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TURINYS

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Įvadinis redaktorių kolegijos žodis

Štai jau treji metai kaip mūsų žurnalas nušviečia aktualius inovacijų plėtros, interaktyvių technologijų bei jų intelektinių išteklių išmatavimo aspektus. Jis vis daugiau jungia Rytų ir Centrinės Europos intelektinių tyrinėtojų branduolį, nors neretai pritraukia ir JAV mokslininkų dėmesį.

Šįkart eilinį *Intelektinės ekonomikos* numerį pradeda Europos Komisijos Pirmininko pavaduotojo, Mykolo Romerio universiteto garbės daktaro Günterio **Verheugen**o kalba inovacijų bei kūrybingumo skatinimo ES klausimais. Spausdinamos taip pat labai įdomios G. **Aleknonio** nuostatos dėl įvaizdžio kainos ir vertės. Inovatyvių bei žmogiškųjų išteklių strategijų derinimo IT srityje problemas apžvelgia Ch. **Le Bas** ir M. **Laužikas**. W. K. M. **Brauers** ir E. K. **Zavadskas** nagrinėja daugiatikslės optimizacijos su diskrečiomis alternatyvomis taikymo metodus. Su elektroninės rinkodaros galimybėmis MVV įmonėse supažindina M. **Kiškis**. E. **Martinaitytė** nušviečia konceptualias plėtros numatymo prielaidas. A. V. **Rutkauskas** ir T. **Ramanauskas** modeliuoja dirbtinės akcijų rinkos su skatinamojo mokymosi agentais situacijas. Internetinei intelektinių sprendimų paramos teorijai nekilnojamojo turto sistemos pavyzdžiu skirtas prof. E.K. **Zavadsko** ir A. **Kaklausko** straipsnis. Su intelektinių sprendimų efektyvumo vertinimais susijęs ir Suhrit K. **Dey,** daug kartų premijuoto JAV mokslų akademijos ir NASA premijomis, straipsnis, skirtas energetikos ekonominės vadybos optimizaciniams aspektams.

Institucinių apžvalgų skyriuje pateikiamas G. **Davulio** straipsnis, skirtas euro įvedimo problemoms Lietuvoje, O. G. **Rakauskienės** ir E. **Krinickienės** straipsnis apie globalios finansų krizės anatomiją ir Kazachstano dėstytojos A.T. **Uskelenovos** straipsnis apie stabilios plėtros infrastruktūros paslaugų ir paramos regioninio vystymo aspektus.

Skaitytojai ras prasmingos informacijos apie naujus Nobelio ekonomikos premijos ekonomikoje laureatus, kaip ir anksčiau apžvelgiama keletas tarptautinių konferencijų, nauji Lietuvos mokslininkų leidiniai artima žurnalui tematika.

Antanas Buračas

Preface of the Editor-in-Chief

For three years already our journal has been revealing the relevant aspects of innovation development, interactive technologies, and the measurement of intellectual resources. The number of researchers of Eastern and Central Europe, and sometimes also scientists from the U.S., publishing their papers in this journal has significantly increased.

This issue of *Intellectual Economics* begins with the speech of Mr. Günter **Verheugen,** the Vice-President of the European Commission and the Doctor Honoris Causa of Mykolas Romeris University, on innovations and creativity in the EU. The article of Dr. G. **Aleknonis** provides interesting insights into the issue of the price and value of image. Ch. **Le Bas** and M. **Laužikas** review the problems of the combination of innovations and human resources strategies in the Lithuanian IT sector. W. K. M. **Brauers** and Prof. E. K. **Zavadskas** analyse the methods of multi-objective optimization with discrete alternatives. Dr. M. **Kiškis** presents direct e-marketing opportunities for SMEs. Dr. E. **Martinaitytė** reveals the conceptual framework for foresight development. Prof. A. V. **Rutkauskas** and T. **Ramanauskas** model the agent-based stock market simulation situations. The web-based intellectual decision support system for real estate is presented by Prof. E. K. **Zavadskas** and Prof. A. **Kaklauskas**. The interesting article of Prof. Suhrit K. **Dey** (the Editor-in-Chief of the *Journal of Applied Science and Computation*) on the optimization of the economics of energy management so important for the Baltic States is also interconnected with the efficiency of intellectual decisions.

Institutional reviews include the publications of Prof. G. **Davulis** on the problems of the adoption of the euro in Lithuania, Prof. O. G. **Rakauskienė** and E. **Krinickienė** on the anatomy of a global financial crisis, and Dr. A.T. **Uskelenova** on the development of infrastructure facilities and support for stable development in Kazakhstan and Russia.

The readers of the issue will find information regarding the Laureates of the Nobel Prizes in Economics as well as the reviews of some recent scientific conferences and publications of Lithuanian scientists.

Antanas Buračas

THE IMPORTANCE OF INNOVATION AND CREATIVITY FOR OUR ECONOMY IN THE CONTEXT OF THE "EUROPEAN YEAR"

Günter VERHEUGEN*

Vice-President of the European Commission responsible for
Enterprise and Industry

Ladies and gentlemen,

I am very pleased to be here today to talk about the importance of innovation and creativity for our economy in the context of the "European Year".

Let me start by a small comment about the title of today's event. I fully agree that as far as innovation is concerned, it is time for speed and ambition at EU level. But, the title of today's event - "time to step on the gas" - is politically incorrect. Our policy agenda must be about the low carbon economy. We therefore need to go faster but with less "gas" rather than more.

The economic forecasts published by the Commission last week indicate that the free fall in which the crisis sent our economies is slowing down, and will hopefully soon be stopping. But let us not have any illusions, this recession risks having a lasting effect on our levels of growth potential and employment creation.

The football player and coach Johan Cruijff used to say that there is always something positive in every bad news. We should be thinking in this direction when we consider scenarios for exiting the current crisis and for building a stronger economy for the future.

From previous economic crises, we know that those economies that stick to investment in research and innovation emerge more competitive when recovery happens. That is because crisis very often bring the will to "break with the past", to do things differently, thus putting a premium on innovation.

Let me give you an example. Many established companies hesitated to innovate during the 1930s' crisis with the consequences we all know. However, the reality is that many new technology companies, such as Hewlett-Packard or Polaroid, that became leading innovators and successful

businesses later in the century, were established as entrepreneurial start-ups that appeared in the 1930s.

From this perspective, the choice of 2009 as the Year of Innovation and Creativity could not be better. In the current crisis, when financial resources are scarce and demand low, creativity is needed more than ever to find new ideas which attract financiers and consumers along.

This hunger for innovation - if you allow me the expression - also offers an opportunity to put our economic model on a more sustainable basis. The challenges of today's world – climate change, the consequences of population ageing or security can only be successfully addressed by a coherent and joint policy approach which has innovation at its heart. This transformation is indispensable if we want to remain competitive in the globalised world and continue to lead the global efforts to fight climate change.

As a new Commission will soon be taking office, as our current economic strategy is coming to its planned term and as a debate on the new financial perspectives is starting, it is a good moment to reflect whether the policies we have put in place in recent years are up to this challenge.

To enable us answer that question, we have just conducted an assessment of the progress made in the implementation of recent Community policies to foster innovation.

Let me share with you the main conclusions of this assessment.

First of all, I wish to repeat once again that innovation is first and foremost the result of private initiative. But clearly businesses and consumers do not act in a vacuum.

They react to incentives, adapt to the regulatory environment, and adjust according to expectations of future policy developments. That is why supportive framework conditions are fundamental for innovative activity. This is particularly important in order to unlock the huge creative potential which resides in the millions of SMEs across the Union.

In this respect, the renewed Growth and Jobs Strategy since 2005 provided the political framework for significant policy achievements both at the EU and Member States level. Let me give you some examples.

Promoting entrepreneurship and facilitating life of SMEs has become a key political priority culminating with the adoption of the Small Business Act with a battery of measures in support of entrepreneurs and SMEs which are now being implemented.

In parallel, excellence in education, skills and training has been widely recognised as a prerequisite for innovation and creativity. The New Skills, New Jobs Strategy in particular is helping improve the skills match and anticipate future skills needs in the labour market.

We have also learned that stimulating the markets for innovative products and services and promoting a positive attitude towards innovation is as important as supporting the "supply side" and "broadened" our strategy accordingly. In this respect, with the launch of the Lead Market Initiative in 2008, the EU has mobilised different policy instruments, regulation, standardisation and public procurement in a targeted way to facilitate market lift-off in six identified areas, namely sustainable construction, recycling, renewable energies, bio-based products, protective textiles and healthcare.

Standardisation policy itself has also evolved to support innovation with a stronger commitment to open and market-led standards.

Collaboration on research and innovation has been reinforced, for instance through the use of public-private partnerships such as the Joint Technology Initiatives. The European Institute of Technology has been established to stimulate world class innovation in Europe. As part of it, the forthcoming knowledge and innovation communities will address major societal challenges.

Last but not least, Cohesion Policy programmes have seen an important budget shift for the period 2007-2013, with some €86 billion within the Structural Funds earmarked to support research and innovation. This provided concrete boost to the reorientation of national and regional policies towards innovation as called for by the renewed Lisbon Strategy.

With all this, why is it that I think we need a new level of ambition for EU innovation policy?

Despite all these actions, I am afraid that clear shortcomings remain in our innovation system. As a result private investment in innovation related expenditures (including R&D, ICT, training and education) remains insufficient in may Member States. We need to turn this around because excellence in innovation remains closely linked with investments and research intensity.

There are several reasons, let me mention only the most important.
- *the internal market, which determines the space in which innovators can capitalize on their investments, still remains to be completed in many respects;*
- *the legal framework for protection of intellectual property remains incomplete;*
- *access to capital remains difficult. Despite our efforts, the venture capital market remains too fragmented, and consequently the level of equity funding low;*
- *the standardisation process is not yet sufficiently synchronised with research results and market needs;*

As far as innovation policy is concerned, in the last years we tried and tested several approaches. I think that now came the time when we should ask ourselves the question whether the number of actions and policies we have deployed in the innovation area really help to make a difference. In some areas, this has certainly been the case. It appears, for example, that the financial instruments of the Competitiveness and Innovation Framework Programme are effectively contributing to cover gaps in innovation financing. It also appears that the work we have done to improve innovation metrics with the European Innovation Scoreboard is widely used and appreciated.

However, looking ahead I see the need for a greater prioritisation. The scale of current EU-level actions in areas which will have strategic importance, such as ecoinnovation or security, appears insufficient. At the same time, actions in other areas should undergo an efficiency and subsidiarity test and be eventually discontinued.

So what are my conclusions for EU innovation policy?

Our joint work on the future innovation strategy has just started, so let me limit myself to some personal considerations only.

Clearly, providing world-class conditions for entrepreneurs and especially the innovative ones should remain a key priority. Wherever the EU level has a lever to provide better conditions, we should act decisively. I think in particular of the Community Patent issue. This is absolutely key to address the biggest weakness of the EU innovation system, its insufficient capacity to transform new ideas into successful business propositions. No need to stress that this policy commitment must be echoed by a strong determination on the side of the business community – as part of its social responsibility - to privilege innovation with perhaps a longer term horizon of return rather than short term profit.

We must also continue our better regulation and simplification work. While we proved that we can add value with direct financial support, I am convinced that our funding programmes should once again be rethought to achieve better complementarity and further simplification. People should not be discouraged from applying by unnecessary bureaucracy as is the case today.

The EU can also make more out of its diversity. We can do more to help the best ideas to circulate quickly and enable others to learn from them. We can also do more to make sure that no opportunity for cooperation is lost at any level. There is in particular more scope for partnership and cooperation to deliver high quality and better value-for-money public services. The need for budgetary consolidation will make this an absolute must if we want to be able to provide the quality of the public service our citizens expect also in the future. In this perspective, there is major potential for joint actions between public buyers to provide critical mass and trigger breakthrough solutions.

How should these considerations work their way through in policy?

As I indicated, I have the feeling that Community action on innovation requires a more strategic approach. We should define priorities more clearly and then put policies and funding in place where the mouth is.

Therefore, for the future innovation policy to succeed, we need to place it at the heart of the new Lisbon Strategy. This does not necessarily require a new innovation policy as such, but it certainly requires putting innovation at the centre of all policies which will form our future economic strategy with commonly agreed objectives.

In this context, we announced that by spring 2010 we stand ready to present an ambitious European Innovation Act. This should in my view be an expression of a joint commitment to making innovation a key political priority based on a clear and ambitious agenda.

Ladies and gentlemen,

European integration, our European project, is a wonderful example of innovation.

Walter Hallstein was right: "Wer in europäischen Dingen nicht an Wunder glaubt, ist kein Realist" - You are not a realist if you don't believe in miracles when it comes to European matters.

The coming weeks and months are the time for debate, for putting ideas on the agenda. I am sure today's discussion will help us to move forward.

Thank you for your attention.

THE PRICE AND THE VALUE OF IMAGE

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Abstract. Nowadays image is a fashionable concept broadly used in business as well as in politics. This trend encourages us to look for methods and possibilities to calculate the value and the price of image. Because the "formula of image" does not exist, direct calculation of the price of image is not possible. Such a situation leads us to an analysis of brand names, attempts to calculate the price of image in daily life as well as in crisis situations, and the investigation of the price paid for the lease of a corporate name. The Reputation Institute gives special attention to the methods of calculation of the reputation quotient. This practice is valuable for the analysis of image-making. From the author's point of view, at present the most important problem is that invoices for image-making are paid through media assets. Today the largest part of media expenses is covered not by media users, but by advertisers and the so-called image-makers. Such a situation only highlights the conflicts between business and public interests in the media. Invoices for image-making are transformed into invoices for the fairness of the media and paid not only by image-makers or their customers, but also by the entire society.

Introduction

The concept of image has become an inseparable component of contemporary politics and one of the leading factors in determining the success of corporate business. Given the importance of its role in today's society, it is no wonder that advertising and public relations professionals successfully exploit image in order to achieve their goals. Deeply rooted in everyday life, image continues to attract the attention of theorists in a variety of fields, including communication, management, marketing, sociology, and psychology. In Lithuania, several attempts have been made to investigate different models of image creation using the experience of Western investigators. The relationship between image and reputation has also been extensively discussed (Drūteikienė, 2002, 2004). The exploration of a complex concept or phenomenon usually brings forth a clash of opinions, and the concept of image is not an exception. As some works by Lithuanian researchers emphasize, "the image does not establish itself; its creation is a continuous, planned, and determined process requiring effort and material resources" (Nugaraitė, 1999: 9). Other publications claim that "public relations can not and do not attempt to create a positive image of an organization or business, since that is impossible; the image is what it is" (Čereška, 2004: 97). Such divergent evaluations of image are primarily influenced by the harsh reality. As the field of public relations has become an aggressive, persuasive business, more and more efforts are put to justify the activities of these companies and boost their presumed value. It is even claimed that image-makers are almighty powers and that every other business should

seek to invest large resources into creating their own image.

This article attempts to show the price of image and its creation. Image can be viewed as a commodity sold by skilful public relations specialists, yet the primary emphasis of the article is not on the financial resources invested into advertising or public relations. The aim is to draw one's attention to what the society can get as well as what it may lose as a consequence of the image-creation process and the earnest practice of image-creators.

The so-called image-makers like to emphasize that a good image has a high price. However, it should be remembered that not only the ones who want to portray themselves in a positive light pay the price of an image. Active creation of image has a hidden price that ends up being paid by everyone. Moreover, the evaluation of the efforts of image-makers should not be restricted to the monetary scale only, since oftentimes money is not the most important facet of the price of image.

1. Attempts to Measure the Value of Image

So far, neither scientific nor popular literature contains a formula that could be used to determine the price or value of image, and it would be overly optimistic to assume that such a calculation method will become reality in the near future. This part of the article outlines several aspects that would possibly be incorporated into the formula to measure the value of image, if it existed.

First of all, endeavours to evaluate the brand should be discussed. Claims that Coca Cola is the most expensive brand in the world (worth approximately U.S.$ 70 bn) and that the Microsoft brand ranks second (U.S.$ 65 bn) simply portray the peculiarities of the world of advertising and only partially aid in determining the real value of image. Competitions of the most famous brands often resemble beauty contests; the final line-up of winners is of the greatest importance primarily to public relations specialists and advertising agencies. For some agencies this is an opportunity to celebrate and be proud of their achievements, for others it is a sign to encourage their clients to invest more into image creation.

Attempts to calculate the price of image can be extended to the everyday life dimension. How much is one or another person ready to invest into his or her own personal image? Here the calculations of image price can be divided into two categories: the one includes prestigious and branded products, and the other consists of mainstream, "no-name" items.

The categorization proves to be difficult and often leads to a deadlock, as it requires an analysis and evaluation of the price and quality of products and services. For example, a used "prestigious" and a new "non-prestigious" car may cost the same amount of money, yet the drivers of the vehicles will have substantially different views on the importance of image and will disagree on the amount of resources that should be invested into the creation of a solid image. Furthermore, how do we measure the value of purchasing the same product in an ordinary store and in an exclusive boutique, as well as the "spiritual comfort" gained through the shopping experience?

Perhaps a clearer and more specific price of image would emerge in unordinary, extreme situations. As a part of their research into the issue of reputation, Ch. J. Fombrun and C. B. M. Van Riel took several examples of large international corporations that have suffered a crisis and computed how these crises influenced the business' market value. As an example, the contamination of the popular medication Tylenol in 1982 cost its manufacturer, Johnson & Johnson, U.S.$ 1 bn, i.e. 14% of the market value. In 1989 the oil spill in Alaska's Prince William Sound reduced the oil giant Exxon's market value by 5%, i.e. U.S.$ 3 bn. In 1995 the computer-chip manufacturer Intel's shares lost 5% of their value in only two weeks following the disclosure of a bug in one of the company's products. Fombrun and Van Riel state that losses in a company's reputation should be incorporated into the calculation of the damage caused by a crisis (Fombrun, Van Riel, 2004: 34). Therefore, image can be seen as an element that provides insurance to a company with a good name, helps business to cope with temporary difficulties and perhaps even aids in surviving a major crisis. This reasoning does not apply to all regions, though. Lithuanian financial market is rather underdeveloped, so it is doubtful whether financial indicators can be reliably used to calculate the value of a company's image or reputation.

Fombrun and Van Riel's examples demonstrate that even in extreme situations when a company's market value drops it is difficult to talk about more precise calculations of image value or about image as a percentage of the business' price on the market. It would seem reasonable to link the value of the image as an insurance element to the type of industry a company belongs to. Given the stable demand for products of the companies of the natural resources exploitation industry, one should expect that the images of such companies are the least influenced by a crisis. The images of businesses directly related to manufacturing are moderately affected by catastro-

phes, while companies providing services or intellectual products are the most vulnerable to scandals, and the relatively high importance of the human factor in their business and sales processes causes the greatest damage to the image and reputation. Currently, the service industry is undergoing a global expansion at the expense of the shrinking manufacturing sector, so it is reasonable to assume that the portion and the importance of "image capital" will continue to increase.

It should not be overlooked that a crisis usually introduces facets that serve to "heat up" the situation. For example, organizations for environmental protection usually react in a more severe manner than the general public and usually succeed in sharpening a crisis. Also, a more drastic reaction should be expected when the issue of discussion is related to health care. Such "heating factors" obviously increase the society's vulnerability and raise the hypothetical price of the image.

The practice of brand-name leasing widely known in the Western world can be used in the computation of the value of image. The brand-name leasing system allows a producer to use another company's name on a commission basis, i.e. usually 8-14% of the forecasted sales volume. If one were to compare these numbers with the image price that becomes apparent in the context of a crisis (such as in the abovementioned examples), it would be observed that the upper price ranges are approximately equal. Meanwhile the minimum brand-name leasing price (8%) is a little higher than the image value observable during a crisis (5%). Once again, such differences can be attributed to the specific nature of different sectors and industries. Business dealing with natural resources rarely lease out their names; this practice is more frequent in the manufacturing industry, and even more often observed in the services sector.

2. Dimensions of the Reputation Quotient

The Reputation Institute (www.reputationin-stitute.com) has made significant contributions to the studies of the crucial influence of reputation on image. The Reputation Institute (RI) is a private research and consulting agency, founded in 1997 by Dr. Charles Fombrun, a former professor of management at NYU's Stern School of Business and by Dr. Cees van Riel, a professor at the Erasmus University Rotterdam. Today RI has offices or associates in about thirty different countries including the U.S., the United Kingdom, France, Italy, the Netherlands,

Denmark, Australia, and Brazil. The company specializes in corporate reputation management, measurement, evaluation, and the creation of management principles. Back in 1999, in collaboration with Harris Interactive, the RI created a methodology for the computation of the so-called Reputation Quotient, which became a popular and universal indicator allowing a measurable comparison in the area of reputation. Reports prepared by the RI are published by some of the most influential newspapers in the business world, including "The Wall Street Journal", "The Financial Times", and "Handelsblatt".

A company's Reputation Quotient (RQ) is computed by quantitatively evaluating twenty indicators, which are classified into six dimensions: emotional appeal, products and services, workplace environment, financial activities, vision and management, and social responsibility. It is apparent that the RQ does not intend to become a complete or partially universal formula for the computation of the image value. However, its methodology is useful in the assessment of the image creation process, helps to detect the areas which image-makers should pay more attention to, and suggests ways to diversify the image creators' activities.

The RI does not disclose the methodology of computing the RQ, yet it must be noted that in the calculation process various dimensions are weighted differently. One should not forget that the methods and tools used to deal with each of the reputation dimensions might vary. There are no strict boundaries between the most important techniques of image creation and reputation formation (i.e. marketing communication, advertising, public relations). Yet these different techniques seem to have established their own bounds; image-makers seeking to create an attractive product or service usually rely on marketing, and emotional appeal is commonly achieved through advertising. Meanwhile, the merits of a work environment, financial activities, vision, management, and social responsibility are most effectively disclosed through public relations.

It is obvious that the implementation of these various organizational and technical tools require different financial resources; therefore, it is complicated to determine their actual value.

Marketing invoices are directly related to the distribution of goods or services; although they may be closely intertwined with direct manufacturing costs, the informational influence of marketing is rather limited. It rarely crosses the boundaries of consumerism and, as a rule, does not influence politics or the broader society.

Advertising expenses are easier to be quantified since they provide less room for hiding unjustified costs. However, the dissemination of advertising is very much related to the functionality of the tools for information dispersal in the society. This aspect reveals the potential influence of the mass media on the society. A successful realization of this potential can significantly affect not only the media, but also the entire society.

Compared to the advertising budget, expenses for public relations are incredibly low. According to "The Economist", in 2005 companies in the United States spent only U.S.\$ 3.7 bn on public relations, whereas the value of the advertising market was U.S.\$ 475 bn. However, it is the public relations sector that has the closest formal and informal ties to the mass media system and holds the greatest and best-kept secrets of invoices for the creation of reputation and image.

The renowned pioneer of market positioning techniques, Al Ries (2004), says that nowadays we witness the fall of advertising and the rise of public relations. The effectiveness of public relations and their relatively small costs create the conditions for the formation of a hidden price of image. This hidden value is not always tangible; the price often expands beyond the traditional means of financing image making and impacts more global processes in society. In such a setting it becomes even less possible to create a universal formula (or at least a formula that could be applied to one specific case) to measure the price of image. The assumption that for the creation of one's image a subject pays not only public relations specialist and image-makers, but also the mass media, narrows the concept of the image price by limiting it to the small costs of that particular segment. On the other hand, the same assumption expands the understanding of the purpose of the image price and shows that not only the image-makers' clients have to pay for the image-creation services. Through the mass media, the society is often indirectly billed for image-making activities.

3. Mass Media Bills

Traditionally it is depicted that the mass media bills image-makers only directly, through invoices for advertisements and commercials. Everything else, i.e. good relations with journalists, the influence of business groups on mass media employees or the content of the message, remains in the "grey zone" which is seldom discussed in public.

At first glance, nothing seems wrong with this communication business, and it seems normal that

the mass media wants to be reimbursed for publishing and for providing commercial services. Yet payment is also expected from the users of the published information, i.e. from the readers and viewers. In the classical communication scheme at least three elements are required for message transmission: the information source, the media channel, and the information receiver. It is apparent that the mass media uses its privileged status (the link between the source and the receiver) and is tempted to demand "commissions" from both sides of the communication process. The distribution of these "commissions" for communication services (in other words, identification of the payers of certain invoices issued by the mass media) can partly aid in determining the price of image creation.

