economic growth, which, in turn, results in reduced unemployment rate and increased earnings.

The issue is of the particular importance in the area of the agricultural policy. As for the European Union (EU) Member States, it is important to streamline the structural and income support policies so that they lead to increase in efficiency as well as competitiveness of the agricultural sector (OECD, FAO, 2011). Therefore, the appropriate benchmarking system would improve the quality of decisions taken by farmers, farmer advisors, and policy makers.

Moreover, the Central and East European countries are specific with relatively high importance of agriculture in the total economy. The latter finding makes agricultural policy especially important here. Usually, the benchmarking processes are based on Key Performance Indicators. Indeed, the multi–criteria assessment should be employed for the analysis, for these indicators are usually conflicting ones and should be considered simultaneously. There is, however, a lack of international comparison of farming efficiency across different farming types. Hence, this study focuses on farming efficiency of the different farming types across the EU Member States.

Data envelopment analysis (DEA) is suitable for the latter purpose. A number of studies have attempted to investigate the issues of efficiency and competitiveness (Krisciukaitiene et al., 2010). Indeed, DEA is a method widely applied for efficiency assessment in agriculture (Van Zyl et al., 1996; Odeck, 2009; Vinciuniene, Rauluskeviciene, 2009; Bojnec and Latruffe, 2008; Van Passel et al., 2009). Gorton and Davidova (2004) provided an overview of papers on farm productivity and efficiency. Rimkuviene et al. (2010), and Balezentis and Balezentis (2011) have performed an international comparison of the EU Member States' achievements in rural development. Nevertheless, there is a lack of such comparison across different farming types.

The aim of this study is to apply the benchmarking method and thus reveal the competitive advantages of the Lithuanian agricultural sector by comparing efficiency of different farming types. More specifically, this paper focuses at the three Baltic States given they are specific with similar geo-political environment as well as production structure. However, farming efficiency in these states is estimated in relative terms with respect to the EU-27 states. The **object** of the research – technical efficiency of different farming types in the EU. The following **tasks** are set: 1) to describe the DEA method; 2) to define variables identifying farming efficiency; and 3) to apply the DEA model when analysing efficiency of different farming types. The research is based on the Farm Accountancy Data Network (FADN) data covering the period of 2009 (European Commission, 2011). The DEA model was implemented by employing *R* language, namely, package *Benchmarking* (Bogetoft, Otto, 2011).

Results and discussion

1. Preliminaries of DEA

DEA is a non-parametric method of measuring the efficiency of a decision–making unit (DMU) such as a firm or a public–sector agency. The very term of efficiency was initially defined by Debreu and then by Koopmans.

[1] *E-mail address*: tomas@laei.lt

Debreu discussed the question of resource utilisation at the aggregate level, whereas Koopmans offered the following definition of an efficient DMU: *A DMU is fully efficient if and only if it is not possible to improve any input or output without worsening some other input or output*. Due to similarity to the definition of Pareto efficiency, the former is called Pareto–Koopmans Efficiency. Finally, Farrell summarised research of Debreu and Koopmans, thus, offering frontier analysis of efficiency and describing two types of *economic efficiency*, namely, *technical efficiency* and *allocative efficiency* (indeed, a different terminology was used at that time). The concept of technical efficiency is defined as the capacity and willingness to produce the maximum possible output from a given bundle of inputs and technology, whereas the allocative efficiency reflects the ability of a DMU to use the inputs in optimal proportions, considering respective marginal costs. However, Farrell did not succeed in handling Pareto–Koopmans Efficiency with a proper mathematical framework.

The modern version of DEA originated in studies of A. Charnes, W. W. Cooper and E. Rhodes. Hence, these DEA models are called CCR models. Initially, the fractional form of DEA was offered. However, this model was transformed into input– and output–oriented multiplier models, which could be solved by means of the linear programming (LP). In addition, the dual CCR model (i. e. envelopment program) can be described for each of the primal programs.

Unlike many traditional analysis tools, DEA does not require to gather information about prices of materials or produced goods, thus making it suitable for evaluating both private– and public–sector efficiency. Suppose that there are $j=1,2,...,t,...,N$ DMUs, each producing $r=1,2,...,m$ outputs from $i=1,2,...,n$ inputs. Hence, DMU *t* exhibits input–oriented technical efficiency θ_t, whereas output–oriented technical efficiency is a reciprocal number $\theta_t = 1/\phi_t$. The output–oriented technical efficiency φ_t may be obtained by solving the following multiplier DEA program:

$$\begin{aligned}
&\max_{\phi,\lambda_j} \phi_t \\
&\text{s. t.} \\
&\sum_{j=1}^{N} \lambda_j x_i^j \le x_i^t, i=1,2,...,n; \\
&\sum_{j=1}^{N} \lambda_j y_r^j \le \phi_t y_r^t, r=1,2,...,m; \\
&\lambda_j \ge 0, j=1,2,...,N; \\
&\phi_t \text{ unrestricted.}
\end{aligned} \tag{1}$$

In Equation (1), coefficients λ_j are weights of peer DMUs. Noteworthy, this model presumes the existing constant returns to scale (CRS), which is rather arbitrary condition. CRS indicates that the manufacturer is able to scale the inputs and outputs linearly without increasing or decreasing efficiency.