A short overview of media history provides additional insights into the issue under investigation. Publishers of the first newspapers and magazines were able to finance their businesses and make profits through their audience. In other words, their activities were funded by the readers' need to receive information and news. At first, revenue from advertisements and commercials was a secondary source of income, yet gradually its financial importance began to grow. A major turning point was reached with the introduction of electronic media channels. The radio and, more importantly, the television began to rely on the "purchased audience" principle. A television show became only a tool to attract viewers to the screen and then sell the audience to suppliers of commercials (Jamieson, Campbell, 1983: 108). This is how a modern media system based on complicated and not transparent payments was created. In this system the information user continued to pay the same amount of money to the media (e.g. for the creation of a TV show), yet that money was collected not directly, but through commercials.

Although commercial television is perhaps the best example of the transformation of the mass media billing systems, similar changes are taking place in the printed press business. In Western Europe and in North America local newspapers get 80% of their revenues from advertising (The Economist, 2005), and Lithuanian newspapers are likely to get close to that ratio. "15 minučių", the free local newspaper launched in 2005, proves that the business model used by electronic media (i.e. transferring bills from consumers to advertisers) can be successfully adopted by the printed press.

The changes in the billing system of the mass media reveal a new tendency: a newspaper can survive without a reader, and a TV show without a viewer, as more importance is laid on sponsors and

advertisers than on the audience. The previously healthy balance between the information source and the information receiver is becoming distorted and the information source side may eventually prevail. Reduction or even disappearance of information consumer fees is not only an economic phenomenon and a redistribution of the media's funding sources. It is quite likely that consumers are ready to pay in order to satisfy their hunger for information and gain access to objective and current news. However, it is doubtful whether advertisers would be ready to pay the bills for the society's ability to use the free press.

The redistribution of the payers financing the goods and services offered by the mass media mostly satisfies the needs of image-makers; advertisers (offering direct and hidden advertising) become the real mass media clients who can obtain the right to dictate trends. These are global tendencies that mature, democratic countries have little to worry about. In an ideal case, this situation can be compared to a peculiar agreement in the society; since democracy creates optimal conditions for corporate business, and since free press is an important condition for a functioning democracy, the business sector should consider it useful and even lucrative to cover most of the mass media expenses without requiring unconditional compliance in return. This mass media financing scheme can even be regarded as a sort of charity, without forgetting, of course, that the mass media itself is a very profitable business. Many Western countries implement effective mechanisms for the self-control of the mass media, thus helping to retain the independence and autonomy of information sources.

A similar redistribution of mass media funding sources in young democracies, such as Lithuania, that have only recently freed themselves from totalitarian systems, can take on a rather sinister form. In Lithuania the media still has a high trust of the society (although this trust is diminishing). The society tends to overstate the importance of media messages and is unlikely to recognize and admit the existence of a "communications game". So far, one can only discuss certain negative tendencies in the Lithuanian media, which are yet more emphasized by the redistribution in the media financing.

One of the key problems of contemporary Lithuanian media is commercialism, and the transfer of fees for information services from the reader or viewer to the advertiser would only highlight the negative aspects of this phenomenon. Owners of media agencies who seek instant profits find the possibility to make the same (or even larger) amount of money with less investment very appealing. Such businessmen do not always understand the peculiarities of the media business and its importance in shaping the society; income from advertisers becomes a player in the barter exchange, and the money from hidden advertising often flows into the so-called grey market.

The Lithuanian market of information services currently concentrates on building clusters of media companies (examples include "Respublika", "Lietuvos rytas"), and companies like "Achema", "MG Baltic" gain more power and attention, although their primary business has little to do with the mass media. New media owners entering the market only shed new light on the problem of media's dependence on commercial and political interests. Traditional media owners, who usually are former journalists themselves, also use their influence when solving corporate and domestic problems; the new generation of owners (large corporations) has much broader and deeper interests, and the redistribution of costs in the media business is of great importance and use for them. In such a context the issue of hidden advertising becomes even more relevant, if the client is not satisfied with classified advertisements and separately purchases newspaper articles, radio or television shows, or pays for his or her own participation in a television broadcast. The positive side of the issue is that a large part (66.3%) of the Lithuanian population claims to be able to identify hidden advertising, purchased articles in the press and broadcasts on television (Reklamos tyrimai, 2008).

The redistribution of media financing sources in Lithuania negatively influences the sensitive issue of the mass media quality and prevents the development of the so-called qualitative media in the country. When the primary interest of the media is to satisfy the needs of its clients and business partners, it is not surprising that the majority of the media sources seem to resemble the nature of the yellow press.

Generalizations

In the media there is usually an inner conflict between entrepreneurship and the public mission. Image-makers have lately been becoming more influential and able to encourage the society's information tools to strive for higher profits; such actions only highlight the problem discussed in this article. The media become unable to resist the temptations of corporate business, what, together with the civil atrophy, is one of the most negative outcomes of the image-makers' intensifying activities. It could be reasonably argued that the belief (or at least the persuasion) that the image and its creation are expensive

items has become not only an economic, but also a societal factor that influences the media's capacity to carry out its social functions and ensure high quality (McQuail, 1994: 79). The price of image creation will have the bitterest effect on the essential responsibilities of the media, common to the so-called serious journalism. These include informing the society, i.e. presenting the news on events and social processes in the local society and in the world, disclosing political matters, encouraging progress and maintaining relationships, describing and clarifying issues and events, commenting and interpreting them. Moreover, the media are responsible for socialization, for maintaining the norms of acknowledged authorities and leaders, for coordinating separate activities, and for building reconciliation and consensus while determining priorities. Lastly, the media should ensure continuity (in the areas of cultural expression, recognition of subcultures, and cultural development) and not only form but also maintain shared values. Meanwhile, secondary functions of the media, such as entertainment, which are especially common to the yellow press, are unaffected by image-creation processes.

At first glance it may seem that the essence of the image creation value does not differ from determining the price of any other good or service: in order to determine it one would have to analyze its components, evaluate the costs, and estimate the market demand. The course of such a process could tempt one to fall for the illusion that the price for image creation is paid only by those desiring to have a good image. However, an image (reputation or a good name) can be sold to the society only in the presence of the ones responsible for spreading news

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ĮVAIZDŽIO KAINA IR VERTĖ

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Santrauka. Šiandienos versle ir politikoje įsišaknijusi įvaizdžio mada verčia kelti klausimą, kaip būtų galima objektyviai apskaičiuoti įvaizdžio vertę ir kokią kainą galima mokėti už įvaizdžio kūrimą. Vargu ar realu svajoti apie kokią nors „įvaizdžio kainos formulę", tad straipsnyje apžvelgiami bandymai įkainoti prekės ženklą, skaičiuoti įvaizdžio vertę buitinėje plotmėje, ekstremaliose situacijose bei vadinamoji „vardo nuomos" praktika. Atskirai aptariama Reputacijos instituto sukurta vadinamojo reputacijos koeficiento skaičiavimo metodika, kuri galėtų būti naudinga vertinant įvaizdžio kūrėjų pastangas. Daugiausiai dėmesio skiriama tam, ką vadintume visuomenės sąskaitomis už įvaizdžio kūrimą, kurias tenka mokėti per žiniasklaidą. Šiandien vis didesnę visuomenės informavimo priemonių išlaidų dalį padengia ne informacijos vartotojai, bet reklamos teikėjai ir vadinamieji įvaizdžio kūrėjai. Tai dar labiau išryškina vidinius žiniasklaidos prieštaravimus tarp verslumo ir visuomeninės pilietinės misijos. Sąskaitos už įvaizdžio kūrimą tampa sąskaitomis už žiniasklaidos principingumą, kurias jau turi apmokėti ne tik (ir ne tiek) patys įvaizdžio kūrėjai ar jų užsakovai, bet visa visuomenė.

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THE COMBINATION OF INNOVATION AND HUMAN RESOURCE STRATEGIES: THE CASE OF INFORMATION TECHNOLOGY SECTOR IN LITHUANIA

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Abstract. The aim of the present research is to present a set of main patterns, related to the combination of innovation and human resource strategies in the information technology sector in Lithuania. To raise productivity, competitiveness and growth potential of modern economies, business innovation appears crucial; however, these objectives are not likely to be achieved without allocating necessary human resources to innovation projects and introducing an appropriate human resource strategy. Survey results have clearly shown a correlation between variables tightly related to the combination of innovation and human resource strategies; these variables include the percentage of employees with doctorate and master degrees in the total headcount, disparity of net average salaries, investment in research and development, the value-added net profit generated from research and development, the percentage of commercialized innovative ideas, and other important factors. The main findings of the research have also contributed to the identification of the strengths and weaknesses of Lithuanian information technology (IT) companies. It is tempting to believe that this research will serve both the Lithuanian government and Lithuanian enterprises as a platform to discuss, analyze and launch innovation policy initiatives supporting the combination of innovation and human resource strategies.

Introduction

Business innovation is a vital ingredient in raising productivity, competitiveness and growth of modern economies. However, it is not possible to achieve these objectives without allocating necessary human resources to innovation projects as well as introducing an appropriate human resource strategy at both macro and micro levels, which could nourish the innovation culture. Therefore, new technologies call for new ways of organizing and managing work.

Though the scope of research into innovation and human resource strategies is rather wide, literature on the combination of the two policies is far from being rich. Moreover, there is a lack of national-level papers related to both innovation strategies within companies themselves and the combination of innovation and human resource strategies in Lithuania on the whole.

The article is based on the results of a survey on the combination of innovation and human resource strategies in Lithuanian IT companies (2008), conducted by LEFI, the University of Lyon 2. The study was based on the analysis of the experience of other countries and the results of a questionnaire of chief executive officers of Lithuanian IT companies.

Notwithstanding that in a larger country an investigation of 130 IT companies would be insufficient, almost one fourth of the target enterprises were questioned and that is more than satisfactory in such a tiny market as Lithuania. Of 130 enterprises selected, 92 valid responses were received, to give a response rate of 71%, which translated to a standard confidence of 95%.

We have chosen Lithuanian IT companies as the object of our research mainly due to their business models and the main activities directed to the introduction of new innovative products or processes, which is crucial in order to survive in a highly competitive market. Moreover, of utmost importance for Lithuanian IT companies is the ability to attract a qualified human capital as well as to allocate their employees to innovative projects. Thus, the competitiveness of the Baltic countries within the global economy depends on their abilities to take full advantage of their own knowledge-based resources and, especially, of the creative energy of entrepreneurs who develop and generate the value-added to end-users through new products and services.

1. Areas in which Lithuanian Information Technology Companies Encourage Innovations

From the neo-Schumpeterian point of view, innovations and, in particular, technological innovations represent the most remarkable form of novelty. However, apart from the technological innovation, we need to focus on the organizational, institutional and social innovations. Thus, economics is concerned with all the patterns of open and uncertain developments in socio-economic systems.

Innovation may take place through a wide variety of business practices; therefore, innovation and human resource strategies are combined in quite different ways across various Lithuanian IT companies. A range of indicators can be used to measure the level of innovations within an enterprise or in the economy as a whole. These include the levels of efforts (measured through resources allocated to innovations) and of achievement (the introduction of new or improved products and processes). A thorough understanding of the types and levels of the innovation activity in Lithuanian IT companies should help to evaluate the combination of innovation and human resource strategies.

The innovation activity may include: introduction of a new or significantly improved good, service or process; involvement in incomplete innovation projects; engagement in longer-term innovation activity, such as the basic research and development (R&D) or technology watch; investment in areas such as internal R&D, training, acquisition of external knowledge or machinery and equipment related to innovation activities; formal cooperation with other organizations.

Overall, 92% of the enterprises under investigation were classed as innovation-active, encouraging more process than product innovation. In addition, the level of product and process innovations was considerably higher in large firms. Such results were more than satisfactory, given a lack of formal cooperation with other enterprises or institutions regarding innovation activities as well as insufficient financial and informational resources, as the major factors inhibiting development of the innovation strategy in Lithuanian IT companies. The claim regarding the lack of financial and informational resources was supported by the fact that only one third of the companies under investigation were involved in internal R&D, training, acquisition of external knowledge or machinery and equipment necessary for innovation; even fewer companies (14%) were

engaged in longer-term innovation activities, such as the basic R&D or technology watch. The reason for such a situation may be a low level of cooperation with educational institutions and intermediaries.

Our survey has shown an increased engagement in innovation activities in Central and Eastern European countries (CEEC): 58% out of 92 companies under investigation encouraged incremental innovation during the investigation period (see Fig. 1). Given insufficiently encouraged marketing and sales (47%) and support group innovations (17%), breakthrough innovations were poorly supported by Lithuanian IT companies (7%). However, this clearly shows the existing potential of Lithuanian IT companies to switch from incremental to breakthrough innovation and to intensify efforts in increasing marketing and sales as well as support group innovations. The results of the survey have also proved that large enterprises were more likely to engage in various forms of innovation activity and encouraged innovations in more areas than small ones. Such a situation seems natural, as large companies allocate more human and financial resources to innovation projects and use more advanced managing techniques, which create a better innovation climate in the company.

Figure 1. Areas in which Lithuanian IT companies encourage innovation (investigation period: 2004-2008)

(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

2. Identification of Factors Preventing Innovation-related Activities

An important aspect of policy analysis is the identification of the factors constraining the ability of enterprises to engage in innovation. These can include obstacles that the enterprise encounters during the process of innovation as well as factors preventing innovation. The companies under investigation were asked about the range of constraining factors and the extent to which these factors affected the ability to engage in innovation. As we expected, two main groups of factors preventing innovation in Lithuanian IT companies were identified: available human and financial resources.

A particular vulnerability to innovation cost, especially in small and medium enterprises, was observed. This could be explained by the fact that Lithuanian IT companies face a necessity to increase general and administrative expenses in order to organically grow their businesses, to expand their services to a larger and highly competitive market as well as to regularly update its technologies in order to respond to the higher requirements of the customers. Currently, the majority of Lithuanian IT companies are focusing on growing revenues, while the bottom line and margins are insufficient to boost the innovation culture. In particular, obtaining affordable finance was more often a problem for small and medium firms than for larger enterprises.

Among other factors constraining the innovation culture, the lack of qualified personnel, which is not unusual in emerging countries facing the "brain drain" phenomenon, was mentioned. Financial and human resources were followed by the excessive perceived economic risk: 33 companies felt constrained by economic circumstances. The third group of heavily influential factors was related to informational issues, such as the lack of information on markets and technology as well as the lack of customer responsiveness. These factors have been mentioned by 24, 22 and 7 companies respectively. The impact of regulations and standards and organization rigidities were not thought to be substantial barriers to innovation (6 and 5 answers out of 92 companies under investigation).

3. Main Contributions from Investment in Research and Development

Many economists believe that among the main patterns of the Soviet model of innovation we could

find important answers to questions regarding current transformation issues in Eastern Europe, particularly, how the transition experience and previously taken decisions influence the current innovation performance in CEEC. According to Malerba (2002), we should discuss a set of the following issues in CEEC during the transformation period: the absence of important relationships and feedbacks as well as severely hampered inter-organizational learning. In particular, the Eastern countries faced serious problems with respect to the integration between R&D and production. As Malerba claims, this was and is "a well-known problem also in Western systems, but, whereas in the West R&D is, to a great extent, an in-house activity and, therefore, carried out in relative proximity to other activities, Soviet-style R&D was almost exclusively extramural (i.e. firm-external) and thus often carried out at both organizational and geographical distance from production units" (ibid.).

According to Radosevic (2002), "the principle issue in the Soviet system was the lack of enterprise as an independent agent and the main carrier of the innovation process". Being regarded as mere production units, enterprises were more discouraged than encouraged to exercise innovative activities, which was further aggravated by difficulties to move innovations horizontally, i.e. between sectors. After the collapse of the USSR, the main challenge was to shift from a system where the innovation process was organized and managed centrally, to a system where innovation is generated by enterprises through a network of public institutions. Similar transformation issues are relevant to the Lithuanian economy and, particularly, to the Lithuanian IT sector.

To boost the innovation culture via various innovation activities and projects, IT companies need to invest in R&D, which appears to be an important indicator of a company's efforts to increase its competitiveness in the market. However, investment in R&D is not possible without qualified professionals, i.e. without the allocation of the necessary 'know-how'. Thus, we have tried to evaluate the combination of innovation and human resource strategies through interpretation of the prime sources, related to investment in R&D and human resources allocated to innovation projects. In more than two thirds of the companies under investigation from 2% to over 5% of the

total annual revenue were invested in R&D. Nearly one third of the respondents managed to allocate up to 2% of the total annual revenue to R&D. Such results were surprisingly high, as, for instance, Scandinavian IT companies invest in R&D approximately 2%-4% of the annual turnover.

On the other hand, such findings can be considered as slightly disappointing taking into account the fact that Lithuanian IT sector still needs to catch up with better developed Scandinavian countries. As mentioned above, larger companies have more financial resources to allocate to innovation projects. This was clearly demonstrated by the results of our survey: more than 80% of larger companies (annual turnover amounting to LTL 1 million - LTL 50 million and above) invested in R&D from 2% to over 5% of the total annual turnover, while in smaller companies less finances were allocated to R&D (see Fig. 2).

Findings concerning the value-added net profit, generated from R&D in percentage added to the bottom line, were also quite unexpected. The profit derived from R&D activities indicates how efficiently investments in R&D are utilized in order to cut both general production costs and general and administrative expenses. According to our survey, approximately 74% of the respondents managed to add from 1% to 5% of the profit derived from R&D activities to the bottom line, while 16.31% of the companies under investigation managed to add from 5% to over 10% of profit to the bottom line. Such results indicate quite rapid positive changes in Lithuanian IT companies. In addition, only 10% of the companies managed to add up to 1% of the profit derived from R&D activities to the bottom line.

Figure 2. The percentage of annual revenue invested in research and development during the period 2004-2008; by the size of a company
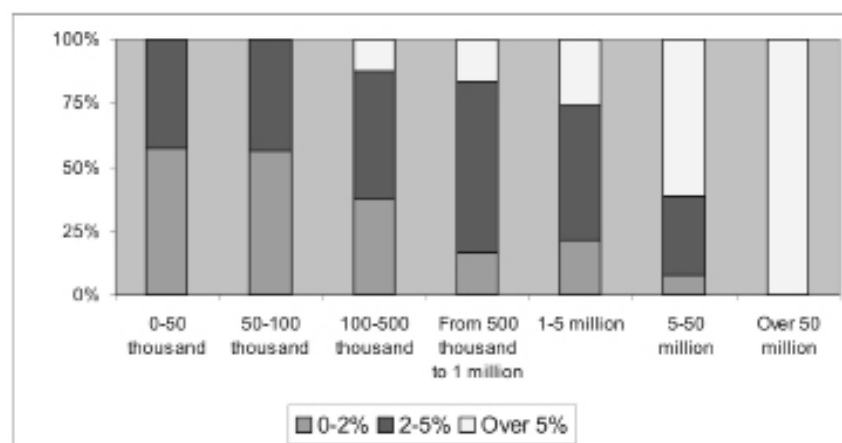
(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

Our survey has shown that the spread of impacts of innovation depended on the amount of total annual revenue invested in R&D. Companies spending more on R&D (higher percentage of total annual revenue invested in R&D) could take advantage of a vaster variety of positive impacts of innovation activities. Ratios of positive impacts of innovation were calculated: firms spending up to 2% on R&D indicated approximately 3 impacts of innovation (a ratio of 2.87); for companies investing from 2% to

Figure 3. Ratios representing positive impacts of innovation during the period 2004-2008 *

*The ratios vary from 0 (minimum) to 9 (maximum)

(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

5% of annual turnover a ratio of 4.03 was calculated; a ratio of 5.68 was calculated for companies investing over 5% of annual turnover in R&D (see Fig. 3).

The larger were companies' investments in R&D, the more positive impacts of innovation (except an extended range and an improved quality of goods or services) were noticed. Such a situation can be explained considering the main trends in the product-oriented IT market, where increasing competition and higher customers' requirements oblige companies to invest in the development of new products and the improvement of the existing ones.

4. Commercialization of Innovative Ideas and Value-added Net Profit

The efficiency of the utilization of financial and human resources can be also expressed by the percentage of commercialized innovative ideas. This variable cannot be measured in cash; however, it shows how many innovative ideas are commer-

cialized by using the existing resources and acting within a particular business strategy and innovation culture of each company. Given a robust organic and structural growth in terms of revenues, commercialized innovative ideas should not necessarily generate a net profit, as it largely depends on the companies' strategies. Furthermore, high percentages of commercialized ideas demonstrate the companies' capabilities to reach their goals.

According to the results of our survey, the companies under investigation were more successful in the commercialization of innovative ideas than in adding a net profit to the bottom line: 46.74% of the companies were able to commercialize from 60% to 80% and over 80% of innovative ideas; 36.95% of the companies managed to commercialize from 20% to 60% of innovative ideas; 16.30% of the companies managed to commercialize up to 20% of innovative ideas. Our survey also revealed a strong interdependence between the percentage of commercialized innovative ideas and the size of a company in terms of the annual turnover. The larger an IT firm is, the more innovative ideas are commercialized. Such interdependence can be explained by a number of factors: availability of vaster financial resources, more developed organizational structure and management techniques creating favourable conditions for innovative activities as well as greater cooperation with partners regarding the issues of innovation. More than two thirds of the companies under investigation with annual turnover from LTL 1 million to LTL 50 million were able to commercialize from 40% to 80% and above 80% of innovative ideas, while less than a half of the enterprises with annual revenues up to LTL 1 million achieved such high results. More than a half of the companies with the annual top line up to LTL 1 million commercialized less than 40% of innovative ideas (see Fig. 4).

Innovation is the key to success, and companies seem to experience no problems in finding good new ideas. Nevertheless, turning those ideas into tangible results, i.e. implementing innovations, is not an easy task. The problem, apparently, is that many companies take a partial approach to innovation. They are successful in finding and assessing new ideas, but rarely complete innovation-related activities. Often there is a lack of time dedicated to effective imple-

Figure 4. Percentage of commercialized promising innovative ideas during the period 2004-2008; by the size of a company
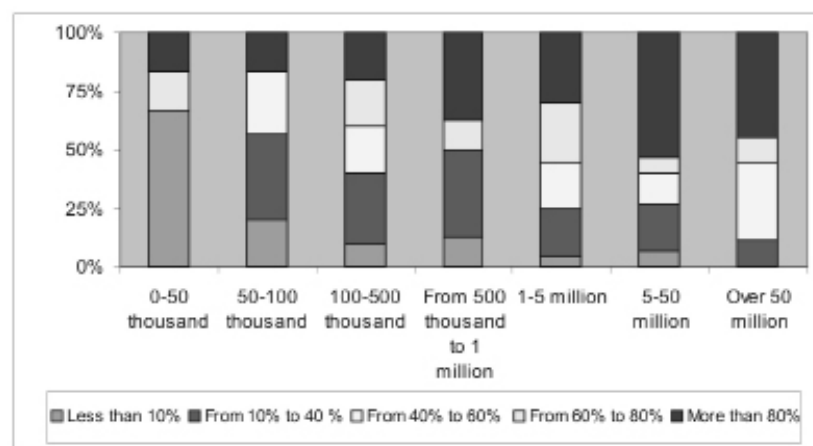
(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

mentation of new ideas that will bear fruit in the future. With reference to the results of our survey, several solutions may be suggested. For example, companies can develop formal, end-to-end innovation processes that encompass everything from the generation of an idea to the evaluation and, especially, implementation. They should outsource some activities and work with partners in order to supplement their overstretched internal resources.

5. Headcount Involved in Research and Development

Given the adverse market conditions within knowledge-intensive economic sectors, the reduction of cost and time necessary to create and release a new product or service is challenging for many companies. Customers become more demanding, and emerging companies find it difficult to generate a robust organic growth and high margins at the same time. The larger players are looking for new sources to grow revenues and profits; thus, they face the necessity to invest in both R&D and human capital. According to Lucas (1988), investments in human capital enhance the economic system's productivity and foster its growth. Technological changes are positively affected by the average level of human capital which determines, as Schultz (1975) argued, the ability of individuals to adapt to technological dynamics. Moreover, labour productivity growth depends on the quality of the physical capital, improvements in the skills of the labour force, technological advances and new ways of organization.

The performance of innovation partially depends on the development of highly trained science

and technology (S&T) human resources and on a firm's capacities to integrate such human resources into innovative activities. Thus, another important factor having impact on the value-added net profit generated from R&D is human resources allocated to innovation activities, particularly R&D. According to our survey, Lithuanian IT companies failed to allocate existing human resources to R&D, as more than two thirds of respondents indicated allocating only up to 10% of the headcount. One third stated that there were from 10% to 25% of the employees involved in R&D, while nearly 10% pointed out having from 25% to 50% and over 50% of the employees involved in R&D. This is largely dependent on the organizational structure of a company, as many Lithuanian companies do not have a special R&D department; thus, there is no clear designation of tasks. On the other hand, they fail to attract qualified human resources, mainly due to inefficient cooperation with educational institutions and incapability to apply new management techniques in order to improve the innovative culture in the company.

At least 45% of larger companies with annual revenues from LTL 1 million to over LTL 50 million had more than 10% of the headcount involved in R&D, and for the largest companies this figure even exceeded 50%. A different situation was observed in firms with annual turnover up to LTL 1 million: in general, they managed to allocate up to 10% of the headcount to innovation activities, particularly, R&D.

As we have previously stated, contributions from R&D depends on the allocation of both financial and human resources. Our survey resulted in another important finding: a strong interconnection between the value-added net profit generated from R&D and the percentage of the headcount involved in R&D exists, which is as well related to the size of a company. The more employees are allocated to R&D, the higher value-added net profit they generate from R&D. Firms with 25%-50% and above 50% of the headcount involved in R&D managed to add from 5% to 10% and over 10% of the profit to the bottom line, while companies with less than 25% of the headcount involved in R&D generated a profit hardly reaching 5% (see Fig. 5).

Figure 5. Value-added profit generated from research and development during the period 2004-2008; by the percentage of the headcount involved in research and development
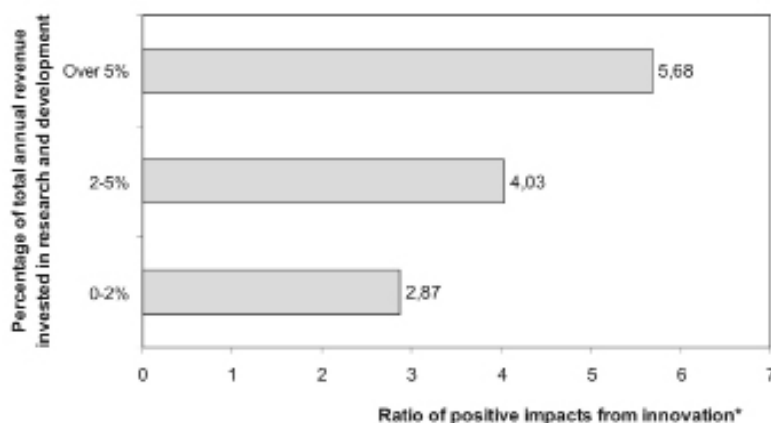

(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

Therefore, another question of our survey was related to the qualification levels of employees, as it is important to employ professionals having the necessary 'know-how' to exercise innovative activities or work in R&D. Our survey confirmed the paradox stated by the World Bank (2003): "Lithuania is among the most educated and the least innovative countries in the world". Not surprisingly, approximately 94.13 % of the headcount employed in the companies under investigation had bachelor or master degrees including other technical or postgraduate qualifications. Only 4% of the headcount had doctorate degrees, as, in general, they prefer to continue their carrier at uni-
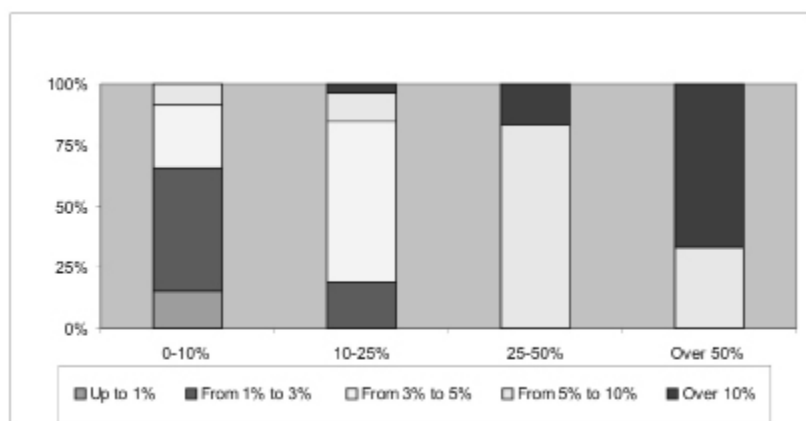
According to our survey, the interconnection between the percentage of the headcount involved in R&D and the percentage of commercialized innovative ideas was not as strong as the interconnection between the percentage of the headcount involved in R&D and the value-added profit generated from R&D. The reason for the more chaotic answers with lower correlation between the two variables was the fact that commercialized innovative ideas are of a quite different character, not so tightly connected to R&D, and deriving from the overall innovation culture in the company, based on such factors as the organization structure, management techniques, cooperation with partners and others. On the other hand, all employees, irrespective of their involvement in R&D, could participate in innovation activities, as they all, directly or indirectly, facilitate innovation activities in the company (see Fig. 6).

6. The Percentage of Employees with Doctorate and Master Degrees in the Total Headcount

One of the major conclusions from the majority of neo-Schumpeterian models is that it pays economically to have a large proportion of well-trained people in the labour force. On the other hand, investment in human capital is a prerequisite but not a sufficient condition for a rapid economic growth.

Figure 6. Commercialized promising innovative ideas during the period 2004-2008; by the percentage of the headcount involved in research and development
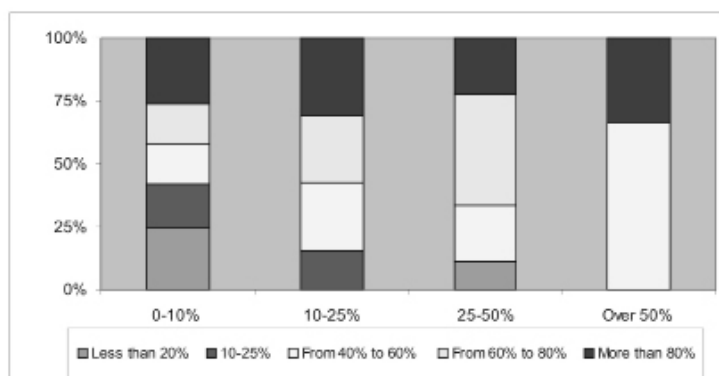
(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

versities or research institutions. In addition, Lithuanian IT companies had very few employees with secondary education or with no qualifications.

Lithuanian IT companies, regardless of their size, were found to have quite equal percentages of employees having doctorate and master degrees in the total headcount; only micro-sized companies were not able to afford such a number of employees with high qualifications. Our survey has not shown any correlation between the percentage of employees with doctorate and master degrees in the total headcount and the size of company. However, a strong correlation between the percentage of employees with doctorate and master degrees in the total headcount and the value-added profit generated from R&D has been observed. Therefore, it is possible to

claim that significant results in innovation activity can be achieved through efficient utilization of human resources, namely, qualified employees.

As Fig. 7 shows, companies having over 80% of employees with doctorate and master degrees in the total headcount managed to add a profit obtained from R&D exceeding 10% to the bottom line. Firms having nearly 50% of employees with doctorate and master degrees in the total headcount generated an extra profit of 3% to 10%. Companies having approximately 44% of employees with high qualifications added a profit of 1% to 3% to the bottom line, while having approximately 21% of employees with doctorate and master degrees in the total headcount allowed to add up to 1% to the net profit. Therefore, it is possible to claim that the larger percentage of employees with high qualifications is employed, the more companies improve their net profit via R&D.

Figure 7. The percentage of employees with doctorate and master degrees in the total headcount during the period 2004-2008
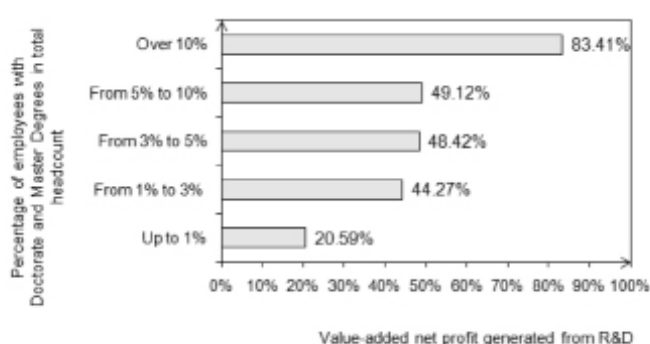
(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

Similarly to the existing strong interdependence between the percentage of employees with doctorate and master degrees in the total headcount and the value-added profit generated from R&D, a particularly strong correlation between the percentage of employees with doctorate and master degrees in the total headcount and the percentage of commercialized innovative ideas was observed. Companies having from 45.64% to 58.98% of employees with doctorate and master degrees in the total headcount were able to commercialize from 40% to over 80% of innovative ideas. The situation was quite different in firms where less than 28.44% of employees in the total headcount had doctorate and master degrees. Such companies managed to commercialize up to 40% of innovative ideas. Therefore, we may claim that the larger percentage of employees with high qualifications is employed, the more innovative ideas are commercialized.

7. Dynamics of Net Average Salaries in Companies under Investigation

Our survey resulted in several important findings regarding the wage policies of the companies under investigation. At more than 92% of the companies the average net salary ranged from LTL 2,000 to LTL 5,000, which is much above the average salary in Lithuania; and only at 6.52% of the companies the average net salary ranged from LTL 1,000 to LTL 2,000. Companies at which the average net salary amounted to over LTL 5,000 comprise 1% of the sample.

Respondents of our survey indicated a lack of personnel as one of the most prominent factors, which emerge due to the "brain drain" and prices increasing faster than salaries. However, our survey did not prove that the average net salary is the most important factor in attracting human resources with high qualification levels. There was no observable correlation between the percentage of employees with doctorate and master degrees in the total headcount and the average net salary at a company; regardless of wage levels, the companies under investigation were able to attract employees with high qualification levels. This allows us to claim that other factors, such as inefficient utilization of human resources or the lack of advanced management techniques and organization structures in order to boost the innovation culture, appear to be crucial for the combination of innovation and human resource strategies. Another prominent factor, as we have previously stated, is the relatively low cooperation between businesses and educational and research institutions. Thus, an important observation can be made: the average net salary does not depend on the size of company, while the percentage of employees with doctorate and master degrees in the total headcount is neither interrelated with the average net salary nor with the size of company.

Another important hypothesis proved by the results of our survey is related to the human resource strategy, particularly, the motivation of human resources allocated to innovation activities. This finding supports our observation regarding a great interdependence between the impacts of innovation and investment in R&D. According to our survey, com-

panies at which the average net salary was relatively high took advantage of a larger variety of impacts of innovation. Ratios to assess positive impacts of innovation were calculated: for firms at which the average net salary was up to LTL 3,000 ratios ranging from 3.33 to 3.67 were calculated; for companies spending on wages from LTL 3 ,000 to LTL 5,000 and over ratios ranging from 5.00 to 5.37 were calculated (see Fig. 8).

Figure 8. Ratios representing positive impacts of innovation during the period 2004-2008; by average net salary*
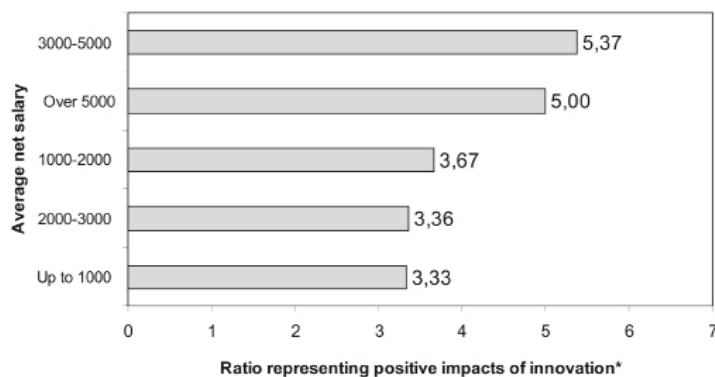
*The ratios vary from 0 (minimum) to 9 (maximum)

(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

Though wage levels did not prove to be the key factor in attracting employees with high qualification levels, our survey proved that the average net salary has an impact on the value-added profit generated from R&D. The majority of the companies at which the average net salary varied from LTL 3,000 to over LTL 5,000 were proud to announce generating from 5% to 10% and above 10% of profit, while only approximately 30% of the enterprises managed to add such a large profit to the bottom line. The performance of the companies at which the average net salary varied from LTL 1,000 to LTL 2,000 was far away from spectacular: those companies hardly added 2%-3% of extra profit. The results regarding micro firms were quite unexpected: over 60% of the companies added up to 1% of extra profit to the bottom line, while nearly one third of micro firms were able to generate over 10% of a

net profit from R&D. This can be explained by great opportunities for organic growth, a weakly developed organizational structure and quite opportunist business strategy. Micro companies, being particularly vulnerable, are at such a point of the economic cycle, where they cannot efficiently cut the cost-base mainly due to great opportunities for organic growth, which are, in general, their top priority (see Fig. 9).

The importance of the average net salary was proved by demonstrating its correlation with the percentage of commercialized innovative ideas; at the same time the significance of such factors as the efficiency of utilization of financial resources and the headcount as well as the overall innovation culture encouraging innovation activities in the company was observed. Nearly two thirds of the firms under investigation at which the average net salary varied from LTL 3,000 to over LTL 5,000 managed to commercialize from 60% to over 80% of innovative ideas. One third of the companies at which the average net salary was up to LTL 3,000 commercialized from 60% to 80% and above 80% of innovative ideas, while the remaining two thirds of the firms commercialized less than 40% of innovative ideas.

The abovementioned results are only a part of the most important results of the survey on the combination of innovation and human resource strategies in Lithuanian IT companies. Some of our preliminary presuppositions

Figure 9. Value-added profit generated from research and development in percentage added to the bottom line during the period 2004-2008; by the average net salary
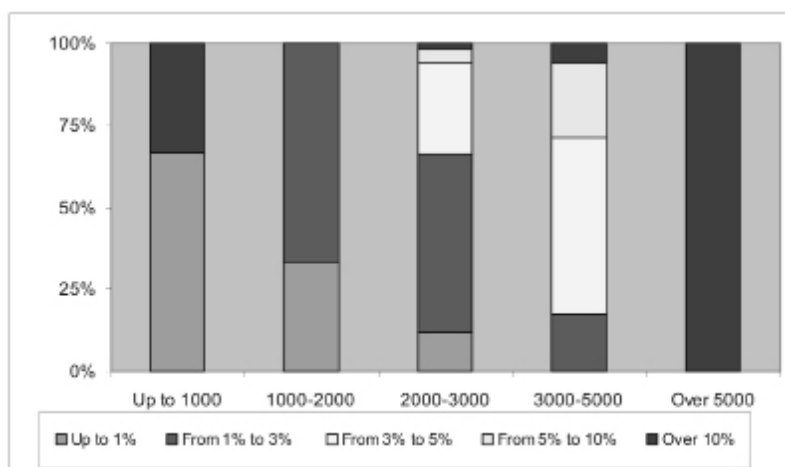
(Source: Survey on the combination of innovation and human resource strategies in Lithuanian information technology companies; LEFI, University Lyon 2, 2008)

were fully supported, while in other cases the survey did not show relations between certain factors.

Efficient combination of innovation and human resource strategies is particularly important for emerging economies such as Lithuania. This phenomenon is thoroughly explained by Nelson (2006) in his article "Economic Development from the Perspective of Evolutionary Economic Theory". Nelson argues that successful catch–up is mainly driven by innovation, which in parallel requires having an access to physical and human capital. Going further, Nelson adds: "to a considerable extent, innovation and effective learning tend to draw supplies of physical and human capital by enabling their rates of return to be high" (ibid.). Given successful examples of catch-up in Japan, Korea and Taiwan, everyone could witness the role of innovation in driving the process and in contributing to higher value-added profits; however, all these countries were able to develop a necessary institutional structure and the environment, where supplies of physical and human capital were available and forthcoming if the returns were high (ibid.). More than that, the educational system should be a flexible component of a "Science-Industry/Business" link, which demands a well developed network, including intermediaries, where knowledge could smoothly circulate without being jeopardized by restrictive regulations or the lack of financial and human resources.

Conclusions

Efficient combination of innovation and human resource strategies is crucial for emerging economies such as Lithuania, where successful catch–up is mainly driven by innovation, which, in parallel, requires having an access to physical and human capital. Our survey has resulted in many significant findings related to the combination of innovation and human resource strategies in the Lithuanian IT sector. Firstly, almost all the companies under investigation were proved to have introduced a new or significantly improved good, service or process; however, process innovation was encouraged more than product innovation. We also proved that large enterprises were more likely to engage in various sorts of innovation activity and encourage innovations in more areas than the small companies; this happens due to larger human and financial resources allocated to innovation projects as well as more advanced managing techniques to create a better innovation climate in the company. In addition, we have discovered a huge potential for Lithuanian IT companies to switch

from the incremental to breakthrough innovation in parallel to stronger efforts in marketing and sales and support group innovations.

Our survey did not prove the interdependence between the net average salary and the size of company, while the percentage of employees with doctorate and master degrees in the total headcount was proved to have no relation to both the average net salary and the size of company. On the other hand, companies with higher average net salary took advantage of a greater variety of impacts of innovation, a larger value-added profit generated from R&D in percentage added to the bottom line, and relatively higher percentages of commercialized innovative ideas. Thus, other factors, such as inefficient utilization of human resources, the lack of advanced management techniques and organization structures or low cooperation with educational and research institutions in order to boost the innovation culture, appear to be crucial for successful combination of innovation and human resource strategies. The enterprises under investigation tended to rely on their own experience and knowledge as well as on the information from suppliers, customers and clients; what is more, the customer-focused view on effects of innovation was proved to be taken into consideration.

According to our survey, Lithuanian IT companies failed to allocate sufficient human resources to R&D. This mainly depends on the organizational structure, as many Lithuanian companies do not have a special R&D department, thus, there is no clear designation of tasks. On the other hand, they could attract more qualified human resources through a stronger cooperation with educational institutions as well as new management techniques in order to improve the innovation culture in the company. Furthermore, our survey proved the existence of a strong interdependence between the percentage of employees with doctorate and master degrees in the total headcount and the value-added net profit generated from R&D as well as with the percentage of commercialized innovative ideas. This makes us believe that it is possible to achieve significant results while exercising innovative activities through efficient utilization of human resources, in particular, qualified employees involved in R&D.

Though nowadays technological catch-up seems to be smoother than 50 years ago mainly due to a relatively stronger body of codified knowledge related to the most important technologies (as much of this knowledge can be transferred through training in relevant sciences or engineering disciplines), it is necessary to build an efficient education system possessing proper financial and institutional struc-

tures. To sum up, the results of the research provided an understanding that Lithuanian IT companies are on the right track to catch up their peers in more developed countries; however, many changes need to be done, and we expect a fast transformation process in the upcoming years.

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INOVACIJŲ IR ŽMOGIŠKŲJŲ IŠTEKLIŲ STRATEGIJŲ DERINIMAS: LIETUVOS INFORMACINIŲ TECHNOLOGIJŲ SEKTORIAUS ATVEJO STUDIJA

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Santrauka. Augant konkurencijai tokiuose ekonomikos sektoriuose kaip informacinės technologijos, šis straipsnis – itin aktualus bei inovatyvus. Efektyviai kuriama ir įgyvendinama inovacijų strategija būtina siekiant mažinti naujų produktų ir paslaugų kūrimo bei pateikimo potencialioms rinkoms išlaidas. Be to, pasirinkta inovacijų strategija turėtų derėti prie kompanijos verslo modelio, technologinės bazės bei žmogiškųjų išteklių strategijos. Žmogiškųjų išteklių bei inovacijų strategijų derinimas yra svarbus tokiose sparčiai besivystančiose šalyse kaip Lietuva. Kaip nauji vynai retai tiekiami senuose buteliuose, naujos technologijos organizacijose taip pat reikalauja naujų organizavimo bei vadovavimo priemonių, o egzistuojanti sėkminga kitų nacionalinių inovacinių sistemų raidos patirtis byloja apie dažną drastišką pertvarką ar net skausmingą destrukciją diegiant inovacijas.

Lietuvos – vienos labiausiai išsilavinusių ir mažiausiai inovatyvių valstybių – paradoksas byloja apie sudėtingą transformacijos procesą, kurį Lietuvos nacionalinė inovacijų sistema išgyvena šiuo metu. Šiame straipsnyje siekta atskleisti inovacijų ir žmogiškųjų išteklių strategijų derinimo galimybes Lietuvos informacinių technologijų sektoriuje. Vertinant pagal vieną kriterijų grupę Lietuvos informacinių technologijų įmonės neišsiskyrė iš bendro Vidurio ir Rytų Europos šalių konteksto – atsilikdamos nuo labiau išsivysčiusių šalių pagal vienus rodiklius, pagal kitus apklaustos įmonės pateikdavo stebėtinai gerus rezultatus. Beveik visos apklausoje dalyvavusios kompanijos buvo inovatyvios ir nukreipiančios savo veiklą daugiau į inkrementines nei radikalias inovacijas.

Nors dauguma apklaustų informacinių technologijų kompanijų vadovų, be finansinių išlaidų inovacijoms, kaip vieną svarbiausių informacinių technologijų kompanijų veiklą ribojančių veiksnių nurodė masinę kvalifikuotų darbuotojų emigraciją iš Lietuvos, vidutinis grynasis metinis atlyginimas nebuvo pagrindinis faktorius siekiant pritraukti magistro ir daktaro laipsnį įgijusius darbuotojus. Kita vertus, vidutinis metinis atlyginimo dydis turėjo lemiamos įtakos kuriant pridėtinę vertę iš tyrimų bei įgyvendinant inovatyvias idėjas. Plėtojant šiuos procesus itin svarbi efektyvi žmogiškųjų išteklių vadyba. Prioritetinis uždavinys – įtraukti kvalifikuotus darbuotojus į tyrimus ir plėtrą bei skatinti inovatyvių idėjų generavimą ir įgyvendinamą. Pasinaudodamos savo didžiausiu turtu – žmonėmis Lietuvos informacinių technologijų kompanijos turi nemažai potencialo ir galimybių prisivyti informacinių technologijų inovacijų srityje labiau pažengusias valstybes. Vis dėlto Lietuvos informacinių technologijų kompanijos tik pradeda ilgą transformacijos kelią, grindžiamą efektyviu inovacijų ir žmogiškųjų išteklių strategijų derinimu.

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MULTI-OBJECTIVE OPTIMIZATION WITH DISCRETE ALTERNATIVES ON THE BASIS OF RATIO ANALYSIS

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Abstract. On the basis of ratio analysis, two methods are developed for multi-objective optimization with discrete alternatives. The first method is MOORA (Multi-objective Optimization on the basis of Ratio Analysis), which serves as a matrix of responses to the alternatives to the objectives to which ratios are applied. The set of ratios has the square roots of the sum of the squared responses as denominators. These ratios are considered to be the best choice among different examples of ratios. The final results varying between zero and one are added up or subtracted to minimize the objective. Finally, all alternatives are ranked according to the size of their obtained dimensionless numbers. Eventually, the most refined way to give more importance to an objective is to replace an objective by different sub-objectives. As a second method, based on the same reasoning as the MOORA method, the Reference Point Method is applied. Ultimately, it is concluded that the second method only serves as a control instrument or as the second best method.

1. Introduction

1.1. Definitions

The issue of utility has always been crucial for researchers in multi-objective decision making, the starting formula being:

$$max\ U(y) = f[u_1(x_1), u_2(x_2), ..., u_n(x_n)] \quad (1)$$

Utility can solely be measured in monetary terms (like in cost-benefit analysis) but researchers consider this attitude to be too materialistic or even unrealistic (Zavadskas, 1990; Roy and Damart, 2005; Brauers, 2004b).

In fact, the utility matter is problematic in four aspects: the choice of units per objective, the normalization, the optimization and the importance given to an objective. In this case the u's can be dropped from the formula.

Nowadays units, attributes, norms, indicators, no matter the name, are used to measure everything, even quality, without any detours to consider the monetary aspects. This is the case in firms, but also in micro- and macroeconomics. Sometimes direct measurement, being too complicated to be made, is substituted by

Alternative Measurement, such as of pollution abatement, quality and individual choice. Let us consider the example of alternative measurement of pollution. Air pollution is difficult to be measured directly. Therefore, pollution abatement costs, for instance, the installation costs in a factory in order to diminish the emission of dangerous gasses and dust represent an alternative measurement of pollution. However, there exist different types of pollution which can be caused by different reasons. For example, air quality in a region like the metropolitan area of Los Angeles could be good, fair or bad. A survey was made in which households in good air quality areas were asked their willingness to pay for a region-wide improvement in air quality. On the basis of the survey and the analysis of the housing market the premium an individual household would have to pay in order to obtain an identical home in a cleaner air region was determined (Brookshire et al., 1982). Regarding noise pollution in residential areas situated near airfields, the cost of complete isolation of houses, the drop in prices of these houses or the amortization of the last models of airplanes would be considered as alternative measurements of noise pollution caused by aircraft noise.