Whereas, the CRS constraint was considered over–restrictive, the BCC (Banker, Charnes, and Cooper) model was introduced. The CRS presumption was overridden by introducing a convexity constraint $\sum_{j=1}^{N} \lambda_j = 1$, which enabled to tackle the variable returns to scale (VRS). The BBC model, hence, can be written as follows:

$$\begin{aligned}
&\max_{\phi,\lambda_j} \phi_t \\
&\text{s. t.} \\
&\sum_{j=1}^{N} \lambda_j x_i^j \le x_i^t, i=1,2,...,n; \\
&\sum_{j=1}^{N} \lambda_j y_r^j \le \phi_t y_r^t, r=1,2,...,m; \\
&\sum_{j=1}^{N} \lambda_j = 1; \\
&\lambda_j \ge 0, j=1,2,...,N; \\
&\phi_t \text{ unrestricted.}
\end{aligned} \tag{2}$$

The best achievable input can therefore be calculated by multiplying actual input by technical efficiency of certain DMU. On the contrary, the best achievable output is obtained by dividing the actual output by the same technical efficiency $\theta_t = 1/\phi_t$, where ϕ_t is obtained from Equation (2). The difference between the actual output and the potential one is called slack. In addition, it is possible to ascertain whether a DMU operates under increasing returns to scale (IRS), CRS, or decreasing returns to scale (DRS). CCR measures gross technical efficiency (TE) and, hence, resembles both TE and scale efficiency (SE), whereas BCC represents pure TE. As a result, pure SE can be obtained by dividing CCR TE by BCC TE. Noteworthy, technical efficiency describes the efficiency in converting inputs to outputs, while scale efficiency recognises that economy of scale cannot be attained at all scales of production.

2. Comparison of farming efficiency in Lithuania and selected countries

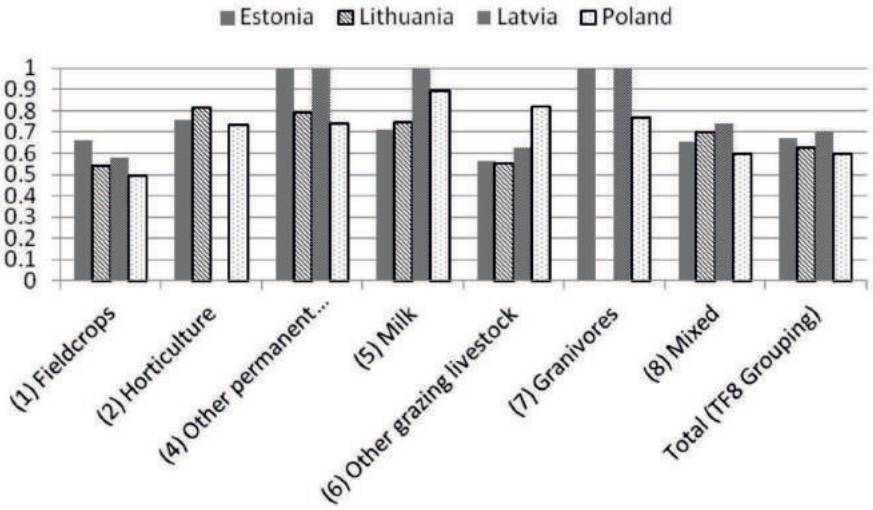
As it was mentioned before, our analysis was based on the FADN data. More specifically, the TF8 farming type classification was employed for the analysis. The latter classification defines the following eight farming types: Fieldcrops; Horticulture; Wine; Other permanent crops; Milk; Other grazing livestock; Granivores; and Mixed. In addition, the aggregate category (Total) is defined for each Member State. Considering wine is not produced in the Baltic States, the authors did not take into account the latter farming type. Thus, the total number of observations accounted for 170 (8 farming types x 27 Member States minus 46 missing observations).

The farming efficiency was estimated in terms of input and output indicators. The following input indicators

covered the land, labour, and capital factors employed in agricultural production: utilised agricultural area (UAA) in hectares (ha), total labour in Annual Working Units (AWU), total assets in EUR, and intermediate consumption in EUR. The output indicators identify crop, livestock, and other output (in EUR). The applied output decomposition enabled to distinguish between different production structures specific to certain farming types. The DEA minimises input and maximises output indicators when calculating efficiency scores.