1.2. Assumptions

This article is based on three assumptions.
- The Assumption of Cardinal Numbers
As all objectives are assumed measurable in a direct or alternative way, only cardinal numbers are involved (not nominal scales, such as excellent, good, fair or bad).
- The Assumption of Discrete Choices
The discrete case counts a number of well-defined and possible alternatives (projects, design). On the contrary, the continuous case generates alternatives during the process itself.
- The Assumption of Stakeholders
A decision maker/dictator is replaced by a group of stakeholders. It is not a question of haphazardly choosing one or more decision makers. On the contrary, all stakeholders interested in the issue have to be involved.

1.3. The Methods

Two methods are proposed: firstly, the MOORA method; secondly, the Reference Method with Maximal Criterion Values.

For each method the starting point is a matrix of responses of different alternatives to different objectives:

$$(x_{ij}) \qquad (2)$$

with: x_{ij} as the response of alternative *j* to objective *i*

i=1,2,...,n as the objectives
j=1,2,...,m as the alternatives

2. The MOORA Method

MOORA is a ratio system in which each response of an alternative to an objective is compared to a denominator which is representative of all the alternatives concerning that particular objective. For this denominator the square root of the sum of squares of each alternative per objective is chosen (Van Delft and Nijkamp, 1977):

$$_N x_{ij} = \frac{x_{ij}}{\sqrt{\sum_{j=1}^{m} x_{ij}^2}} \qquad (3)$$

with: x_{ij} = response of alternative *j* to objective *i*
j = 1,2,...,m; m being the number of alternatives
i = 1,2,...n; n being the number of objectives
$_N x_{ij}$ = the normalized response of alternative *j* to objective *i*; normalized as a dimensionless number

Dimensionless Numbers, having no specific unit of measurement, are obtained, for instance, by deduction, multiplication or division. The normalized responses of the alternatives to the objectives belong to the interval [0; 1]. However, sometimes the interval could be [-1; 1]. Indeed, for instance, in the case of productivity growth some sectors, regions or countries may show a decrease instead of an increase in productivity, i.e. a negative dimensionless number[1].

For optimization these responses are added in case of maximization and subtracted in case of minimization:

$$_N y_j = \sum_{i=1}^{i=g} {_N x_{ij}} - \sum_{i=g+1}^{i=n} {_N x_{ij}} \qquad (4)$$

with: *i = 1,2,...,g* representing the objectives to be maximized
i = g+1, g+2,..., n representing the objectives to be minimized
$_N y_j$ = the normalized situation of alternative *j* responding to all objectives

A simulation exercise on privatization illustrates the application of the MOORA and Reference Point methods (Brauers, 2004c, 64).

An ordinal ranking of the $_N y_j$ shows the final preference (Arrow et al., 1949). As Arrow (1974: 256) claims, "a cardinal utility implies an ordinal preference but not vice versa".

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[1] Instead of a normal increase in productivity growth a decrease is possible. At that moment the interval becomes [-1, 1]. Consider the example of productivity which has to increase (positive). Consequently, we look into a maximization of productivity, e.g. in European and American countries. What if the opposite variant occurs? For instance, consider the change from USSR to Russia. Contrary to other European countries, productivity decreased. It means that in formula (1) the numerator for Russia would be negative with the whole ratio becoming negative. Consequently, the interval becomes: [-1, +1] instead of [0, 1].

3. Introduction of Ratios in the Reference Point Theory

This method starts from the already normalized ratios as defined in the MOORA method, namely, formula (3).

Concerning the Reference Point Theory a Maximal Criterion Reference Point is chosen, possessing as co-ordinates the highest co-ordinates per objective of all the candidate alternatives. For minimization the lowest co-ordinate is chosen.

In order to measure the distance between the co-ordinates of the alternatives and the reference point, the *Min-Max Metric of Tchebycheff* is chosen (Karlin and Studden, 1966: 280):

$$\underset{(j)}{Min}\left\{\underset{(i)}{max}/\,r_i -_N x_{ij}\,/\right\} \tag{5}$$

with: $i = 1, 2,..., n$ representing the objectives

$j = 1, 2,..., m$ representing the alternatives

r_i = the ith co-ordinate of the maximal criterion reference point. Each co-ordinate of the reference point is selected as the highest corresponding co-ordinate of the alternatives

$_N x_{ij}$ = the normalized objective i of alternative j

In the case of a minimum the distances between the rather low co-ordinate of the reference point and the corresponding co-ordinates of the responses of the alternatives to an objective are negative. Therefore, only absolute values are introduced in the Min-Max metric.

The preference for this nonconvex result is necessary in order to respect *Consumer Sovereignty* (further explained in Brauers, 2004b: 132-163).

A simulation exercise illustrates the application of the MOORA method (Table 1).

Table 1. A Simulation of MOORA and the Reference Point Method based on Ratios

1a - Matrix of responses of alternatives to objectives: (x_{ij})

Projects	1. IRR (%) MAX	2. Payback Period (in years) MIN	3. New Inv. (10^9 €) MAX	4. New Employm. (in jobs) MAX	5. V.A. (10^6 €) (discounted) MAX	6. Bal. of Paym. curr. acc. (10^6 €) MAX
Project A	12	5	4.5	750	800	150
Project B	12	7	3	800	600	200
Project C	10	9	2.5	900	850	150
Totals	34	21	10	2,450	2250	500

1b - Sum of squares and their square roots

Projects						
Project A	144	25	20.25	562500	640000	22500
Project B	144	49	9	640000	360000	40000
Project C	100	81	6.25	810000	722500	22500
Sum of squares	388	155	35.5	2012500	1722500	85000
Square roots	19.6977156	12.4498996	5.9581876	1418.6261	1312.4405	291.5475947

1c - Objectives divided by their square roots and MOORA

							sum	rank
Project A	0.609207699	0.401610	0.7552632	0.52868053	0.60955	0.514495755	2.61559	1
Project B	0.609207699	0.562254	0.5035088	0.563926	0.4571636	0.685994341	2.2575	2
Project C	0.507673083	0.722897	0.4195907	0.63441664	0.6476484	0.514495755	2.1560	3

1d - Reference Point Theory with Ratios: co-ordinates of the Reference Point equal to the maximal criterion values

r_i	0.609207699	0.401610	0.7552632	0.63441664	0.64765	0.685994341

1e - Reference Point Theory: deviations from the Reference Point

							max	Rank min
Project A	0	0	0	0.10573611	0.03810	0.171498585	0.17150	1
Project B	0	0.160644	0.2517544	0.070491	0.19048	0	0.251754	2
Project C	0.101534617	0.321288	0.3356725	0	0.00000	0.171498585	0.33567	3

By introducing small changes into the simulation it is shown that the Min-Max Metric of Reference Point Theory with ratios is not flexible enough to react to such changes (Brauers, 2004a: 180). Therefore, this Reference Point Theory is considered to be the second best method (after the MOORA method) or as a control system for MOORA.

In MOORA the choice of the square roots of the sum of the squared responses as denominators may look rather arbitrary (Brauers, 2007a, 2007b; Brauers et. al., 2007; Brauers and Zavadskas, 2006). Therefore, the search for alternative denominators is the main issue of this research.

4. Is the Use of other Denominators in the MOORA Method Advisable?

In the MOORA formula (3) the denominator $\sqrt{\sum_{j=1}^{m} x_{ij}^2}$ was chosen.

Possibilities with other denominators will also be discussed as the following description cannot be said to be exhaustive.

4.1. Voogd (1983) Ratios

$$_N x_{ij} = \frac{x_{ij}}{\sum_{j=1}^{m} x_{ij}} \qquad (6)$$

Allen (1951) already used this formula, but Voogd (1983) applied it for multi-objective evaluation. For optimization these responses are added in case of maximization and subtracted in case of minimization (formula (8)).

The total ratios are smaller than those in the square roots method but their calculation is less complicated. However, they will not necessarily lead to the same outcome, e.g. the simulation of marketing in a department store showed different results (Brauers, 2004b: 307-309). Moreover, if many situations similar to the example of productivity occur, the denominator of the ratio could become positive, negative or even equal to zero. Then the ratio itself could obtain all positive or negative values, or could even be undefined. Consequently, the intervals [0; 1] or [-1; 1] are not maintained in the formula of total ratios.

4.2. Schärlig (1985) Ratios

What regards Schärlig Ratios, one of the alternatives is taken as a basis. This mechanical approach is comparable with the formula of Schärlig which multiplies all the fractions.

A problem arises if the alternative which is used as a basis lacks one of the objectives. As a result, some undefined ratios are obtained because the denominator is zero. Therefore, an alternative with no objectives equal to zero has to be chosen as a basis.

Obviously, if another alternative is chosen as a basis, different results are obtained; therefore, a ratio analysis in which one of the alternatives is taken as a basis does not produce a univocal outcome (see simulations in Brauers, 2004b: 297).

4.3. Weitendorf (1976) Ratios

Weitendorf compares the responses with the Maximum-Minimum interval in the following way:
- if $_N x_{ij}$ should be maximized:

$$_N x_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \qquad (7)$$

- if $_N x_{ij}$ should be minimized:

$$_N x_{ij} = \frac{x_i^+ - x_{ij}}{x_i^+ - x_i^-} \qquad (8)$$

with: x_i^+ representing the maximum value and x_i^- representing the minimum value of objective *i*.

The normalized responses belong to the interval *[0; 1]*.

This method which at the first glance seems interesting has to be rejected on the following grounds:

1) the Reference Method with the co-ordinates of the reference point equal to the maximal criterion values cannot be applied as all co-ordinates of the reference point are equal to one (see Table 2e and Table 2f).

2) If only the maximum and the minimum per objective of all alternatives are taken into consideration, the composition of the whole series of objectives remains disregarded, i.e. the following points are not considered:

- the spread as measured by the standard deviation. For several series this spread can be different though with the same maxima and minima;

- the median and the quartiles can be different for several series though with the same maxima and minima.

Therefore, a simulation is made with Weitendorf ratios of the same matrix of responses of alternatives to objectives as in Table 1. In comparison to the square roots ratios presented in Table 1, Table 2 shows the results of the application of the Weitendorf Ratios.

Table 2. Multiple Objectives Optimization with Weitendorf Ratios

2a – Matrix of Responses of Alternatives to Objectives: (x_{ij})

Projects	1. IRR (%) MAX	2. Payback Period (in years) MIN	3. New Inv. (10^9 €) MAX	4. New Employm. (in jobs) MAX	5. V.A. (10^6 €) (discounted) MAX	6. Bal. of Paym. curr. acc. (10^6 €) MAX
Project A	12	5	4.5	750	800	150
Project B	12	7	3	800	600	200
Project C	10	9	2.5	900	850	150

2b - Responses minus minimum for maximization or
maximum minus responses for minimization

Projects						
Project A	2	4	2	0	200	0
Project B	2	2	0.5	50	0	50
Project C	0	0	0	150	250	0

2c – For the denominator: maximum minus minimum

r_i	2	4	2	150	250	50

2d - Data 2b divided by 2c and additive method with Weitendorf
ratios

							sum	rank
Project A	1	1	1	0	0.80000	0	1.80000	2
Project B	1	0.50	0.25	0.333333	0	1	2.0833	1
Project C	0	0	0	1	1	0	1.0833	3

2e - Reference Point Theory: co-ordinates of the reference point equal to
the maximal criterion values

r_i	1	1	1	1	1	1

2f - Reference Point Theory: deviations from the reference point

							max	rank min	
Project A	0	0	0	1	0.20	1	1	1	1
Project B	0	0.50	0.75	0.666667	1	0	1	1	1
Project C	1	1	1	0	0	1	1	1	1

Thousands and thousands of other matrices of responses of alternatives to objectives with the same outcomes of formulae (7) and (8), as given in Tables 2b and 2c, will lead to the same ranking. What is more, the same results would be obtained. For example, the ranking and final results in Table 3 are the same as in Table 2 and have the same relations to their maxima and minima even though the matrix of responses taken as a starting point is different.

Table 3. Multiple Objectives Optimization with Weitendorf Ratios (second trial)
3a – Matrix of Responses of Alternatives to Objectives: (x_{ij})

Projects	1. IRR (%) MAX	2. Payback Period (in years) MIN	3. New Inv. (10^6 €) MAX	4. New Employm. (in jobs) MAX	5. V.A. (10^6 €) (discounted) MAX	6. Bal. of Paym. curr. acc. (10^6 €) MAX
Project A	14	6	7	1000	1200	0
Project B	14	8	5.5	1050	1000	50
Project C	12	10	5	1150	1250	0

3b - Responses minus minimum for maximization or maximum minus responses for minimization

Projects						
Project A	2	4	2	0	200	0
Project B	2	2	0.5	50	0	50
Project C	0	0	0	150	250	0

3c - Maximum minus minimum

r_i	2	4	2	150	250	50

3d - Data 3b divided by 3c and additive method with Weitendorfratios

							sum	rank
Project A	1	1	1	0	0.80000	0	1.80000	2
Project B	1	0.50	0.25	0.333333	0	1	2.0833	1
Project C	0	0	0	1	1	0	1.0833	3

3e - Reference Point Theory: co-ordinates of the reference point equal to the maximal criterion values

r_i	1	1	1	1	1	1

3f - Reference Point Theory: deviations from the reference point

						max	rank min	
Project A	0	0	0	1	0.20	1	1	1
Project B	0	0.50	0.75	0.666667	1	0	1	1
Project C	1	1	1	0	0	1	1	1

4.4. Van Delft and Nijkamp (1977) Ratios of Maximum Value

In the method of maximum value the objectives per alternative are divided by the maximum or the minimum value of that objective which are found in one of the alternatives.

$$_N x_{ij} = \frac{x_{ij}}{x_i^+} \qquad (9)$$

with: x_i^+ representing the maximum or minimum x_{ij} depending on whether a maximum or a minimum of an objective is strived for.

As only maxima, minima and the responses are involved here, the same comments on the spread, the median and quartiles as mentioned for the Weitendorf ratios are relevant.

A fundamental problem arises regarding minimization. The ideal situation for minimization occurs when zero is attained. This could mean dividing by zero. If the numerator is not zero the fraction is undefined. Even if in that case a symbolic number, for instance, 0.001 is given to an alternative, for other alternatives the result would be negatively biased. It could solely determine the final ranking of the alternatives, and that is incorrect (an example is given in Brauers, 2004b: 298).

In any case, the ratios can deviate largely from the interval [0; 1]. In this way one of the advantages of the ratio system disappears, namely, the relation between the ratios can differ by one at most.

Once again, when the Reference Point Theory is applied, all co-ordinates of the maximal criterion reference point are equal to one. Indeed, the maximal criterion values are either the maximum value divided by itself or the minimum value divided by itself.

4.5. Jüttler (1966) Ratios

For normalization it is also possible to use Jüttler's ratios:

$$_N x_{ij} = \frac{x_j^+ - x_{ij}}{x_i^+} \qquad (10)$$

As only maxima, minima and the responses are involved here, the remarks on the spread, the median and the quartiles, mentioned earlier, are relevant.

If x_i^+ represents a minimum, as the denominator it can have a zero value. Therefore, the same criticism as against the van Delft and Nijkamp Method of Maximum Value can be expressed.

4.6. Stopp (1975) Ratios

If max x_{ij} is desirable:

$$_N x_{ij} = \frac{100 x_{ij}}{x_i^+} \qquad (11)$$

If min x_{ij} is desirable:

$$_N x_{ij} = \frac{100 x_i^-}{x_{ij}} \qquad (12)$$

These normalized values are expressed in percentages.

As maxima and minima are used, the same criticism as against the Weitendorf Ratios can be expressed.

Hwang and Yoon (1981: 100) mention the same formulae but without percentages.

4.7. Körth (1969 a, b) Ratios

$$_N x_{ij} = 1 - \left| \frac{x_i^+ - x_{ij}}{x_i^+} \right| \qquad (13)$$

Here the same criticism as against the van Delft and Nijkamp Method of Maximum Value and the Weitendorf Ratios can be expressed as well because the maximum value is used.

4.8. Peldschus et al. (1983) and Peldschus (1986, 2007) Ratios for Nonlinear Normalization

If Minimum x_{ij} is desirable:

$$_N x_{ij} = (\frac{x_i^-}{x_{ij}})^3 \qquad (14)$$

If Maximum x_{ij} is desirable:

$$_N x_{ij} = (\frac{x_{ij}}{x_i^+})^2 \qquad (15)$$

Once again, as only maxima and minima are used, the same arguments as against the Weitendorf Ratios are relevant.

5. The Importance Given to an Objective by the Attribution Method in MOORA

One objective i of $_N x_{ij}$ cannot be significantly more important than the other as all their ratios are smaller than one (see formula (7)). Nevertheless, it may turn out to be necessary to stress that some objectives are more important than others. In order to give more importance to an objective it could be multiplied with a *Significance Coefficient* (for an example see Brauers et al, 2007).

The *Attribution of Sub-Objectives* represents another solution. Consider the example of the purchase of fighter planes (Brauers, 2002). Economically, the objectives concerning the fighter planes are threefold: price, use and balance of payments; however, there is also military effectiveness. In order to give more importance to military defence, effectiveness is reduced by, for instance, giving more importance to the maximum speed, the power of the engines and the maximum range of the plane. Anyway, the Attribution Method is more refined than the Significance Coefficient Method: a more comprehensive characterisation is possible when the Attribution Method is applied. For instance, for employment a significance coefficient of 2 is replaced by two sub-objectives characterizing the direct and the indirect use. In Table 1c for Project A, 2 x 0.52868 is changed by two separate numbers characterizing the direct and the indirect side of employment. However, it is not always easy to find enough sub-objectives on which the stakeholders would agree.

In the Reference Point Theory the Min-Max metric is considered to be the second best method. Is this a correct choice?

6. Is the Min-Max Metric the Best Choice for Reference Point Theory?

6.1. Reference Point Theory as a Very Respectable Theory

The history of the development of the Reference Point Theory is rather long. The foundations of the theory were laid by Tchebycheff (1821-1894) and Minkowski (1864-1909) (see: Karlin and Studden, 1966; Minkowski, 1896, 1911). For further development of the theory significant contributions were made by Benayoun et al. (1971); Wierzbicki (1977, 1980, 1982); van Delft and Nijkamp (1977); Steuer (1989a, 1989b and Steuer and Choo, 1983), Nakayama and Sawaragi (1983), etc. Goal programming represents another development in this sphere; here names such as Lee (1972), Dyer (1972), Tamiz and Jones (1996), etc. must be mentioned.

The choice of the reference point, the distance and the characteristics of the objectives determine the use of the Reference Point Theory (Brauers, 2004b: 156-165).

A method called "TOPSIS" (Technique for Order Preference by Similarity to Ideal Solution) is of particular interest for practitioners (Zavadskas, 1986; Šaparauskas and Turskis, 2006; Zavadskas and Antuchevičienė, 2006).

6.2 I. TOPSIS a Better Choice for the Reference Point Theory?

TOPSIS is a Reference Point Theory which was developed a bit later than the other theories (Hwang and Yoon, 1981: 128).

TOPSIS is "based upon the concept that the chosen alternative should have the shortest distance from the ideal solution" (Hwang and Yoon, 1981: 128) which is, in fact, the aim of every Reference Point Theory or an ideal point, as it is called. The distinction between the TOPSIS method and the MOORA method lies in the definition of distance and in the fact that the ideal point and, ipso facto, each alternative have many co-ordinates corresponding to the number of attributes (a vector). Moreover, an attribute can ask for a maximum or for a minimum attainment. The choice of the distance function and ways to handle maxima and minima make TOPSIS debatable (Zavadskas et. al, 2006; Opricovic and Tzeng, 2004, 2007)

6.2.1. What is Meant by the Shortest Distance?

In TOPSIS the Euclidean distance is chosen to define the shortest distance. Euclidean distances are represented by radii of concentric circles, concentric spheres and, in general, hypersurfaces around the ideal point as a central point. Therefore, according to the definition offered by Minkowski, Euclidean distances are convex: a hypersurface is called convex if it contains with any two points the entire segment joining these two points (Minkowski, 1896: 200; Minkowski, 1911: 103; Pogorelov, 1978: 9). Consequently, in the calculation of Euclidean distances non-convexity (as required by *Consumer Sovereignty)* is disregarded. On the contrary, in the Tchebicheff Min-Max Metric only one (the largest) distance per alternative is kept in the process of calculation; therefore, non-convexity is taken into account.

Calculation of Euclidean distances leads to many similar results. For instance, for the ideal point (100,100) the midway solution (50;50), the extreme positions (100;0) and (0;100) but also (60;40), (40;60), (30;70) and (70;30) have the same Euclidean distances. Even worse, an infinite number of points belonging to the same hypersurface have the same Euclidean distance.

Nevertheless, it is possible that the hypersurfaces are not complete. Everything depends on the philosophy regarding the ideal point. If the ideal point is a *Utopian Criterion Point* no co-ordinate of an alternative can surpass the corresponding co-ordinate of the ideal point. This could be the case in *Performance Management* when the requirements are very high. For instance, in general education the requirements of all subjects of the curriculum could be very high. In the case of choosing marriage candidates the requirements for beauty and cooking could, for instance, be lower but a very high level of intelligence could be required.

If the ideal point is called a *Reference Point* it will have as co-ordinates the highest corresponding co-ordinates of the alternatives. In fact, a reference point is not an optimum point. Therefore, such a situation is sometimes called a *Satisficing Result* or *Bounded Rationality* as it seems that the stakeholders are completely satisfied if the realistic reference point is reached (Wierzbicki, 1982; Ahituv and Spector, 1990). If a new alternative is introduced, the co-ordinates of the reference point could be surpassed. A new reference point could be chosen.

Once again, when the Tchebicheff Min-Max Metric is applied different ideal points can be chosen without difficulties. The only problem may occur if one or more co-ordinates of a newly introduced alternative are larger than those of the existing reference point. In this case the order of the preferences for all alternatives may change. In order to avoid this, the previously established reference point can be maintained, but then negative distances may arise. If, for example, the reference point is r* (15000; 6500; 400) and a new alternative is M (15000; 12000; 0), the deviation for the second co-ordinate will be: - 5500. Therefore, absolute values were introduced in the min-max metric. If this deviation is not allowed, the alternative is fined for 5500 by changing the maximum in a minimum for that response of the alternative to that objective.

6.2.2. How to Handle Maxima and Minima

After normalization and attribution of weights TOPSIS proposes two kinds of reference points: a positive and a negative. The positive reference point has as co-ordinates the highest corresponding co-ordinates of the alternatives (the lowest in case of a minimum). The negative reference point has as co-ordinates the lowest corresponding co-ordinates of the alternatives (the highest in the case of a minimum). With regard to these two kinds of reference points Euclidean distances are calculated. Consequently, each alternative will have two outcomes. Let us call them $_Ny_{j+}$ and $_Ny_{j-}$. In order to come to a single solution, TOPSIS proposes the following formula which is rather arbitrarily chosen (Hwang and Yoon, 1981: 128-134):

$$_N y_j = {_N}y_{j-} / {_N}y_{j+} + {_N}y_{j-} \qquad (16)$$

with: *j = 1,2,...,m; m* representing the number of alternatives

In addition, Opricovic and Tzeng (2004: 450) conclude that the relative importance of the two outcomes is not considered, although it could be a major concern in decision making.

7. General Conclusions

Several alternative solutions to a problem of utility must be suggested. The notion of utility has always been a crucial point for researchers in multi-objective decision making. For us the notion of utility is problematic in four aspects: the choice of units per objective, the normalization, the optimization and the importance given to an objective.

Ratio development can be a full-fledged method for multiple objective optimization. It can also serve as an additive method with ratios for MOORA. Square roots ratios are the most suitable for the Reference Point Method with a Maximal Criterion Reference Point, while the Voogd ratios are the second best. On the basis of mathematical logic and with

reference to several simulations all other methods are considered to be of no value.

At first glance the Weitendorf Ratios look promising. Several tests, however, proved that the method is ambiguous. This is understandable as, regarding the minimum and the maximum, the spread, the median and the quartiles can vary and make the series not univocal. In addition, in the Van Delft and Nijkamp Ratios of Maximum Value, in the denominator a zero value as a minimum can appear making the results undefined. The abovementioned remarks are also relevant to the Juttler, Stopp, Körth and Peldschus Ratios. The ratios *à la* Schärlig are of another kind. As one of the alternatives is taken as a reference with each other alternative the outcome will be different. Of course, minima and maxima are very important notions in many fields of sciences. Unfortunately, they are not sufficient to properly characterize and optimize a matrix of responses of alternatives to objectives.

It is taken for granted that every objective can be measured either directly or by alternative measurement. Is a final ranking universally accepted? Arrow is right in claiming that "obviously, a cardinal utility implies an ordinal preference but not vice versa" (1974: 256).

What regards the square roots ratios and the Voogd sum ratios, one objective cannot be very much larger than another as their ratios are smaller than one. However, it may be necessary to consider some objectives more important than others. How is it possible to take this importance into account? The traditional (but not the best) way is to use weights. To many stakeholders it may be difficult to reach an agreement regarding the choice of weights. A solution could be reached by the analysis of objectives in Sub-Objectives.

In the Reference Point Theory preference is given to the Tchebycheff Min-Max Metric. A reference point per objective possesses as co-ordinates the dominating co-ordinates of the candidate alternatives. For minimization the lowest co-ordinates are chosen and that is more logical than in the TOPSIS method. When the TOPSIS method is applied to two kinds of reference points, a maximum and a minimum, are arrived at, thus making the co-ordination of the sets of points extremely difficult.

The following conclusions regarding the MOORA method can be drawn:

1) Square Roots Ratios are chosen as the best choice for MOORA; Voogd Ratios are the second best.

2) Eventually, more importance to an objective is given by weights or by replacing the objective by different sub-objectives.

3) The ratios per alternative for the objectives to be maximized are added. The ratios per alternative for the objectives to be minimized are subtracted. The general total per alternative will compete in a ranking.

4) The ranking is established.

5) The Reference Point Theory with the Min-Max Metric (but not with TOPSIS) will be used as a control instrument.

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DIDKREČIŲJŲ ALTERNATYVŲ DAUGIATIKSLIS OPTIMIZAVIMAS SANTYKIŲ ANALIZĖS PAGRINDU

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Remiantis santykių analize buvo suformuoti du metodai, skirti daugiatiksliam optimizavimui su diskrečiomis alternatyvomis. Pirmasis metodas yra MOORA (daugiatikslis optimizavimas remiantis santykių analize), kuris veikia kaip atsakymų matrica tikslų alternatyvoms, kurioms yra taikomi santykiai. Šie santykiai laikomi geriausiu pasirinkimu iš skirtingų santykių pavyzdžių. Galutiniai rezultatai, kintantys nuo nulio iki vieneto, yra sudedami arba atimami norint sumažinti tikslų skaičių. Galiausiai visos alternatyvos yra surikiuojamos į prioritetų eilę pagal gautų bemačių skaičių dydį. Geriausias būdas tikslui suteikti didesnį reikšmingumą yra šį tikslą pakeisti papildomais tikslais. Antrasis metodas yra atskaitos taško metodas. Jis paremtas ta pačia argumentacija kaip ir MOORA. Atskaitos taško metodas yra taikomas pirmosios MOORA dalies rezultatams patikrinti.

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OPTIMIZATION OF THE ECONOMICS OF ENERGY MANAGEMENT

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Abstract. In the world of economics the words "Energy Management" carry different conno- tations for different groups of people. From the point of view of producers, they mean the scheme of optimization of all the different factors costing productions of different types of energy such that the total amount of revenue is maximized and the total cost of operation is minimized. They attempt to achieve both. But they must achieve at least one of these primary objectives. From the point of view of consumers, "Energy Management" means use of all different types of energy to sustain life and health most economically. Often both producers and consumers fail to understand what environmentalists mean by "Energy Management." To this group energy management must be done in such a way, so that all factors needed for production and usage of all forms of energy must meet all the strin- gent criteria to control pollutants released into the atmosphere by all agents of production and consumption of energy.

Unfortunately, companies who are in the business of production, look into how to manage energy by considering different forms of energy production in order to make their investment most profitable. However, they are bound by the rules of the department of energy and they must follow the guidelines of the Environ- mental Protection Agency (EPA) and other mandates of federal, state and local governments. This topic is energy management in production control and it has a strong impact on the global economy.

In this article energy management is studied applying mathematical methods of optimization. The model is quite general and the solution is quite simple which may be done using the calculator. The model predicts how many units of types of energy must be produced to maximize the revenue which depends on the demands for those types of energy in the market and the protocol and policies that the company plans to adopt for production. Thus the method developed in this article is to be applied at the planning stage for optimization of the economics of energy management. A model illustration has been used in the text explaining the step- by-step application of the theory.

1. Introduction

Energy sustains life. Life exists in social and physical environments. Economy is the very foundation for maintenance of these environments. Industries support and control economy. They play a most significant role on production of energy while balancing all the essential ingredients of nature so that life can roll on. But they need cooperation from all of us. In March 2009, EPA (Environmental Protection Agency) of the United States has set up some energy conservation action plans. They show how "opportunities for energy conservation are increasingly available in almost every application in any setting. Home, school, office, and industrial environments have all benefited from cost- saving and energy-saving innovations. The advantages of energy conservation have been quantified on the local level as tons of air-pollutants avoided and dollars saved." But one must understand that industries work with agencies working on pollution control, on the basis that they must make profits so that they could be in business. The fact is: all over the world, demand for energy is continuously increasing. We are all hungry for comforts and these comforts require a large amount of consumption of energy, primarily electricity and petroleum. This urge for comfort often becomes greed for comfort.

The Science Education Foundation of the United States [2] reported that per megawatt of electricity produced: 854 pounds of CO_2 causing global warming, 0.048 pounds of par- ticulates, that

contribute to smog causing lung diseases, 0.024 pounds of sulfur oxides causing acid rain are released into the atmosphere. Our greed for luxury and comfort is indeed one of the most significant sources of our misery. This is also putting more pressure on industries to generate more energy.

There are two sources of energy: primary and secondary. Primary sources are fossil fuels (like coal, petroleum and natural gas), nuclear energy, biomass, geothermal, hydro- electricity, solar power, tidal power, wind power, etc. These sources can not be readily used by the consumers. They must be converted into secondary sources into secondary energy resources like electricity, hot water, hot gas, etc. using some mechanical/chemical processes so that consumers will be able to make use of them. These transformations from primary to secondary, are some of the main culprits for environmental pollution.

All of these topics are discussed very analytically with many statistical surveys in the references [3, 4, 5, 6, 7, 8, 9, 10, 11, 12]. But we have to keep in mind that energy is a most needed commodity of the society and we need industries to invest on converting primary sources of energy into the secondary sources and stay in business as partners for better life and health.

Scientists, economists, environmentalists, must look into conditions under which in- dustries in charge of production of energy must prosper and at the same time consumers must see how energy should be used efficiently minimizing any waste.

For most industries, before manufacturing and marketing their products, manage- ments put most emphasis on detailed analysis of all constraints for various services required to start their business. They must consider all the possible line items in the service category like labor, equipments, transportation, storage, maintenance, pollution control, marketing, legal expenses, etc. and their limitations which are imposed upon the industry by the economical and political environments. Sometimes, these cause severe global issues which must be resolved before the industry may begin any operation. All limitations put forward constraints whose units often depend on time, tool, technology and money, or combinations of some of them. For instance constraints on labor depend on hours, available tools, technical training and of course, money.

Optimization of revenue or profit is a huge econo-mathematical challenge when all these factors are taken into consideration, because it may take months or years to collect available data and analyze all of them before they could be useful for the model. These efforts are expensive. Finally consumers pay for these expenses. Because the bottom line in an industry is how to make their business profitable. Thus some form of optimization of revenue is an absolute requirement for an industry.

A burning question is: Can the tedious task of collection of hundreds of data from various sources and a complete analysis of them before being applied in the model for optimization be simplified by some simplistic set of data for an effective optimization scheme? The answer is: This may be possible.

In this article, an attempt has been made to collect available data from the reports of progress and expenses incurred as stated by industries to produce and distribute various forms of energy. For example a coal-fired station producing electricity must report their expenses related to megawatts of electricity produced monthly/quarterly and the same is true for a nuclear power station, solar power station, etc. They also report in general total expenses for each line item of service. These information may be collected from several companies and will form the necessary data to be implemented in the algorithm developed here. Such implementations could be simplified considerably by considering the optimization model developed in this article. Emissions from coal-fired power plants represent one of the largest sources of emission of carbon dioxide, a main cause for global warming and all forms of lung disease. Ristinen and Kraushaar [15] reported in October, 1998.

National Average Emission Factor Per Megawatt of Electricity Generation

	CO_2 lb/MWhe	NO_x lb/MWhe	SO_2 lb/MWhe
Coal	2400	8.8	17
Fuel Oil	2000	4.2	1
Natural Gas	1300	4.6	0

where CO_2 = carbon-dioxide, NO_x = nitrogen oxide and SO_2 = sulphur-dioxide. These gases are being continuously emitted ruining our environment and health. Thus our badly needed energy is the primary cause of deterioration of our greatly needed health. This suggests that every industry must look into all the necessary means to minimize release of pollutants in the atmosphere. These operations cost money. In the model this has been included.

We have not been able to use actual data from any company. In that sense our work is theoretical in nature. However, we expect that in the future our model will generate relevant data in the study on applied modeling of cost effective energy management which should be more environment friendly.

2. The Model for Optimization

Let an energy enterprise decide to produce and supply J number of different forms of energy for an estimated cost C_{max} amount of dollars. To administer production and supply let I number of various schemes of service be deployed. These are labor, equipment, transportation, storage, maintenance, etc. Under each of these schemes, there may be other kinds of services.

Let x_j $(j = 1, 2, \ldots J)$ represent the number of units of different forms of energy (like petroleum, natural gas, propane, nuclear, coal, solar, wind, etc.) to be manufactured.

a_{ij} = The estimated cost for the ith ($i = 1,2,\ldots$ I) line item in the category for the production of one unit of the jth form $(j = 1, 2, \ldots J)$

r_j = the estimated revenue from one unit of the jth form of energy to be produced.

C_{imax} = *Max* estimated cost for the ith category of service.

Table 1. The chart showing line items of service required for productions of different forms of energy, the max line item budget and the estimated revenue from each kind of energy

Estimated Revenue		r_1	r_2	$r_{3\ldots}$	$r_{j\ldots}$	r_3	
Line Items of Service	Forms of Energy	x_1	x_2	$x_{3\ldots}$	$x_{j\ldots}$	$x_{j\ldots}$	C_{max} = Upperlimit of the operating budget
Service #1	S_1	a_{11}	a_{12}	$a_{13\ldots}$	$a_{1j\ldots}$	a_{1j}	C_{1max}
Service #2	S_2	a_{21}	a_{22}	$a_{23\ldots}$	$a_{2j\ldots}$	a_{2j}	C_{2max}
Service #3	S_3	a_{31}	a_{32}	$a_{33\ldots}$	$a_{3j\ldots}$	a_{3j}	C_{3max}
...	...	...	...	...	...	...	...
Service #i	S_i	a_{i1}	a_{i2}	$a_{13\ldots}$	$a_{ij\ldots}$	a_{ij}	C_{imax}
...	...	...	...	...	...	...	...
Service #I	S_j	a_{I1}	a_{I2}	$a_{13\ldots}$	$a_{Ij\ldots}$	a_{Ij}	C_{Imax}

Then the optimization of the economics of energy management in terms of cost/revenue is:

Maximize $F = r^T x$ (Objective Function)

subject to $A_x \le C_{max}$

$$x \ge 0 \tag{1}$$

a_{ij} = the amount of money spent on the ith type of service to produce one unit of the jth kind of energy.

x_j = the amount of the jth form of energy. where

$r = (r_1 \ r_2 \ldots r_j)^T \in R^{J+}$

r_j = The amount of revenue obtained by selling one unit of the jth form of energy.

$x = (x_1 \ x_2 \ldots x_J)^T \in R^{J+}$

$A : R^I_+ \times R^J_+ \to R^I_+$

defined by $A = [a_{ij}]_{\substack{i=1,2,\ldots I \\ j=1,2,\ldots J}}$

and $C_{max} = (C_{1max} \ C_{2max} \ldots C_{Imax})^T \in R^{I+}$.

R^I_+ = Real non-negative I-dimensional space

R^J_+ = Real non-negative J-dimensional space

In general, a_{ij}'s are found out through tedious, laborious data analysis costing a huge amount of man hour and money. We will now make an attempt to simplify this whole system.

C_{imax} = The upper limit of the operating budget to be spent for the production of the ith form of energy. The model for optimization is (1) subject to I number of inequalities which are the constraints of the objective function.

F_{max} = Maximum Revenue to be collected.

3. Computation of Maximum Ravenue

Let E_{max} = the upper limit of the total operating budget

$$= \sum_{i=1}^{I} C_{imax} \tag{2}$$

Let E = the total operating budget. Obviously, $E \le E_{max}$ (3)

$E_{max} - E$ = the amount of leeway, reserved for an allowable margin of freedom or variation needed for inflation and/or emergency expenses.

Let E_j = the operating budget for the jth form of energy.

Then

$$E_j = \sum_{i=1}^{I} a_{ij} x_j, \qquad j = 1, 2. \ldots J \tag{4}$$

If C_i = the operating budget for the ith form of service.

$$C_j = \sum_{j=1}^{I} a_{ij} x_j, \qquad i = 1, 2. \ldots J \tag{5}$$

Let $E = p\%$ of $E_{max} = p \cdot E_{max} \cdot 10^{-2}$. Hence

$$\frac{E_{max}}{E} = \frac{10^2}{p} \tag{6}$$

Also in general, for each category of service and for each form of energy-investment a given percentage of E is kept aside.

Let $E_j = \alpha_j \%$ of the operating budget, then

$$E_j = \alpha_j \cdot E \cdot 10^{-2} \tag{7}$$

From available data published by energy-producing companies, it can be figured out howmuch they are spending and/or willing to spend to generate 100 units of a particular form of energy.

These units could be 100 barrels of crude oil, or 1000 BTU's of heat or 1000 megawatts of electricity etc. From those data one can compute for one unit of that form of energy, how much expenses are estimated. Let for one unit the expense for the *j*th form of energy $= \beta_j$ % of $E_j = \beta_j (\alpha_j \cdot E \cdot 10^{-2}) \cdot 10^{-2}$

$$= \alpha_j \beta_j G \tag{8}$$

where

$$G = E \cdot 10^{-4}. \tag{9}$$

Also, estimations are done by each company for each line item of service.

Let for the ith line item of service the estimation for the *j*th product be γ_i % of E_j

$$= \gamma_i \cdot E_j \cdot 10^{-2} \tag{10}$$

Then

a_{ij} = estimated cost for the ith line item of service for the expenses of pro-duction of one unit of the jth form of energy (here $x_j = 1$).

$$= \gamma_i \cdot (\alpha_j \beta_j G) \cdot 10^{-2} \tag{11}$$

Then for the expenses for the ith category of service,

$$\sum_{j=1}^{J} a_{ij} x_j \le C_{i\max} \tag{12}$$

gives,

$$\sum_{j=1}^{J} \gamma (a_j \beta_j) x_j \cdot G \cdot 10^{-2} \le C_{i\max}$$

or

$$\sum_{j=1}^{J} \sigma_j \cdot x_j \le \frac{C_{\max} \cdot 10^2}{\gamma_i \cdot G} \tag{13}$$

where $\sigma_j = \alpha_j \cdot \beta_j$.

We should observe that $C_{i\max}$ and G are to be given in terms of dollars; and σ_j 's and x_j's are pure numbers with no dimension.

The inequality (13) should be valid for all $i = 1, 2 \dots I$. Hence all constraints are reduced to

$$\sum_{j=1}^{J} \sigma_j x_j \le \min_i \left(\frac{C_{i\max}}{\gamma_i} \right) \cdot \frac{10^2}{G} \tag{14}$$

Now, from (9)

$$\frac{10^2}{G} = \frac{10^6}{E} = \frac{10^8}{p \cdot E_{\max}} \tag{15}$$

From (14) and (15)

$$\sum_{j=1}^{J} \sigma_j x_j \le \min_i \left(\frac{C_{i\max}}{\gamma_i} \right) \cdot \frac{10^8}{p \cdot E_{\max}} \tag{16}$$

If

$$C_{i\max} = \gamma_i \text{ % of } E_{\max} = \gamma_i \cdot E_{\max} \cdot 10^{-2} \tag{17}$$

then (16) becomes

$$\sum_{j=1}^{J} \sigma_j x_j \le \frac{10^6}{G} \tag{18}$$

If

$$K - 10^6/p \quad \text{and} \quad \theta_j = \frac{K}{\sigma_j} \tag{19}$$

then (18) may be written as

$$\sum_{j=1}^{J} x_j / \theta_j \le 1 \tag{20}$$

This defines the feasible region on which F must be maximized.

According to the Simplex Algorithm F will be a maximum at one of the vertices which are given by $(\theta_1, 0, 0, \dots 0), (0, \theta_2, 0, 0 \dots 0), \dots (0, 0, \dots 0, \theta_J)$.

Thus

$$x_j = \theta_j = \frac{K'}{\sigma_j} \forall j \tag{21}$$

From the point of view of consumers in the market, demands for the types of energy to be produced will determine $r_1, r_2 \dots r_J$, the coefficients of the objective function, and the objective function is given by

$$F = \sum_{j=1}^{J} r_j x_j$$

Thus

$$F_{\max} = \max_i (r_j \theta_j)$$

$$= \max_j \frac{r_j}{\sigma_j} \cdot K \tag{22}$$

where K and σ_j are pure dimensionless numbers and r_j's are expressed in dollars. If the company has to follow a mandate which requires that for
$j = J1, J2, J3$, where $J1 < J$, $J2 < J$ and $J3 < J$, it must produce x_{J1}, x_{J2}, and x_{J3} respectively, then

$$F_{max} = \frac{max}{j}(r_j/\sigma_j)K + V$$

$$j \neq J1, j \neq J2, j \neq J3$$

$$V = r_{J1}X_{J1} + r_{J2}X_{J2} + r_{J3} \cdot X_{J3} \qquad (24)$$

Depending upon the amount of total investment (22) and (23) will determine a profit or a loss for the company.

Now let us understand thoroughly what we have done so far.

$K = 10^6/p$ is a dimensionless number where p is chosen somewhat arbitrarily. To compute F_{max} we choose the largest value of (r_j/σ_j). If for $j = m$, (r_j/σ_j) is the max, then the corresponding x_j is

$$x_m = \frac{K}{\sigma_m} \qquad (25)$$

is dimensionless (given in units), and the vertex of the feasible region is $(0, 0, \ldots x_m, 0, \ldots 0)$ in the R^{J+}, where F attains a maximum, given by

$$F_{max} = r_m x_m \qquad (26)$$

We note that this F_{max} depends only on r_j's α_j's, β_j s and p. These are all known from the analysis of the data collected from various sources and not directly on the value of the operating budget. We need to choose operating budget such that revenue must exceed this budget so that a profit can be made. Thus for profit, (from (6), (9), and (19))

$$F_{max} > E_{max} = KG \qquad (27)$$

suggests,

$$r_m \cdot \frac{K}{\sigma_m} > K \cdot G$$

Giving selling price of one unit of $x_m = r_m > \sigma_m \cdot E \cdot 10^{-4}$ (from (9))

$$= \beta_m(\alpha_m \cdot E \cdot 10^{-2}) \cdot 10^{-2} \qquad (28)$$

$$= \beta_m \cdot E_m \cdot 10^{-2} \qquad (29)$$

$$= \text{expense to manufacture one unit of } x_m$$

Thus our formula (25) is compatible with the market economics.

Thus, at the planning stage, once we choose r_j, α_j, β_j ($j = 1, 2, \ldots J$), we will compute first

$$F_{max} = \frac{r_m}{\sigma_m} \cdot K, \text{ where,}$$

$$\sigma_m = \alpha_m \cdot \beta_m.$$

Then we choose an operating budget E such that

$$E < \frac{r_m}{\sigma_m} \cdot \frac{10^6}{p} = \frac{r_m}{\sigma_m} 10^4 \qquad (30)$$

when p = 100. If and when this is possible, one may go ahead with the planned investment, else the project should be dropped. It may also be observed that γ_i's do not directly affect *Fmax*. That suggests that if the management decides to cut costs in all or some of the line items of service, the total revenue and hence profit may not be affected.

4. A Model Illustration

A company plans to spend E (to be determined) amount of dollars to generate electrical energy using six different sources, namely, coal, nuclear, biomass, hydro-power, solar and wind. This will be done by applying several different forms of services like labor, equipment, transportation, storage, pollution control, maintenance, marketing, etc. The management has decided to spend on each category of energy as follows:

E_1 = operating budget $\leq E$:

Expenditures	Total	Per Unit
Coal	E_1 = 24% of E	0.1% of E_1
Nuclear	E_2 = 21% of E	0.15% of E_2
Biomass	E_3 = 19% of E	0.2% of E_3
Hydro-power	E_4 = 16% of E	0.1% of E_4
Solar	E_5 = 11% of E	0.13% of E_5
Wind	E_6 = 9% of E	0.2% of E_6

Let the fluctuating market show that on the average if r_j = revenue from one unit of x_j (types of energy) then r is given by

$$r = (r_1, r_2 \ldots r_J)^T \ (J = 6)$$

$$= (30 \ 42 \ 45 \ 19 \ 22 \ 19)^T$$

We will now compute how to optimize the revenue function

$$F = r_1x_1 + r_2x_2 + \cdots + r_6 x_6.$$

under the limitations of the operating budget given by the table above and demands for the various forms of energy in the market as recorded by r_j's.

<u>Solution:</u> From the given data

$\alpha_1 = 24$,	$\alpha_2 = 21$,	$\alpha_3 = 19$,	$\alpha_4 = 16$,	$\alpha_5 = 11$,	$\alpha_6 = 9$
$\beta_1 = .1$,	$\beta_2 = 0.15$,	$\beta_3 = .2$,	$\beta_4 = .1$,	$\beta_5 = 0.13$,	$\beta_6 = 0.2$
$\sigma_1 = 2.4$,	$\sigma_2 = 3.15$,	$\sigma_3 = 3.8$,	$\sigma_4 = 1.6$,	$\sigma_5 = 1.43$,	$\sigma_6 = 1.8$

The constraint is

$$24x_1 + 31.5x_2 + 38x_3 + 16x_4 + 14.3x_5 + 18x_6 \leq K$$
where

$$K = 10^6/p$$

Now to compute F_{max} we need to see

$$\max_j \left(\frac{r_j}{\sigma_j} \right) = r_m/\sigma_m$$

We have	$r_1/\sigma_1 = 30/2.4 = 12.5$	$r_2/\sigma_2 = 42/3.15 = 13.33$
	$r_3/\sigma_3 = 45/3.8 = 11.84$	$r_4/\sigma_4 = 19/1.6 = 11.87$
	$r_5/\sigma_5 = 22/1.43 = 15.39$	$r_6/\sigma_6 = 19/18 = 10.56$

Thus $r_m/\sigma_m = 15.39$, and, $F_{max} = 15.39 \times \dfrac{10^6}{p}$

(from (26)).

If p = 80, F_{max} = 192375.00.
If p = 90, F_{max} = 171000.00.
If p = 100, F_{max} = 153900.00.

In each case, E = operating budget <

$\dfrac{r_m}{\sigma_m} \cdot 10^4$ (from (30)), p = 100. That means,

$$E < 15.39 \times 10^4 = 153900.00.$$

Since the market fluctuates continuously, an industry cannot and should not depend only on one product. Thus several relatively high values of (r_j/σ_j) should be taken into serious consideration and productions of those forms of energy should be undertaken. That will increase both the revenue and the operating costs, and profit will fluctuate.

One must remember that mathematical optimizations give some guidelines and should not be considered to be the exact code of action of a company. The real world is full of many unknowns and unpredictables. Nevertheless, the help that we receive from mathematical optimization cannot be ignored.