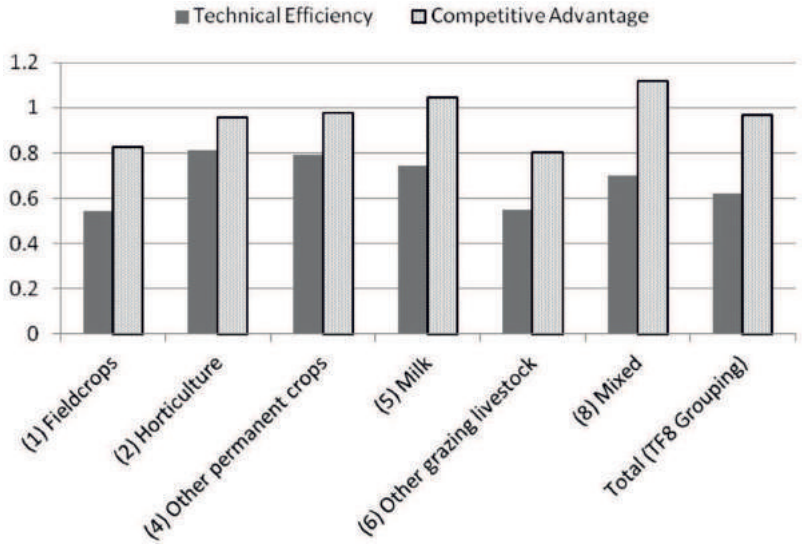
The *R* package *Benchmarking* (Bogetoft, Otto, 2011) was employed for DEA computations described in the antecedent section. More specifically, the output-oriented DEA model was applied, for agricultural producers can increase outputs by means of modernisation, whereas inputs are less likely to be altered.

The main findings are presented in Figure 1, which depicts VRS technical efficiency across the three Baltic States and Poland. In this case, Poland was chosen as the most proximate state peculiar with similar geo-political environment. The last group of columns in Figure 1 describes the overall technical efficiency of farming in the enumerated states. More specifically, Latvia was ranked the first (TE=0.7), whereas Estonia (TE=0.67), Lithuania (TE=0.62), and Poland (TE=0.6) remained behind. As for Lithuania, the most efficient farming types were horticulture (TE=0.81), other permanent crops (fruit and permanent crops combined; TE=0.79), milk (TE=0.74), and mixed farming (TE=0.7), in that order. Meanwhile, other permanent crop farming and granivore farming appeared to be fully efficient in Estonia, whereas the same types plus dairying were fully



Source: authors' estimations based on the FADN data (European Commission, 2011)

Fig. 1. **Technical efficiency of various farming types across the selected states, 2009**



Source: authors' estimations based on the FADN data (European Commission, 2011)

Fig. 2. **Technical efficiency and competitive advantage of various farming types in Lithuania, 2009**

efficient in Latvia. However, the FADN did not provide data for granivore farming in Lithuania and horticulture in Latvia.

These differences in TE, however, are impacted by the nature of different farming types. Hence, further analysis is needed for each particular farming type. For instance, the mean efficiency of granivore farming was 0.86, that of horticulture – 0.85, that of other permanent crops – 0.81, that of dairying – 0.71 etc. (as of 2009). The competitive advantages in this case can be revealed by comparing, for instance, Lithuanian TE and the EU-27 TE for specific farming type. The latter ratio and technical efficiency for each farming type are depicted in Figure 2. As one can note, the highest competitive advantage was observed for mixed farming and dairying. These farming types were more efficient than the average EU farm specialised in respective area (ratios 1.12 and 1.04, respectively). The previously mentioned farming types—horticulture and other permanent crops (fruit and permanent crops combined—were also approaching the mean EU efficiency for certain farming type (ratios 0.95 and 0.97, respectively).

For Lithuania, the most prospective farming types in terms of international competitiveness are those related to cattle production, namely, dairying (milk) and mixed farming. Indeed, Lithuania is specific with high availability of feed. Furthermore, the dairying sector underwent some kind of modernisation even before Lithuania acceded to the EU. Hence, milk products are being exported to both the EU and third countries, thus, constituting a stable source of income. The enumerated advantages, however, are likely to shrink in the future, mainly because of growing wages and other expenditures. In addition, the current absolute level of intermediate consumption might lead to high values of efficiency measures, albeit it is not sufficient to provide momentum for Lithuanian farmers' graduation in the commodity chain. Noteworthy, the increased activity of animal farming would in turn lead to increase in demand for feed. To conclude, the new Rural Development Programme as well as the agricultural policy in general should be focused on support of the farming types, which contribute to increase in export.