Once *E* is known the total amount to be spent on each category of service, will be known if γ_i's are known. If the company plans to spend for labor, transportation, storage, maintenance, pollution control, and marketing 22%, 20%, 8%, 32%, 10%, and 8% of E respectively which means $\gamma_1 = 22$, $\gamma_2 = 20$, $\gamma_3 = 8$, $\gamma_4 = 32$, $\gamma_5 = 32$, $\gamma_6 = 8$, and if we choose $E = 150,000$, then expenses for labor = 33,000.00, expenses for transportation = 30,000, expenses for maintenance = 48,000, expenses for pollution control = 15,000, expenses for marketing = 12,000.

The complete picture is as follows:
E = operating budget = $150,000.00. Cost for labor = $33,000.00

Cost for transportation = $30,000.00
Cost for storage = $12,000.00
Cost for maintenance = $48,000.00
Cost for pollution control = $15,000.00
Cost for marketing = $12,000.00

To be spent under the given market conditions, on x_j (j = 5) which is solar energy and the number of units to be produced is give by

$$x_5 = \frac{K}{\sigma_5} = \frac{10^6}{1.4 \times p}$$

= 8741.26 if p = 80
= 7770.01 if p = 90
= 6993.01 if p = 100

F_{max} = 192,375.00 if p = 80
= 171,000.000 if p = 90
= 153,900,00 if p = 100

The time-span for all these expenses may be daily, weekly, monthly and each unit of and these give a max revenue as follows: *xj* may be 10 Megawatts, 20 Megawatts or much more.

This is of course a theoretical model.

We should note that α_j, β_j and γ_i, all of these parameters should be estimated, after relevant data from other industries doing similar business are reviewed and analyzed.

From the algorithm it is quite clear that at the planning stage, the algorithm works as follows:

Step #1 From available data find γ_i, α_j, β_j, r_j.

i = 1, 2, . . . I = Number of types of services to be used.

j = 1, 2, . . . J = Number of different energies to be produced.

Step # 2 Find maximum revenue, and x_j's to be manufactured.

Step # 3 Find the operating budget to be invested.

Step # 4 Find the budgets for all line items for service. Make the final decision to undertake the project or not.

5. Cost Optimization Scheme

We have discussed the scheme for optimization of revenue. But this is valid provided the industry is running efficiently. Iin order that an industry may function efficiently, all line items of service must function at an optimum capacity. Every industry requires a minimum amount of these services, measured in time and translated into dollars.

Let us now consider the model for optimization of cost. We will study how to compute the minimum amount of time needed in each category of service.

Let,

b_{mn} = the amount of the mth type of energy production requiring one unit of the nth type of service which is measured in time.

y_n = the amount of units of time needed for the nth type of service.

The units of time may be measured in hours, days, weeks or even months as decided by the company.

Then,

$$\sum_{n=1}^{I} b_{mn} y_n = \text{Total amount of the } m\text{th type of energy}$$

produced by I number of different services.   (31)

If there are J-types of energy *(m = 1, 2, . . . J)* the company understands that E_{mmin} = the minimum amount of the *m*th type of energy must be produced to meet the demands in the market.

Thus the constraints are

$$\sum_{n=1}^{I} b_{mn} y_n \geq E_{m\,min}.$$ (32)

m = 1, 2, ... J

If C_n = the cost per unit of time for production of energy using nth type of service, the cost function to be minimized is:

$$Cost = \sum_{n=1}^{I} C_n Y_n.$$ (33)

Statistical surveys will show that the company should need a minimum amount of service in each category. That means

$y_n \geq Y_{nmin}$, (n = 1, 2, . . . **J**)   (34)

Thus (33) will be minimized applying constraints (32) and (34).

From the previous section, if the company decides to produce only one form of energy (say m = M), then (32) reduces to only one inequality.

$$\sum_{n=1}^{I} b_{Mn} Y_n \geq E_{M\ min}$$ (35)

giving

$$\sum_{n=1}^{I} \frac{Y_n}{\varphi_n} \geq 1$$ (36)

where

$\varphi_n = E_{Mmin} / b_{Mmin}$ (37)

and $y^T = (0, 0, . . . 0, \varphi_n , 0 . . . 0)^T$. This gives

the least cost in the service category

$$(\text{cost})_{\text{least}} = \frac{\min(C_n \varphi_n)}{n}$$ (38)

Obviously an industry cannot function if it uses only one kind of service. In fact, there are several categories of services which are absolutely essential for an industry to stay in operation.

The inequality (36) shows that the values of y where the minimum value of Cost could be found must stay on or above the hyper I-dimensional plane

$$\sum_{n=1}^{I} y_n / \varphi_n = 1.$$

giving $y_n = \varphi_n$ for *n = 1, 2, ... I*, and when $y_n = \varphi_n$, all other y's are zero. The points on the I-dimensional plane at the intersections with the axes y_i *(i = 1, 2, . . . I)* are: $(\varphi_1 , 0, 0, . . . 0)$, $(0, \varphi_2 , 0, 0, . . . 0)$, $(0, 0, \varphi_3 , 0, . . . 0)$, . . . $(0, 0, . . . 0, \varphi_I)$ respectively. If y_i 's exceed φ_i's the inequality (36) will be satisfied, but total cost will increase.

Thus if all the services are to be retained, the minimum cost will be

$$(\text{Cost})_{\text{least}} = \sum_{i=1}^{I} c_1 \varphi_1.$$ (39)

This brings forth the concept of "Minimum Wage" and the minimum hours of service in each category to be used. Ironically, minimum hours of service required by the industry is the same as the maximum hours of service that workers can work for.

This principle may be extended if the industry plans to produce other forms of energy.

If

$E_{Mmin} = x_{jmax}$ (40)

then,

$$Y_n = y_{n\,min} = \frac{x_{j\,max}}{b_{Mn}}$$ (41)

Obviously, $M_{min} = j_{max}$. This is compatible with the basic economic principle which implies that if the production of a particular kind of energy is increased that will require the units of time in some service category like labor, maintenance, storage etc. to be increased.

This cost minimization scheme is really not needed by householders. They must use their common sense instead. Like, "turn the lights off" when you do not need it; "stop burning gasoline" when you need it, etc. No mathematical theory is required. We all know energy costs money and production of energy causes pollution in the environment.

Thus saving energy means saving money and

improving health, which means saving more money.

6. Application of Dual of (1)

If γ_i , α_j , β_j are not properly found then the method discussed above will certainly fail. At that point the model (1) may be directly solved by the standard Simplex method by applying the laborious survey to collect data for A. If that is hard one may consider the dual of (1) for minimization.

Since r^T is known, the dual of (1) given by

Minimize $W = C_{\max}^T z$

subject to

$$A^T z \geq r, \quad z \geq 0 \qquad (42)$$

may also be solved with x_j's as slack variables for this model.

$A^T =$ Transpose of $A : R^{J+} \times R^{I+} \to R^{J+}$
$z \in R^{I+}$
$C_{\max} = (C_{1\max} , C_{2\max} , \ldots C_{I\max})^T$

It is well known that dual leads to the same solution given by the original problem.

7. Discussions

The study conducted by Stromberg [16] indicates the following chart for future de- mands for primary sources of energy:

Energy	Demand in 2006	Demand in 2030
Fossil Fuel	80%	85%
Nuclear	15%	6%
Renewable	6%	8%

Renewable energy sources include biomass, geothermal, hydropower, solar, wind, tidal, etc. They are renewable because they may be replenished in a short time. Sun shines. Wind blows. River flows. They supply primary energy continuously. We need to trap these sources economically. Obviously Stromberg thinks that such an energy economy is not attainable within the next 30 years.

Experts believe, that is not the case. We have to achieve it for our own survival. Apollo PAC [17] reported from the Official Earth Day Guide to Planet Repair, that wind energy production in North Dakota alone could produce a third of the United States' energy needs. All other nations are also eager to do the same. Thus the prediction of Stromberg' that about 90% of our demand for energy "will be supplied by the fossil fuel" by 2030 is not acceptable. Fossil fuel is non-renewable. Experts believe that oil production in North America is fast approaching a plateau and EIA (Energy Information Administration) believes that roughly in 60 years we will have used up 80% of the world oil reserve (at the rate we are consuming now).

The world attention is now focused on "Green Energy" which refers to sources of energy which have been found to be less polluting and as such environmentally more safe. These are solar, wind, hydroelectric, geothermal etc. Green Energy is being used for electricity, heating and cooling and all consumers including various kinds of businesses and industries could purchase green energy according to their energy requirements fully or at least partially. That will greatly reduce pollution level and save lives and better our ecosystem. Many media used the term "Green Energy" and "Renewable Energy" interchangeably. However, it must be noted that production of all forms of energy depends on technologies which will have some negative impact on our environment. Several countries, states and cities are purchasing electricity from utility and/or some green energy provider. In the city of San Francisco, California, they are trying to use

51% renewable energy for their energy requirements. The Dutch government exempts green power from pollution taxes. That made green energy no more expensive than other standard energy. In Massachusetts and California, a new approach to community energy supply has provided several communities with necessary means to solicit a competitive electricity supplier and use municipal revenue bonds to finance and develop local green energy resources. In the European Union and in India several incentives have been undertaken to develop and distribute green energy to consumers. However, for all these efforts industries and consortium working on these projects must look into models which are mathematically sound, to maximize the revenue and minimize the cost of operation.

8. Conclusion

We have looked into the study of "Energy Management" and its impact on economy mostly from a theoretical standpoint. However, the theory is quite general and applica- ble. In the model we have included the concept of pollution control and costs that go with it. This cannot be ignored and should not be ignored.

"Energy Management" is a vital task of every nation, every city and every individual. Else, health will deteriorate, medical cost will skyrocket, GNP will decline and disasters in environment and economy will devastate all that we need to maintain a better life.

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ENERGETINĖS EKONOMIKOS VADYBOS OPTIMIZAVIMAS

Suhrit K. Dey

Santrauka. Energetikos vadybą nagrinėja įvairių sričių atstovai. Gamintojai orientuoti optimizuoti visas produkcijos sąnaudas, energijos sistemas taip, kad sumažintų išlaidas. Energetikos vadyba suprantama kaip visų rūšių energijos naudojimas gyvybei ir sveikatai palaikyti, labiausiai akcentuojant ekonominį naudingumą. Dažnai gamintojai ir vartotojai nesugeba suprasti, ką aplinkosaugai reiškia energetikos vadyba. Visi veiksniai, turintys įtakos gamybai, visų formų energijos naudojimui turi atitikti griežtus kriterijus, turi būti kontroliuojama teršalų į atmosferą išmetimo lygis, gamybos ir energijos suvartojimo lygiai. Deja, gamybos bendrovės į tai dėmesį kreipia tik jei tokios investicijos yra pelningos. Reikia pažymėti, jog numatytas reguliavimas yra privalomas, ir Energetikos departamentas parengęs taisyklių sąvadus, ir šios taisyklės privalomos Aplinkos apsaugos agentūrai, taip pat kitoms įgaliotoms institucijoms. Energijos valdymo ir gamybos kontrolė turi didelę įtaką pasaulio ekonomikai. Šiame straipsnyje energijos valdymas yra tiriamas taikant matematinio optimizavimo metodus. Modelis yra bendras ir sprendimas yra paprastas, viskas gali būti atliekama naudojant skaičiuotuvą. Modelis prognozuoja, kiek vienetų įvairių rūšių energijos turi būti pagaminta, siekiant padidinti pajamas, kurios priklauso nuo šių rūšių energijos rinkoje. Sukurtas metodas turėtų būti taikomas planuojant optimizuoti energijos valdymą.

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WEB-BASED INTELLIGENT DECISION SUPPORT SYSTEM FOR REAL ESTATE

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Abstract. By finding, capturing, and sharing explicit and tacit knowledge, real estate companies can significantly improve customer results. One of the main roles of explicit and tacit knowledge management in the real estate sector is sharing best practice. Throughout the world there are many examples of the application of best practice by the major players (appraisal services, brokers, consulting, facility management, insurance, matching/listing services, mortgages, property management, project development, real estate finance, real estate transaction process, relocation services) in the real estate market. In order to demonstrate the application of best practice, explicit and tacit knowledge in the real estate sector, a Web-based Intelligent DSS for Real Estate (IDSS-RE) will be studied as an example.

JEL Classification: R31, C02, D81

Keywords: decision support system, real estate, explicit and tacit knowledge, Multiple Listing Service

Reikšminiai žodžiai: sprendimų paramos sistema, nekilnojamasis turtas, išreikštinės ir neišreikštinės žinios, daugiafunkcė paieškos sistema.

1. Introduction

Explicit knowledge belongs to the group of the traditional resources of a real estate company. Knowledge is the integrated sum of physically intangible resources, the bigger part of which is tacit: skills, competences, experiences, organizational culture, informal organizational communication networks, and intellectual capital of an organization. It is often believed that as employees leave a real estate company at the end of each working day, the utmost knowledge resources existent in their heads leave the company as well. Capturing the tacit knowledge of individuals so that it could be put into practice by real estate companies is perhaps one of the biggest challenges in the real estate sector. For real estate companies that successfully tap into this invaluable information source there is a tremendous payoff in improved customer results.

One of the main roles of explicit and tacit knowledge management in the real estate sector is sharing best practice. Throughout the world there are many examples of the application of best practice by the major players (appraisal services, brokers, consulting, facility management, insurance, matching/listing services, mortgages, property management, project development, real estate finance, real estate transaction process, relocation services) in the real estate market.

The authors of this paper participated in the project Framework 6 "Intelligent Cities" (INTELCITIES). The main objective of INTELCITIES is to create a new and innovative set of interoperable e-government services to meet the needs of both citizens and businesses. One of the INTELCITIES' goals (on the Lithuanian part) was to develop a Web-based Intelligent DSS for Real Estate (IDSS-RE)

which can use best practice, explicit and tacit knowledge.

The paper is structured as follows: following this introduction, Section 2 deals with explicit and tacit knowledge in the real estate sector; in Section 3 we describe best practice in the real estate sector and Multiple Listing Service Systems; the development of a Web-based Intelligent DSS for Real Estate is introduced in Section 4; finally, some concluding remarks are provided in Section 5.

2. Explicit and Tacit Knowledge in the Real Estate Sector

Knowledge can be explicit and tacit.

Explicit knowledge is comprised of documents (appraisal reports, balance sheets, sale-purchase agreements, insurances, market analyses, contracts, declarations, etc.) and data that are stored within the memory of computers. This information must be easily accessible to a real estate organization, i.e. the obtainment of the necessary knowledge should not be obstructed. Explicit knowledge is information that is widely used in information technologies.

The main real estate organizational knowledge is tacit. The creation and distribution of tacit knowledge requires creativity and competence. Tacit knowledge is a mixture of informal and non-registered procedures, practice, skills, deliberations, subjective insights, intuition, and judgments that employees acquire by virtue of their experience and expertise. This knowledge is vitally important because it defines the abilities and experience of employees. Tacit knowledge represents an important intellectual resource that cannot easily be duplicated by competitors. In order to be recorded, tacit knowledge must be converted into explicit knowledge. However, recorded knowledge is static and can soon become outdated. Therefore, innovative real estate organisations establish an environment where knowledge is continuously created, captured, and disseminated.

The transfer of tacit knowledge is unverifiable and requires face-to-face contact; therefore, spatial nearness is significant. Creating and sharing tacit knowledge are basically social activities. Therefore, the key to effectively capturing tacit knowledge within a real estate organization is the precise choice of the right expert to perform a particular task. Expertise management becomes the central principle of tacit knowledge. Experts can share information about a current issue, problem or topic through meetings, workshops, seminars, video conferencing, e-mail, intranet-based discussion groups, extranets, telephone, working on joint projects, coffee conversations, canteen discussions, brainstorming sessions. For example, via regular meetings know-how can be transmitted among group members, communities of practice can help to drive strategy, solve problems quickly, transfer best practices, and develop new skills.

Experience allows an expert to transform information (economic, technical, infrastructure and qualitative characteristics of a dwelling, market survey, etc.) into a work product (i.e. calculation of the market value of a dwelling) that is delivered to a client. The task is to get this tacit knowledge out of the mind of an expert and capture it in a form that can be used by clients; traditionally, in the form of calculations and written word.

In order to be converted into explicit knowledge, tacit knowledge must be extracted and formatted. Some tacit knowledge systems use the natural learning questions WHAT-HOW-WHY and codify the answers in a specific knowledge structure, which allows stakeholders to analyse their actions and results more effectively. Most advanced real estate organisations have focused on tacit knowledge; they routinely conduct sessions between knowledge management staff and real estate employees to capture tacit knowledge. This knowledge may then be converted into multiple forms of explicit knowledge, such as methodologies, precedent documents or a record of newly acquired skills and expertise. Different knowledge-capture techniques (interview, on-site observation, brainstorming, protocol analysis, consensus decision making, nominal-group technique, Delphi method, concept mapping) can be used to capture tacit knowledge and codify it in a form of appraisal reports, sale-purchase agreements, market analyses, contracts, methodologies. Once knowledge is captured or codified, it is no longer tacit.

Different techniques of harvesting the tacit knowledge of experts and transforming it into explicit forms can be used in practice. LearnerFirst [10] is a company that specializes in harvesting the knowledge of experts and incorporating it into computer-based learning resources. These learning resources encapsulate the tacit knowledge of an expert and transform it into an explicit form. The process is akin to the more familiar Knowledge Engineering practice in the Expert Systems field. As a result of the process, special software is designed in a way that an individual can simultaneously understand, learn, perform, and record the performance. In this sense, such a technique can be classified as an Electronic Performance Support System [10]. According to Mitri [11], "the problem of tacit knowledge capture is a central theme in the field of knowledge management, and assessment management can be thought of as a form of knowledge management". Therefore, tacit assessment management can be facilitated through technologies commonly used in knowledge management systems such as databases,

Internet architectures, artificial intelligence, and decision-support techniques. Mitri [11] describes tacit performance assessment in the context of knowledge management and presents a prototype decision-support system for managing tacit performance assessment using knowledge management techniques.

Knowledge management systems facilitate the storage, registration, organization, filtration, analysis, collection, and distribution of tacit knowledge.

One of the main roles of knowledge management in real estate sector is sharing best practice.

3. Best Practice in the Real Estate Sector and Multiple Listing Service

Much more attention has to be paid to knowledge creation and its distribution in a form of the databases of best practice; this process has recently begun in the most progressive activities of the real estate sector.

Search, storage, management and improvement of best practice, knowledge, and databases of best practice are among the newest priorities of the real estate sector in most advanced countries.

Comparative analyses of best practice are becoming more popular in the real estate sector. Comparative analyses are based on the analysis of the best examples of services available to clients. The results of comparative analyses allow to make certain recommendations on the possibilities to provide services of higher quality and to better satisfy the needs of the clients. Comparative analyses provide the possibility to quickly and efficiently understand and apply the methods, which could help to achieve the world-class quality of client service.

Best practice in the real estate sector is obtained in different ways, e.g. applied research, wisdom and experience gained through practice and experience of clients and other stakeholders, opinion of experts, etc. Real estate databases and knowledge databases of best practice are knowledge-obtaining tools which allow one to save a lot of time and provide information on the best real estate practice in different forms (appraisal reports, sale-purchase agreements, insurances, market analyses, contracts, declarations, e-mail messages, slide presentations, text, video and audio material).

Stakeholders in the real estate sector usually are trying to achieve different economic, maintenance, facilities management, comfort, technical, technological, social and other aims. Different means could be used to achieve them. Some aims are not so easy to be achieved and may require a lot of expenses. Best practice allows not to limit oneself only to the achievement of economic aims; it creates conditions to reach a higher level and realize the perspective, from which a certain practice is considered the best.

The main problem of many best practices is the way they are presented, i.e. they are suggested without taking into account the peculiarities of a certain situation.

Best practice comparative analysis systems facilitate the establishment of the principle lines of activity oriented towards an increase in efficiency. What is more, these systems enable real estate companies to easier estimate their progress: a company is able to compare its performance with the achievements of other organisations. Finally, these systems allow to identify the gaps in activity efficiency and suggest methods to fill these gaps. Modern real estate companies know how to exhaust the possibilities provided by comparative analyses and, consequently, reduce their expenditure and increase their competitive abilities.

In order to demonstrate the application of best practice in the real estate sector a Multiple Listing Service (MLS) system will be studied as an example. Various aspects of MLS systems were investigated by researchers from various countries [2-4, 7, 9, 12-15].

MLS systems have produced outstanding results in different countries and could be adapted for Lithuania and other countries. According to real estate experts, a MLS benefits both, the buyers, who gain access to the maximum numbers of listings, and the sellers, who are enabled to reach the maximum number of potential customers.

The MLS system was introduced at the end of the last century in the US; afterwards it was introduced in the majority of the countries in which the free real estate market exists. Due to the MLS system, complex services were introduced into local real estate markets and the activity of brokers was united [7].

The MLS is created and run by real estate professionals; it accumulates all property listings into a single source, thus, for purchasers it becomes very convenient to review all available properties. The MLS is also designed to regulate commission splitting and deal with other issues regarding the contacts between brokers and agents.

A major part of MLS contains data on various types of real property objects offered for sale and lease. The MLS may be applied for various purposes: to encourage business efficiency, to enable MLS members to occupy a special place on the market, to assist realtors in the search for information about sales of compatible facilities, to accelerate and facilitate the procedures of purchase and sale of property for customers; the MLS may also provide precise statistical data about the market, information on the existing trends, and become a valuable source of income for an association [12].

At present, the developed MLS systems do not allow for the performance of the following functions: multiple criteria analysis of alternatives (priority, utility degree, and market value of the analysed real estate alternatives), negotiations and determination of the most rational real estate purchase variant based on real calculations. In order to demonstrate the abovementioned functions in practice a Web-based Intelligent DSS for Real Estate developed by the authors of the present paper will be studied as an example.

4. Web-based Intelligent DSS for Real Estate

The IDSS-RE is a Web-based Intelligent DSS for Real Estate and is available from: http://dss.vtu.lt/realestate/. Figure 1 shows the screen which appears when the website is loaded:

Fig. 1. The start-up menu screen of the web-based DSS
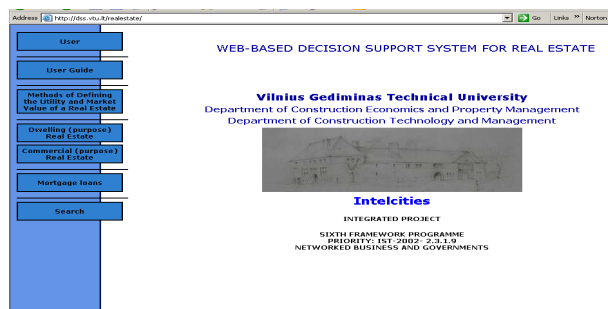
The IDSS-RE includes an intelligent decision support tool based on methods of alternative generation, multiple criteria analysis, and negotiation [1, 5, 6, 8, 16, 17]. This tool, developed by the authors of this paper, enables the negotiating parties to evaluate their systems of preferences and recognize opportunities for trade-off between differently valued objectives and for joint gains. Negotiators can elaborate on different arguments in support of their position through the e-mail facility. The decisions of the parties are based on a more complete and more thoroughly quantitatively and qualitatively evaluated real estate alternatives.

During the negotiation process, all negotiating parties are automatically networked with one another and can exchange offers and counteroffers via the Internet. Also, private and confidential data is kept safe and secure; this is an obvious advantage when there is a great physical distance between the parties and meetings are difficult to be arranged.

Real estate brokers, wishing to present their knowledge and information on their objects, should ask permission from the IDSS-RE administrator. When the permission is obtained, the broker inserts all necessary information and knowledge about the real estate objects for sale into the IDSS-RE databases and the database of best practice according to the system's requirements (system of explicit and tacit criteria, values and weights of criteria). Access to the brokers' personal IDSS-RE databases and the database of best practice is available only to the broker and to the IDSS-RE administrator.

At the moment the following databases are developed: dwelling real estate (apartments in houses with few flats, apartments in blocks of flats: single-room, 2-room, 3-room, 4-room, 5-room), garden houses, farmsteads, cottages, private houses and commercial real estate (premises, buildings).

At present, the IDSS-RE allows for the performance of the following five main functions:

1. Search for real estate alternatives. A customer may use databases of different brokers to perform the search for alternatives. This is possible because the forms of data submissions are standardized at a specific level. Such standardization is also advantageous for special intelligent agents that are performing a search for the required real estate in various databases as well as in the database of best practice and gathering information/knowledge.

2. Finding out alternatives and making an initial negotiation table (see Fig. 2). Consumers specify requirements and constraints and the system queries the information regarding a specific real estate item from a number of online brokers. The system performs the tedious, time-consuming, and repetitive tasks of searching various databases and the database of best practice, retrieving and filtering information/knowledge, and delivering it to the user. Results of a search for a specific real estate item are presented in the initial negotiation table, which may include direct links to Web pages of brokers. Due to such a display, the support for the multiple criteria comparisons can become more effective.

3. Multiple criteria analysis of alternatives. During the purchase decision process, a customer should examine a large number of alternatives each of which must be considered with regard to a number of factors (economic, quality (architectural, aesthetic, comfort), infrastructure, technical, legal, technological, etc.). When the information and knowledge are gathered, the multiple criteria analysis is carried out. During this analysis the buyer (broker) determines the initial priority, utility degree, and market value of the analysed real estate alternatives.

4. Negotiations based on real calculations. During negotiations the buyer and the seller may use the IDSS-RE to perform real calculations (the utility degree, market value and purchase priorities) of real estate. These calculations are performed on the basis of characteristics describing real estate alternatives obtained during negotiations (explicit and tacit crite-

ria system, criteria values and weights). According to the results of the calculations, the final comparative table is made.

5. Determination of the most rational real estate purchase variant on the ground of characteristics describing effectiveness of the analysed alternatives (priority, utility degree and market value) (see Fig. 3). When the final comparative table is made, the multiple criteria analysis can be carried out and the best real estate purchase version can be selected using the IDSS-RE.

Fig. 2. A fragment of the process of finding out alternatives and making an initial negotiation table

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Results of Multiple Criteria Evaluation

No.	Criteria under evaluation	Measuring units of criteria	*	Weights of criteria	987	988	989	990	991	992	993	994	995	996	997	998	999
1	1 m^2 price	Litas	-	1	4500	4900	5086	5024	5400	5100	4533	5029	5300	5000	5029	5500	5400
2	Apartment area	m^2	+	0.06	44.16	46	44.43	35.83	44	44	44.12	47.72	47	41.88	44.17	45	44.5
3	Building height	points	+	0.02	5	9	5	1	5	5	5	5	5	4	5	5	5
4	Floor in which apartment is located	points	+	0.08	1	9	3	1	1	1	1	5	3	4	1	1	3
5	Years of construction	years	-	0.06	1967	1970	1965	1940	1964	1962	1966	1967	1963	1960	1966	1963	1962
6	Apartment condition	points	+	0.06	3	3	3	2	3	4	1	4	2	3	1	2	4
7	Parking	points	+	0.08	1	2	2	2	4	2	1	3	3	3	3	1	3
8	Heating	points	+	0.07	2	3	3	1	3	2	2	1	1	2	2	2	2
9	Place	points	+	0.31	2	3	3	3	4	3	1	4	3	3	4	4	3
10	Communications	points	+	0.06	1	2	2	2	2	2	1	2	1	2	1	1	2
11	Transport flows	points	-	0.07	4	4	1	2	2	5	5	2	2	3	1	2	1
12	Level of contamination	points	-	0.04	4	3	2	2	1	4	5	1	2	3	2	1	1
13	Evaluation of thermographic analysis	points	+	0.011	3	2	2	3	3	3	2	3	3	4	2	3	3
14	Volume flow	m^3/h	+	0.015	9.55	11.55	10	7.5	8.45	10.5	9.65	8.25	8.75	7.85	8.55	7.65	
15	Air velocity	m/s	-	0.016	0.08	0.11	0.04	0.09	0.09	0.08	0.09	0.07	0.08	0.07	0.08	0.08	0.07
16	Relative humidity	%	+	0.015	35	50	41	25.45	35.45	55	40.45	30	30.5	25.95	25.8	25.8	30.9
17	Air temperature	oC	+	0.017	18	16	17	20	18	18	18	19	20	21	19	19	21
18	Luminosity	lux	+	0.018	80	65.45	60.5	90.5	110	100.55	90.5	95	110.9	110	80.9	80.9	100
19	Vibration	mm	-	0.01	0.06	0.07	0.1	0.06	0.07	0.06	0.06	0.1	0.05	0.06	0.06	0.06	0.06
20	Acoustic performance	dB	-	0.015	51	53	50	45	45	49	46	45	46	45	50	50	45
21	House dust mites	%	-	0.002	65	60	63	100	80	75	75	90	100	100	90	90	100
22	Dermotophagoides pteronysinus allergen	%	-	0.002	1	20	2	1	1	1	1	1	1	1	1	1	1
23	Noise pollution	dB	-	0.038	84.7	78	54.3	54.3	65.2	78	84.7	60.3	65.2	78	60.3	65.2	65.2
24	Carbon monoxide (CO)	µg/m^3	-	0.017	7.13	4.12	0.21	0.28	1.51	4.12	7.13	0.66	1.51	4.12	0.66	1.51	1.51
25	Suspended particulate matter	µg/m^3	-	0.017	0.069	0.047	0.001	0.001	0.003	0.047	0.069	0.022	0.003	0.047	0.022	0.003	0.003
26	Nitrogen oxide (NO$_x$)	µg/m^3	-	0.017	59	56	49	52	51	57	60	50	49	55	52	53	49
27	Ozone	µg/m^3	-	0.017	110	110	78	75	84	99	110	62	82	101	69	79	63

Back

The functions of the IDSS-RE, reasoned negotiations, and determination of the most rational real estate purchase variant are described below.

After a number of alternatives are considered and the most suitable variant is chosen, the process of negotiating starts. As a rule, the buyer usually has a certain strategy for negotiations. For example, at the beginning the buyer offers a 10% lower sum than the price set by the broker or seller and later, during the negotiations, the buyer may increase that initially suggested sum. By that time the seller might have been contacted with the buyer that offered an even higher price. The broker, in his turn, may come up with other reasonable proposals on how to deal with this issue. Besides, an e-moderator may also be of great importance when holding negotiations (for example, an e-moderator can help to assess the market value of a specific real estate item).

Fig. 3. Determination of the initial priority, utility degree and market value of the analysed real estate alternatives

KNOWLEDGE BASED E-NEGOTIATION DECISION SUPPORT SYSTEM FOR REAL ESTATE

Results of Multiple Criteria Evaluation

No.	Criteria under evaluation	Measuring units of criteria	*	Weights of criteria	987	988	989	990	991	992	993	994	995	996	997	998
1	1 m² price	Litas	-	1,0000	0,0429	0,0467	0,0484	0,0478	0,0514	0,0486	0,0432	0,0479	0,0505	0,0476	0,0479	0,0524
2	Apartment area	m²	+	0,0600	0,0028	0,0029	0,0028	0,0023	0,0028	0,0028	0,0028	0,0030	0,0030	0,0026	0,0028	0,0028
3	Building height	points	+	0,0200	0,0010	0,0017	0,0010	0,0002	0,0010	0,0010	0,0010	0,0010	0,0010	0,0008	0,0010	0,0010
4	Floor in which apartment is located	points	+	0,0800	0,0012	0,0111	0,0037	0,0012	0,0012	0,0012	0,0012	0,0062	0,0037	0,0049	0,0012	0,0012
5	Years of construction	years	-	0,0600	0,0029	0,0029	0,0029	0,0028	0,0029	0,0029	0,0029	0,0029	0,0029	0,0029	0,0029	0,0029
6	Apartment condition	points	+	0,0600	0,0031	0,0031	0,0031	0,0020	0,0031	0,0041	0,0010	0,0041	0,0020	0,0031	0,0010	0,0020
7	Parking	points	+	0,0800	0,0018	0,0036	0,0036	0,0036	0,0073	0,0036	0,0018	0,0055	0,0055	0,0055	0,0055	0,0018
8	Heating	points	+	0,0700	0,0033	0,0049	0,0049	0,0016	0,0049	0,0033	0,0033	0,0016	0,0016	0,0033	0,0033	0,0033
9	Place	points	+	0,3100	0,0102	0,0152	0,0152	0,0152	0,0203	0,0152	0,0051	0,0203	0,0152	0,0152	0,0203	0,0203
10	Communications	points	+	0,0600	0,0017	0,0033	0,0033	0,0033	0,0033	0,0033	0,0017	0,0033	0,0017	0,0033	0,0017	0,0017
11	Transport flows	points	-	0,0700	0,0047	0,0047	0,0012	0,0023	0,0023	0,0058	0,0058	0,0023	0,0023	0,0035	0,0012	0,0023
12	Level of contamination	points	-	0,0400	0,0029	0,0021	0,0014	0,0014	0,0007	0,0029	0,0036	0,0007	0,0014	0,0021	0,0014	0,0007
13	Evaluation of thermographic analysis	points	+	0,0110	0,0005	0,0004	0,0004	0,0005	0,0005	0,0005	0,0004	0,0005	0,0005	0,0007	0,0004	0,0005
14	Volume flow	m³/h	+	0,0150	0,0008	0,0009	0,0008	0,0006	0,0007	0,0008	0,0008	0,0007	0,0007	0,0006	0,0007	0,0007
15	Air velocity	m/s	-	0,0160	0,0008	0,0011	0,0004	0,0009	0,0009	0,0008	0,0009	0,0007	0,0008	0,0007	0,0008	0,0008
16	Relative humidity	%	+	0,0150	0,0007	0,0010	0,0009	0,0005	0,0007	0,0011	0,0008	0,0006	0,0006	0,0005	0,0005	0,0005
17	Air temperature	oC	+	0,0170	0,0008	0,0007	0,0007	0,0008	0,0008	0,0008	0,0008	0,0008	0,0008	0,0009	0,0008	0,0008
18	Luminosity	lux	+	0,0180	0,0008	0,0006	0,0006	0,0009	0,0011	0,0010	0,0009	0,0009	0,0011	0,0011	0,0008	0,0008
19	Vibration	mm	-	0,0100	0,0004	0,0005	0,0007	0,0004	0,0005	0,0004	0,0004	0,0007	0,0003	0,0004	0,0004	0,0004
20	Acoustic performance	dB	-	0,0150	0,0008	0,0008	0,0008	0,0007	0,0007	0,0007	0,0007	0,0007	0,0007	0,0007	0,0008	0,0008
21	House dust mites	%	-	0,0020	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001
22	Dermotophagoides pteronysinus allergen	%	-	0,0020	0,0000	0,0010	0,0001	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
23	Noise pollution	dB	-	0,0380	0,0022	0,0020	0,0014	0,0014	0,0017	0,0020	0,0022	0,0016	0,0017	0,0020	0,0016	0,0017
24	Carbon monoxide (CO)	µg/m³	-	0,0170	0,0022	0,0013	0,0001	0,0001	0,0005	0,0013	0,0022	0,0002	0,0005	0,0013	0,0002	0,0005
25	Suspended particulate matter	µg/m³	-	0,0170	0,0018	0,0012	0,0000	0,0000	0,0001	0,0012	0,0018	0,0006	0,0001	0,0012	0,0006	0,0001
26	Nitrogen oxide (NOx)	µg/m³	-	0,0170	0,0009	0,0008	0,0007	0,0008	0,0008	0,0009	0,0009	0,0007	0,0007	0,0008	0,0008	0,0008
27	Ozone	µg/m³	-	0,0170	0,0010	0,0010	0,0007	0,0007	0,0008	0,0009	0,0010	0,0006	0,0008	0,0009	0,0006	0,0007
	Total sum of maximizing normalized balanced rates S_{+j}				0.0287	0.0494	0.041	0.0327	0.0477	0.0387	0.0216	0.0485	0.0374	0.0425	0.04	0.0374
	Total sum of minimizing normalized balanced rates S_{-j}				0.0636	0.0662	0.0589	0.0594	0.0634	0.0685	0.0657	0.0597	0.0628	0.0642	0.0593	0.0642
	Object's significance Q_j				0.0909	0.1092	0.1082	0.0993	0.1101	0.0965	0.0818	0.1148	0.1004	0.1041	0.1067	0.099
	Object's utility degree N_j				79%	95%	94%	86%	96%	84%	71%	100%	87%	91%	93%	86%
	Object's priority				19	5	6	13	4	17	21	1	12	9	7	14
	Supply price				4.500,00	4.900,00	5.086,00	5.024,00	5.400,00	5.100,00	4.533,00	5.029,00	5.300,00	5.000,00	5.029,00	5.500,0
	Market value				3.506,73	4.900,00	5.086,00	4.841,82	5.400,00	4.573,72	2.807,87	5.029,00	5.168,20	5.000,00	5.029,00	5.303,2
	Mass Appraisal Value				3.459,00	3.395,00	3.272,00	3.499,00	3.272,00	3.398,00	3.429,00	3.445,00	3.237,00	3.398,00	3.429,00	3.221,0

Back

The functions of the IDSS-RE, reasoned negotiations, and determination of the most rational real estate purchase variant are described below.

After a number of alternatives are considered and the most suitable variant is chosen, the process of negotiating starts. As a rule, the buyer usually has a certain strategy for negotiations. For example, at the beginning the buyer offers a 10% lower sum than the price set by the broker or seller and later, during the negotiations, the buyer may increase that initially suggested sum. By that time the seller might have been contacted with the buyer that offered an even higher price. The broker, in his turn, may come up with other reasonable proposals on how to deal with this issue. Besides, an e-moderator may also be of great importance when holding negotiations (for example, an e-moderator can help to assess the market value of a specific real estate item).

It is obvious that the main obstruction to the agreement between the seller and the buyer is price. Both parties have a variety of alternatives. On the other hand, the actions of both are restricted by the set real estate purchase and sale limits. Thus, an optimal decision should be made. This process can be

supported by the reasoned calculations, i.e. the IDSS-RE negotiating subsystem can be applied. Noteworthy is the fact that the real estate buyer and seller can apply this subsystem either individually or together.

In order to decrease the offered prices and find the most rational solution, the buyer can negotiate with many real estate sellers simultaneously and successfully convince them by revealing the discrepancy between the price and the quality. For example, the buyer appeals to the evaluations of alternatives (priority, utility degree and market value of a real estate item) and then, at the third stage, negotiations with the foremost sellers of the most rational real estate variants begin. Buyer sends the address of the IDSS-RE Web site, where the calculations are presented. The seller may repeat the calculations on the Web site by changing the alternatives and their characteristics, e.g. explicit and tacit criteria system, criteria values and weights.

Analogously, the seller, wishing to persuade the potential buyers, may apply the IDSS-RE to demonstrate his/her alternative being the most rational among the existing variants.

The IDSS-RE is based on symmetry and provides an identical set of multiple criteria analysis tools to both parties. The central component of the IDSS-RE is the alternative generation and multiple criteria analysis (AGMCA) model developed by the authors of the present paper; this model provides assistance in individual or joint decision-making as well as the e-moderator decision-making. Alternative generation and the multiple criteria analysis model are aimed at searching for those multiple negotiated solutions that are beneficial for all parties.

The negotiation is modelled as a combination of three processes: individual (real estate broker, seller or buyer) alternative generation and multiple criteria negotiation process; joint problem solving; e-moderator decision-making.

Individual alternative generation and multiple criteria negotiation process is aimed at assisting the parties in structuring their systems of preferences (explicit and tacit criteria system, criteria values and weights) that are related to the rational real estate price determination; therefore, this process can perform the functions of an individual decision support system. Before the actual negotiation, the real estate broker or buyer must consider his or her own criteria system, values and weights of each criterion. The explicit and tacit criteria (criteria system, criteria values and weights) of one party are independent of the criteria of another party. These explicit and tacit criteria are the parties' objectives. Generally, the objectives (or the criteria) can be quantitative and qualitative. Criteria weights, calculated by the party, are individual and confidential. Therefore, the nego-

tiator must define his or her preferences regarding the criteria and consider what trade-off may be required. Each party can individually use the AGMCA model and introduce various real estate price alternatives, criteria values and weights into it. By using the model, each party can calculate market value and its own priority and utility degree for the negotiated alternatives. Priority, utility degree, and market value of the alternatives calculated by the party are confidential. Individual decision support system enables each party to properly analyse and evaluate its negotiation position. The negotiation framework is based on the idea of dynamic evaluation of the objectives which reflect the parties' interests, goals, perceptions, and present position in the real estate market. The IDSS-RE could be used to integrate ongoing negotiations with different brokers/buyers. Each new offer by the opponent could be entered in order to observe the progress that has been made (or the absence of progress) and the possible trade-offs. Each party evaluates (in terms of confidential information) the efficiency (priority, utility degree and market value) of alternative solutions according to his or her own explicit and tacit criteria system, criteria values and weights.

In search of joint gains, the two parties can perform a multiple criteria analysis jointly. An iterative process of negotiations is designed to lead the parties towards solutions that improve their overall satisfaction. The priority and utility degree, as a measure of a party's overall satisfaction, is established on the ground of that party's explicit and tacit criteria system, criteria values and weights. In the new negotiation iteration the parties can change their criteria (objectives) by adding and/or removing criteria, and/or changing their relative weight and values. For both parties the search for rational weights of criteria (objectives) is a problem in the multiple criteria iterative process. An accounting system develops a selection of the best joint negotiation solution for the utility degree of both parties. Once the parties have evaluated their utility degree for a given set of negotiated real estate prices and quality, their individual overall rankings can be presented in a joint utility degree priority.

A new alternative halfway solution may be offered by the e-moderator. E-moderator is a subsystem of the IDSS-RE, creating a possibility to design compromise alternatives in an automated way. An e-moderator can propose and evaluate different alternatives depending on the alternatives previously proposed by the two parties.

The negotiation process is modelled as an alternating sequence of individual, joint, and e-moderator activities which enable the parties to successfully manipulate a set of real estate prices and quality in parallel ongoing negotiations with different bro-

kers/buyers. This system is aimed at improving the negotiation process by creating and proposing new alternatives and removing the ones that are non-efficient. Such enlargement and narrowing of the set of alternatives are repeated in an iterative manner.

There are two main scenarios for finishing negotiations: either the buyer and the seller agree on the price and the purchase is made or they do not agree and the negotiations are stopped. As the broker (buyer) takes part in negotiations at the same time with several potential buyers (sellers), they reach various compromise solutions. The seller sells his or her real estate to the person who offers the best price. During negotiations, the buyer receives a revised decision-making matrix of real estate alternatives. The number of alternatives and their characteristics (explicit and tacit criteria system, criteria values and weights) will already be changed in the revised matrix. By performing an analysis of new results obtained during the negotiation process with the IDSS-RE the priority, the market value, and utility degree of real estate alternatives are calculated. The buyer selects the most ration real estate variant on the basis of the results of the analysis.

The iterative nature of the negotiation process enables the parties to constantly revise their preference structures (explicit and tacit criteria system, values and weight), develop and refer to a dynamic set of the alternative real estate prices and quality. Such a system is supposed to eventually lead to a stable real estate price. Both parties, showing an adequate level of mutual trust and being aware of the present state in the real estate market, set the most rational real estate price by common agreement. However, the negotiators often find themselves in situations when it seems impossible to reach an agreement which would satisfy both parties, consequently, at least one of them breaks off the negotiation process.

5. Conclusions

One of the major difficulties regarding Internet-based information systems is to find what one wants. There are countless alternative products and services that are offered on the Internet. How can customers find the most suitable products and services then? In order to find a desired product or service the customer usually wants to compare alternatives. There are five types of aids to comparison shopping: search on hypertext files by agents, search of alternatives on databases, alternative search and tabular comparison, comparison of alternative products and services from multiple malls, search and multiple criteria decision-making. The authors of the present paper have developed a Web-based Intelligent DSS for Real Estate. The proposed Web-based Intelligent DSS for

Real Estate can be applied to: search for real estate alternatives, finding out alternatives and making an initial negotiation table, multiple criteria analysis of alternatives, negotiations based on real calculations, and determination of the most rational real estate purchase variant.

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NEKILNOJAMOJO TURTO INTERNETINĖ INTELEKTINĖ SPRENDIMŲ PARAMOS SISTEMA

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Santrauka. Surasdamos, saugodamos ir pasidalydamos išreikštinėmis ir neišreikštinėmis žiniomis nekilnojamojo turto organizacijos gali gerokai pagerinti užsakovų rezultatus. Vienas iš pagrindinių išreikštinių ir neišreikštinių žinių valdymo nekilnojamojo turto sektoriuje vaidmenų yra dalijimasis geriausia patirtimi. Pasaulyje pateikiama daug geriausios patirties taikymo pavyzdžių, naudojamų daugumos nekilnojamojo turto rinkos dalyvių (vertinimo paslaugos, brokeriai, konsultavimas, pastatų ūkio valdymas, draudimas, hipoteka, turto valdymas, projektų vystymas, nekilnojamojo turto sandorių sudarymas, perkraustymo paslaugos ir t. t.). Norint pademonstruoti geriausios patirties taikymą, išreikštines ir neišreikštines žinias nekilnojamojo turto sektoriuje kaip pavyzdys buvo nagrinėjama Nekilnojamojo turto internetinė intelektinė sprendimų paramos sistema.

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DIRECT ELECTRONIC MARKETING OPPORTUNITIES FOR SMEs

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Abstract. The paper deals with an analysis of direct electronic marketing as an important marketing channel for SMEs primarily focusing on the identification of its advantages and disadvantages as well as efficient best practices for SMEs. Available direct electronic marketing statistics, cost-benefit analysis, business and consumer value, and regulatory mechanisms are investigated in the international as well as in the Lithuanian context. The present research focuses on the analysis of the balance of private and entrepreneurial interests and identification of the efficiency and acceptability criteria in regulating and adopting direct electronic marketing. The paper concludes that direct electronic marketing is very advantageous to local businesses and especially to SMEs. Unfortunately, the common perception of direct marketing and especially electronic direct marketing is negative, since it may compromise personal privacy. Analysis of the U.S. business experience shows that direct marketing is among the most efficient marketing channels. Analysis of the Lithuanian experience demonstrates that the advantages of direct electronic marketing are not considered and negative perceptions and strict regulation prevent businesses from employing direct electronic marketing. The paper summarizes the best practices in applying direct electronic marketing principles in order to consolidate privacy interests with economic interests, suggests amendments to the regulations, and encourages a wider acceptance of business self-regulation.

Introduction

During the last decade the significance and the scope of electronic marketing has drastically grown all over the world. Such trends are primarily conditioned by an enormous growth of electronic communication. The Internet, i.e. the medium of electronic communication, is the most speedily developing new technology among households. Technological progress leads to an increase in the complexity of the Internet, a growth in the number of communication channels, an increase in the amount and quality of transferred information, an improvement of the possibilities to use the Internet, a notably easy access to and easy use of electronic communication by all groups of the population. Due to these reasons, both business and consumers are getting more and more active in cyberspace. Cyberspace becomes a usual business marketing instrument, means of communication of the public authorities and interest groups with the public.

The development of the Internet is also followed by an immensely rapid development of electronic communication. The Internet medium may be used for unilateral communication (to send electronic messages, read information in the websites) as well as for multi-communication (when users actively share information in various forums, social websites, news groups, blogs, etc.). Ultimately, cyberspace may also be used for direct interactive communication in virtual work groups, collaboration media,

chat rooms, etc. Such technical possibilities provide unprecedented space for marketing communication, including communication orientated to a particular user and his needs, i.e. direct electronic marketing. Completely new forms of marketing have emerged in the Internet, e.g. search marketing or virus marketing, which in the traditional media would be unthinkable. If one is searching for more effective marketing channels and forms, electronic marketing may seem in many aspects very attractive (Hanson, Kalyanam, 2006).

It should be noted that cyberspace actually has neither physical nor legal boundaries, nor any "central authority" which would determine the circulation of information in the Internet, namely, the information placed in cyberspace immediately becomes universally accessible all over the world; moreover, it can be accessed by all interested users simultaneously. Therefore, the costs of access to information and the distribution of information in cyberspace are very low, particularly in comparison with other means of information distribution (e.g. printed mass media). Such factors are extremely important for marketing communication. Basically, cyberspace provided new exceptional opportunities for business and consumers to engage in marketing communication relevant to them, to offer and buy products and services.

The use of the Internet in economic activity and, in particular, for marketing started in the ninth decade of the 20th century. During the last five years (2003 – 2008, at the end of the so-called .com crisis) the market for electronic advertising, i.e. marketing in the Internet, has been growing by about 10% per year and has been replacing traditional marketing channels, i.e. printed mass media, radio and television. In 2008 electronic marketing comprised almost 9% of the U.S. advertising market and surpassed the share of marketing attributed to radio and newspapers (Holahan, 2006).