Conclusions

1. The farming efficiency was estimated in terms of input and output indicators. The output-oriented data envelopment analysis model was applied for the analysis. Comparison of the selected EU Member States showed that the Latvian agricultural sector was ranked the first (TE=0.7), whereas Estonia (TE=0.67), Lithuania (TE=0.62), and Poland (TE=0.6) remained behind (as of 2009).
2. For Lithuania, the most prospective farming types in terms of international competitiveness are those related to animal farming, namely, dairying (milk) and mixed farming. Indeed, this situation is due to low production costs. Accordingly, the new Rural Development Programme as well as the agricultural policy in general should be focused on support of the farming types, which contribute to increase in export. The public support could be delivered through income and structural support measures as well as institutional alleviations (establishment of farmers' markets).
3. The current level of intermediate consumption is relatively high in Lithuania if compared with other EU Member States. However, it still might not be sufficient in absolute terms to modernise the agricultural production and, thus, successfully compete in the common market. In this context, the pressure on a more reasonable CAP payments' distribution among the EU Member States becomes especially important.
4. The FADN practice can be improved by establishing the uniform estimation of input costs. For instance, labour costs and capital depreciation costs remain the most problematic issues. Thereafter, the allocative efficiency of farming could be estimated.

Bibliography

1. Alvarez, A., Arias, C. (2004). Technical Efficiency and Farm Size: A Conditional Analysis. *Agricultural Economics*. Volume 30, pp. 241–250.
2. Balezentis, T., Balezentis, A. (2011). A Multi–Criteria Assessment of the Relative Farming Efficiency in the European Union Member States. *Zemes ukio mokslai* (Agricultural Sciences), Volume 18, Issue 3, pp. 125–135.
3. Bogan, C. E., English, M. J. (1994). *Benchmarking for Best Practices: Winning through Innovative Adaptation*. New York, McGraw-Hill. P. 312.
4. Bogetoft, P., Otto, L. (2011). *Benchmarking with DEA, SFA, and R*. International Series in Operations Research and Management Science, Vol. 157. Springer. p. 351.
5. Bojnec, S., Latruffe, L. (2008). Measures of Farm Business Efficiency. *Industrial Management & Data Systems*, Volume 108, Issue 2, pp. 258–270.
6. European Commission (2011). FADN Public Database. Retrieved: http://ec.europa.eu/agriculture/rica/database/database_en.cfm. Access: 6 January 2012.
7. Jack, L., Boone, J. (2009). Sustainable Change and Benchmarking in the Food Supply Chain. In: Jack, L. (Ed.). *Benchmarking in Food and Farming*. Gower. p. 132.
8. Krisciukaitiene, I., Tamosaitiene, A., Andrikiene, S. (2010). Lietuvos ukininku ukiu gamybinio potencialo kompleksinis vertinimas (Complex Assessment of Lithuanian Family Farms' Productive Potential). *Management Theory and Studies for Rural Business and Infrastructure Development*, Issue 22(3), pp. 87–95.
9. Odeck, J. (2009). Statistical Precision of DEA and Malmquist Indices: A Bootstrap Application to Norwegian Grain Producers. *Omega*, Volume 37, Issue 5, pp. 1007–1017.
10. OECD, Food and Agriculture Organisation of the United Nations. (2011). *OECD-FAO Agricultural Outlook 2011-2020*. OECD Publishing.
11. Rimkuviene, D., Laurinaviciene, N., Laurinavicius, J. (2010). ES saliu zemes ukio efektyvumo ivertinimas (Evaluation of Agricultural Efficiency in the EU Countries). *Vagos: LZUU mokslo darbai* [VAGOS:

Scientific Papers of LUA], Volume 87, Issue 40, pp. 81–89.
12. Van Passel, S., Van Huylenbroeck, G., Lauwers, L., Mathijs, E. (2009). Sustainable Value Assessments of Farms Using Frontier Efficiency Benchmarks. *Journal of Environmental Management*, Volume 90, pp. 3057–3069.
13. Van Zyl, J., Miller, B. R., Parker, A. (1996). *Agrarian Structure in Poland: The Myth of Large-Farm Superiority*. Policy Research Working Paper 1596. The World Bank. p. 47.
14. Vinciuniene, V., Rauluskeviciene, J. (2009). Lietuvos respondentinių ukininku ukiu techninio ir masto efektyvumo neparametrinis vertinimas (Technical and Scale Efficiency of Family Farms in Lithuania: A Non-Parametric Approach). *Vagos: LZUU mokslo darbai* [VAGOS: Scientific Papers of LUA], Volume 85, Issue 38, pp. 39–46.