Obviously, such rapid development has lead to certain social pressures. Possibilities of the Internet and cyberspace to reach an individual user have automatically determined the fact that the major part of electronic marketing is direct marketing, i.e. marketing directed at a particular person defined by individual characteristics. Therefore, the development of electronic marketing (e.g. Gmail marketing model or Facebook marketing model) is constantly accompanied by controversy and privacy concerns. Direct electronic marketing or, in other words, marketing through electronic communication is forthrightly associated with its illegal forms, i.e. spam.

Unfortunately, there is a lack of scientific research into the topic of direct electronic marketing in Lithuania. Most commonly direct electronic marketing is identified as a subtype of direct marketing, which, in turn, is given relatively little attention within the area of marketing research.

The aim of this article is to analyse the value of direct electronic marketing via electronic communication (e-mail) for SMEs. The article is aimed at identifying the negative and positive aspects of direct electronic marketing, analyzing the legal environment in Lithuania, as well as proposing best practice guidelines for acceptable direct electronic marketing regulation and use by the SMEs. The article employs the methods of systemic, historical and comparative analysis, cost-benefit analysis, non-interventional qualitative research. With reference to a survey of the international and Lithuanian experience, it deals with the existing statistics on direct electronic marketing, regulatory environment and practice as well as their efficiency. Both the current situation and historical perspective are discussed.

The Definition, the Advantages and Drawbacks of Electronic Marketing

In most general terms, any marketing in the Internet should be considered electronic marketing. As it has been mentioned, due to the technical peculiarities of the Internet, almost all forms of electronic marketing have certain features of direct marketing (Stone, 2007). The main forms of electronic marketing are as follows:

- Electronic marketing (marketing by e-mail);
- Search marketing (marketing related to the Internet search results);
- Marketing websites, links and banners;
- Marketing in social networks;
- Alternative electronic marketing (e.g. viral marketing).

It should be noted that marketing by e-mail is not a predominant form of electronic marketing. Presently, search marketing and, in Lithuania, marketing of advertising websites, fields and headlines can be considered the predominant forms. On the other hand, marketing by e-mail has the notably expressed advantages of electronic marketing, i.e. apart from businessmen's own websites, marketing by e-mail is the cheapest and the most accessible (Tapp, 2009). Very often marketing by e-mail is identified with a socially undesirable or even negative marketing, spam, since social challenges raised by electronic marketing manifest themselves in its form rather dis-

tinctly. Due to the abovementioned reasons, in this article marketing by e-mail is regarded as the fair representative of all types of direct electronic marketing.

Cases when marketing by e-mail is implemented by addressing it to a particular user are extremely controversial. As mentioned before, other forms of electronic marketing (e.g. search marketing) are also very often realised as direct marketing (addressed to a particular user); however, in these cases less personal data are dealt with and, therefore, less controversy arises.

At the macroeconomic level, the attractiveness of electronic marketing (and, in particular, direct electronic marketing) is determined by the following two basic macro factors (Arens, 2006):

- Firstly, in the present-day business the use of mass marketing is constantly decreasing, in general. In small, clearly defined markets more and more special marketing means are used to establish and maintain close contacts with consumers.
- Secondly, the development of information technologies and the Internet stimulates orientation towards marketing segmentation. Mass marketing is replaced by marketing orientated to a particular user or a group of users.

Micro-level factors are even more significant in determining the attractiveness of electronic marketing:

- Firstly, electronic marketing offers a significant economy of business resources in comparison with the traditional marketing channels. Most of the small and medium enterprises cannot afford a big marketing budget (especially at the time of economic recession), human resources and their time resources are limited too. Electronic marketing is significantly cheaper, besides, fixed costs related to it are also minimum: several or even several tens of times lower than, for example, those of TV marketing. Electronic marketing may be subject to an extremely precise dosing in terms of the marketing resources available in the company at a particular time, i.e. it is scalable and its overhead costs (costs incurred in increasing the audience of marketing) are rather low (Strauss, Frost, 2008).
- Secondly, electronic marketing and, in particular, direct electronic marketing provides unique segmentation opportunities; electronic marketing allows an easy and rather cheap (or even free of charge) segmentation of consumers according to the geographical criteria, interests, sales history, etc. (Stone, 2007).
- Thirdly, differently from the traditional marketing forms, electronic marketing allows to fix its efficiency, i.e. conversion into sales; in most cases it is necessary to pay for electronic marketing only if a consumer responses to the marketing communication (e.g. reads the marketing message, clicks on the link of the marketing client, etc.) (Tapp, 2009).
- Fourthly, electronic marketing allows to establish a direct contact with a client or a potential client; present-day technical possibilities allow immediate interactive communication with a consumer responding to the marketing.
- Fifthly, electronic marketing, in essence, is global, i.e. it allows to reach a global consumer with minimum efforts and costs; most marketing means are global, suppliers of marketing services (e.g. Google or Facebook) offer substantially unified and universal marketing instruments for any market or consumer segment (Theodosiou, 2006).

Every company, irrespective of its size, may take advantage of the majority of the abovementioned factors; therefore, electronic marketing is especially attractive to SMEs.

All the abovementioned advantages can also be observed while analysing electronic marketing (marketing by e-mail) or direct electronic marketing, as it referred to in this article. The efficiency of direct electronic communication by e-mail, i.e. the reaction of consumers to a marketing message, is below 1%; however, due to significantly low costs of such marketing, its economic efficiency (determined through the evaluation of investments or return on investment) is almost twice or even thrice higher than that of such traditional marketing means as television or radio (Diakova, 2006).

Table 1 compares the costs and efficiency of direct electronic marketing (e-mail marketing) and traditional media channels (DMA, 2004):

Table 1. Comparig costs and efficiency of direct electronic marketing and marketing through traditional media channels

Average cost and efficiency of different marketing channels			
	Comparative costs per contact	Response rate (efficiency)	ROI
Direct mail communication	0.55	1.61	7.2
Direct electronic marketing by e-mail	0.09	0.99	14.2
Newspapers and magazines	0.35	0.14	2.1
TV	0.16	0.27	8.4
Radio	0.74	0.38	5.1

The cost of direct electronic marketing (electronic marketing by e-mail) does not comprise a large share of the marketing budget of business companies; however, it generates a rather significant income. Moreover, a considerably high return on investment of direct electronic marketing determines its increasing attractiveness at the time of economic recession, which is illustrated in Table 2 below (Grau, 2009).

Table 2. Direct electronic marketing (e-mail) vs. electronic marketing in general (U.S. companies)

	Electronic marketing in general	Direct electronic marketing (e-mail)	Percentage of direct electronic marketing (e-mail)
Sales (U.S.$ bn)	2,149.6	32.6	1.5%
Marketing budget (U.S.$ bn)	183.1	0.7	0.4%
ROI	11.74	43.52	

The Usefulness of Direct Electronic Marketing for SMEs

As it has been discussed in the introduction, direct marketing first of all is related to direct (electronic and non-electronic) communication with a consumer, while most consumers associate direct electronic marketing primarily with spam, i.e. unlawful direct electronic marketing. There has been little research into direct marketing and, in particular, direct electronic marketing in Lithuania. Moreover, the investigations usually deal with the negative aspects and the restrictions of direct marketing.

In general, direct marketing is understood as marketing carried out by employing various means facilitating the establishment of a direct contact with consumers by mail, telephone, the Internet and usually aimed at getting direct response from consumers. In direct marketing the buyer usually does not meet the seller, as the aim is distant selling. Using various databases of consumers, direct marketing specialists create specialised offers and marketing messages, meeting the needs of a particular segment of consumers or even individual persons to which a commercial offer is targeted. As a rule, direct marketing is aimed not at forming an image of a supplier of a product or service (or a product or service itself), but rather at obtaining a direct, immediate and measurable reaction of consumers (Tapp, 2009).

The process of direct marketing (and direct electronic marketing) is comprised of the following five basic stages (Strauss, Frost, 2008):
- Adoption of strategic decisions (segmentation, market research);
- Communication between the buyer and the seller;
- Order (or other response of a buyer);
- Fulfilment of orders;
- Further maintaining relations with a client.

Direct electronic marketing is advantageous not only to business but also to their clients.

First of all, it is convenient. Buyers do not need to waste time in search of the desired product in traditional shops. Instead, a consumer receives a concrete offer and may purchase the desired product through the medium convenient to him. A consumer

may use direct electronic marketing at any time; the possibilities to get full information about an offer are considerably wide (in comparison with the information which could be provided by the seller through the traditional medium), a consumer may easily compare different offers. What is more, direct electronic marketing is interactive and instantaneous.

Products and services sold by using direct electronic marketing may be much cheaper than those sold from the shelves of stores, because a businessman does not need to pay for the trade premises, utility fees, hire sales personnel, i.e. the costs of business carried out by means of direct electronic marketing are significantly lower than those of the traditional business. All this leads to an increase in the number of sellers (through minimizing barriers to market access) and opportunities to launch new products, which stimulates competition and causes reduction of consumer prices.

Obviously, direct electronic marketing often is the most effective and the fastest way of providing consumers with the information about new products and services or other information relevant to the consumers (e.g. about discounts or special prices). Besides, through direct electronic marketing favourable conditions for the sale of personalised or even unique products or services are established.

Since in present times consumers are surrounded by an extremely large and sometimes "noisy" marketing communication flow, its major part may remain unnoticed. Abundant marketing through traditional marketing channels often puts its content into the shade. Enormous amount of information received daily prevents a consumer from memorising either the name of the promoted product or its advantages enumerated in the advertisement. Such disability of a consumer to perceive information is conditioned not only by its abundance, but also by impersonalised presentation of marketing. In this situation individualisation of direct electronic marketing helps to attract the consumer's attention and provides business with the possibilities to show exceptional attention or present a special offer to a loyal client. Exceptional attention to a client results in his loyalty and a positive opinion about the company (Stone, 2007).

Direct marketing has certain drawbacks, too, and raises serious social tensions, namely:
- Firstly, direct marketing always involves private information of the consumers and raises issues of personal data processing. This challenge is particularly relevant to direct electronic marketing, because electronic and automatic processing of personal data may cause increased security risks and unauthorised use of personal data.
- Secondly, direct electronic marketing, usually undesired or unlawful, significantly burdens the infrastructure of electronic communications. In 2007 – 2008 undesired or unlawful direct electronic marketing, spam, comprised almost 80% of the entire e-mail communication.
- Thirdly, direct electronic marketing is an impediment to usual activity, particularly in the cases when a consumer does not wish to receive any advertisements, is unable or unwilling to make use of it.

Despite such drawbacks, for SMEs direct electronic marketing is the most accessible and often the only channel of communication with consumers. Consequently, the balance between commercial activity and consumer's privacy may be disturbed. Due to its accessibility and attractiveness, direct electronic marketing of SMEs is important to regional development and overall business spirit.

Due to particularly conspicuous negative attitudes and mass proliferation, undesired electronic communication (spam) has become a synonym of direct electronic marketing. Besides, increasing interference with a person's privacy can also be seen in direct electronic marketing carried out through search websites, social network websites, etc. (Kiškis et al., 2006). All this has caused an unfavourable attitude towards direct marketing resulting in its strict legal regulation. Consequently, without the possibilities to make use of the advantages of direct marketing, socio-economic development is prevented.

Undesirable or even unlawful form of direct electronic marketing is spam or e-mail trash. The unacceptability of spam is determined by its total ignorance of the privacy interests of the recipient. Spam has become a mass phenomenon; however, almost always it is undesirable as the promoted products and services usually are very doubtful and, in most cases, unnecessary (marginal) to consumers. Marketing through spam is usually intrusive or even deceptive; the consumer gets offers at a time inconvenient for him. Moreover, spam is often used for the distribution of computer viruses, electronic worms and privacy-invasive software as well as for electronic fraud. A high volume of spam may hinder the operation of information systems; an internet user, swamped with spam, may lose personal messages addressed directly to him. A consumer is not only forced to waste time deleting undesirable letters, but also is at risk to suffer financial or other losses (e.g. e-mail letters called "phishing" are aimed at obtai-

ning important personal data, such as bank account details; e-mails offering jobs may be sent in order to make use of another person's bank accounts for money laundering). Merely opening spam messages (and especially attachments) can result in an exposure to computer virus risk.

Spam is increasingly proliferating both globally and in Lithuania. According to Google and Symantec, in 2008 the amount of spam increased by 25% in comparison with 2007. In 2008 an average user (in absence of security systems) would have received about 45000 spam messages (in comparison with 36000 spam messages in 2007), while presently the total amount of spam in the overall e-mail communication flow makes up about 80% (Kleha, 2009). Besides, Europe has become the major source of spam in the world. Presently, about 44% of the overall amount of spam is distributed from workstations registered in Europe (Symantec, 2008).

In Lithuania only limited statistical data on spam is available. A quantitative research (a poll of consumers) performed upon an order of the Communications Regulatory Authority shows that in Lithuania in 2008 the number of Internet users which received undesirable marketing letters increased by 8% in comparison with 2007. In 2008 undesirable e-mails were received by 65% of the Internet users and 75% of the companies surveyed. According to the data of the survey, spam is the most frequent cause of network security incidents, while computer viruses rank second.

Due to the above reasons in most states, including the EU, spam is regulated or even prohibited by law, and consumers and Internet service providers actively install spam filtration tools. Thus, due to a frequent identification of direct electronic marketing with spam, direct electronic marketing channel is rather limited.

Legal Aspects of Direct Electronic Marketing in Lithuania

In the European Union direct marketing and processing of personal data for the purposes of direct marketing is regulated by the Recommendation No. R(85)20 adopted by the EU Committee of Ministers in as early as 1985. It contains the provisions regarding the right to use personal data for the purposes of marketing (data collected from public sources, such as public registers, telephone and address directories, and under special conditions, even from other undertakings and recipients of advertising themselves). It should be noted that the same provisions are present in the European Parliament and Council Di-

rective 95/46/EC of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data. The above EU Recommendation, although not mandatory, has been implemented in the Scandinavian states (e.g. Finland or Sweden) taking into account the positive aspects of direct marketing. The principles defined in the Recommendation as early as 20 years ago, establish a certain balance between personal privacy, social and business interests.

Direct marketing (and, accordingly, direct electronic marketing) in Lithuania is regulated by the Law of the Republic of Lithuania on Advertising, the Law of the Republic of Lithuania on Legal Protection of Personal Data and the Law of the Republic of Lithuania on Electronic Communications. It should be noted that these laws are harmonised with the European Parliament and Council Directive 95/46/EC of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data and with the European Parliament and Council Directive 2002/58/EC of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector. However, the Recommendation No. R(85)20 of the EU Committee of Ministers is not considered when regulating direct electronic marketing in Lithuania.

Unfortunately, legal restrictions on direct marketing (and, accordingly, direct electronic marketing) are unreasonably strict; almost in all cases a consent of the recipient of advertising is required thus actually eliminating the possibilities to use any data of the clients (collected from public sources or other undertakings) for marketing purposes. Moreover, legal provisions are inadequate and set a real legal trap.

In paragraph 12 of Article 2 of the Law of the Republic of Lithuania on Legal Protection of Personal Data direct marketing is defined as an activity intended for offering goods or services to individuals by post, telephone or any other direct means and/or inquiring their opinion about the offered goods or services. This definition is rather limited (it does not include marketing meant for promotion of a trade mark or a company, also marketing without offering goods or services for payment), yet confusing and abstruse for persons with no legal knowledge.

The historically earliest regulations of direct marketing activity in Lithuania were introduced in the Law of the Republic of Lithuania on Advertising. Paragraph 1 of Article 13 of this law prohibits direct marketing by telephone, fax, telex and e-mail without the consent of the person for whom the mar-

keting communication is intended, i.e. it establishes the so-called opt-in principle. The opt-in principle means that marketing may be directed to a particular person and his or her personal data may be processed only if a prior consent is given. On the contrary, Paragraph 2 of Article 13 of this law prohibits marketing directed to a particular person only in a situation when a direct refusal of consent is expressed by that person, i.e. it establishes the so-called opt-out principle. An opt-out principle was also established in the Law of the Republic of Lithuania on Legal Protection of Personal Data which remained valid until 1 July 2003. The opt-out principle means that marketing may be directed to a particular person and his or her personal data may be processed as long as a refusal of consent for personal data processing is expressed.

In the wording of the Law of the Republic of Lithuania on Legal Protection of Personal Data which came into effect on 1 July 2003 the opt-out principle was replaced by the opt-in principle. In Paragraph 2 of Article 14 of the law it was established point-blank that personal data may be processed for the purposes of direct marketing if a person to whom the marketing is directed (i.e. the personal data subject) gives his consent. The above provisions of the Law of the Republic of Lithuania on Advertising, which establish the opt-in principle for direct electronic marketing and the opt-out principle for direct marketing through non-electronic channels, were not amended; therefore, the contradictory provisions caused much confusion and led to frequent application of administrative liability for marketing directed to a particular person.

The provisions of the Law of the Republic of Lithuania on Legal Protection of Personal Data must be followed in carrying out direct marketing activities, because direct marketing involves the use of certain personal data. The opt-in principle established in this law implies that in all cases a voluntary consent of a data subject needs to be obtained prior to using the personal data for the purpose of direct marketing.

Attention must be drawn to the fact that the use of personal data for the purpose of direct marketing should not be excessive. Item 4 of paragraph 1 of Article 3 of the Law of the Republic of Lithuania on Legal Protection of Personal Data sets forth that personal data must be identical, adequate and not excessive in relation to the purposes for which they are collected and processed. According to the State Data Protection Inspectorate, which supervises the observance of the Law of the Republic of Lithuania on Legal Protection of Personal Data, a personal code is excessive data for direct marketing because less

specific data (e.g. name, surname, date of birth, place of residence) may be sufficient to identify a person. Therefore, using personal codes for the purpose of direct marketing is a violation of item 4 of paragraph 1 of Article 3 of the Law of the Republic of Lithuania on Legal Protection of Personal Data.

Besides, a business entity intending to process personal data for the purpose of direct marketing must determine the period for the storage of personal data (paragraph 1 of Article 14 of the Law of the Republic of Lithuania on Legal Protection of Personal Data). Usually the period for the storage of personal data for the purpose of direct marketing should be specified in internal documentation of a company. In practice the period for the storage of personal data is defined in terms of time or the existence of certain circumstances. Although it is not legally regulated, the State Data Protection Inspectorate is of the opinion that for the purpose of direct marketing personal data should be stored for as short period of time as possible; what is more, in the case of a consumer's (data subject's) refusal of consent the storage of personal data must immediately be terminated.

When using personal data in direct marketing, it is also important to take into consideration the statutory duty of a marketing provider (businessman) to make a person (data subject) familiar with his right to refuse consent to his data processing for the purpose of direct marketing. A person may, without indicating reasons, refuse consent to his data processing for the purpose of direct marketing in any form acceptable to him, i.e. either orally or in writing. When a data subject expresses refusal of consent, the data controller (businessman) must terminate personal data processing immediately and without payment, and inform other persons to whom the respective user's personal data were transferred. Moreover, a businessman processing personal data for the purpose of direct marketing also needs to respect other rights of the consumer (data subject), including the right to be aware (be informed) of his personal data processing, the right to get access to his data being processed and be aware of the method of processing, the right to request correction or cancellation of his personal data or the right to request to stop processing his personal data.

Under the provisions of paragraph 2 of Article 14 of the Law of the Republic of Lithuania on Legal Protection of Personal Data, a business subject (data controller) must provide the consumer (data subject), whose personal data are being collected directly from him, with the following information, unless the consumer (data subject) already has such information:

1) information about its own (data controller's) identity and the identity of its representative, if any, and the place of residence (if the data controller or its representative is a natural person) or the requisites and the registered office (if the data controller or its representative is a legal person);

2) purposes for which the personal data of the data subject are processed;

3) other additional information (to whom and for which purposes the personal data of the data subject are provided; the personal data which must be provided by the data subject and legal consequences of non-provision of data; information about the data subject's right to get access to his personal data and the right to require to correct erroneous, incomplete, imprecise personal data), required to ensure proper processing of personal data without violating the rights of the data subject.

In order to protect interests of a person whose data are processed for the purpose of direct marketing, the Law of the Republic of Lithuania on Legal Protection of Personal Data stipulates the duty of the data controller, prior to providing personal data to any third parties (i.e. other business subjects), to inform the person about the third parties to which his personal data will be disclosed and for what purposes.

When processing personal data for the purpose of direct marketing, the required technical and organisational measures to ensure security and confidentiality of the data should be undertaken. The company's personnel should be constantly informed about such measures and the necessity to comply with them.

As stipulated in Articles 214[14]-214[17] of the Code of Administrative Law Violations of the Republic of Lithuania, a company may be held liable for unlawful processing of personal data for the purpose of direct marketing. In practice administrative liability is applied rather actively; it is one of the most frequent violations of the rules on processing of personal data. According to Article 214[23] of the Code of Administrative Law Violations of the Republic of Lithuania, liability is established for the violation of the procedure for processing personal data and the protection of privacy, stipulated in the Law of the Republic of Lithuania on Electronic Communications (see explanation below). Under the provisions of the Law of the Republic of Lithuania on Advertising, direct electronic marketing, when used without a consumer's consent, may incur a monetary penalty. Violations of this law are prosecuted by the State Consumer Rights Protection Authority. Moreover, general civil liability is applied for damage caused by unlawful marketing communicationYet another regulation related to direct marketing through electronic communication channels (direct electronic marketing) until 1 January 2009 was stipulated in paragraph 2 of Article 68 of the Law of the Republic of Lithuania on Electronic Communications: the use of the data of the undertakings' clients for the marketing of the same undertaking's products or services without a prior consumer's consent was allowed. Until 1 January 2009 different regulations regarding non-electronic direct marketing and electronic direct marketing existed: in the first case the right to provide marketing material to the existing clients and process their personal data for that purpose was not established.

Article 68 of the Law of the Republic of Lithuania on Electronic Communications sets fort that the use of electronic communication services, including sending of e-mail messages, for the purpose of direct marketing is allowed only if a prior consent of a subscriber is given. It should be noted that, differently from the Law of the Republic of Lithuania on Legal Protection of Personal Data, the Law of the Republic of Lithuania on Electronic Communications regulates direct marketing in respect of both natural and legal persons. The law does not specify how a prior consent of a subscriber (both natural and legal person) needs to be obtained; however, it sets forth that a sender (doing it on his own initiative or upon the instructions of other persons) is responsible for the compliance with the above provision, and in case of its violation administrative liability for unlawful use of electronic communications services (e.g. sending spam) applies to the sender.

Although the primary focus of the abovementioned laws is on the legal regulation of spam, they stipulate the prohibition of the use of e-mail messages, short messages (SMS), automated calling systems without human intervention (automatic calling machines), and facsimile machines (fax) for the purpose of direct marketing.

Paragraph 2 of Article 68 of the Law of the Republic of Lithuania on Electronic Communications is exceptionally devoted to the regulation of electronic direct marketing through e-mail messages, which is extremely significant. Until 1 January 2009 more preference was given to electronic direct marketing in comparison with non-electronic direct marketing. It stipulates that a person who obtains from its customers their electronic contact details for electronic mail, in the context of the sale of a product or a service, in accordance with the procedure and conditions set out in the Law of the Republic of Lithuania on Legal Protection of Personal Data, may use these

electronic contact details for marketing of its own similar products or services under the following two conditions:

1) customers clearly and distinctly are given the opportunity to refuse consent, free of charge and in an easy manner, to such use of electronic contact details for the above purposes when they are collected; and

2) on the occasion of each message, in case the customer has not initially objected to such use of the data.

It is prohibited to send e-mail messages for the purpose of direct marketing if:

1) the identity of the sender in whose name the information is sent is concealed, or

2) the valid address to which the recipient could send a request to terminate sending such information is not indicated.

From 1 January 2009 analogous provisions were transferred to the Law of the Republic of Lithuania on Legal Protection of Personal Data, thereby somewhat unifying the legal regulations of electronic and non-electronic direct marketing.

To summarize, in accordance with the laws of the Republic of Lithuania (valid from 1 January 2009), electronic direct marketing is allowed only if a prior consent of a consumer is obtained (opt-in), except for the only case when it is carried out for marketing of a company's similar products or services to the already existing clients. The conflicting provisions still remain in the Law of the Republic of Lithuania on Advertising, which recently became a basis for controversial sanctions against e-marketers (e.g. the decision of the Vilnius District Administrative Court of April 6th, 2009 in the Administrative Case No. I-679-473/2009). Although the EU law leaves full discretion to national regulation and even recommends a more liberal approach to direct marketing, the regulations established in Lithuania are among the most stringent in the EU, and the supervision of the application of the regulations by the State Data Protection Inspectorate and the State Consumer Rights Protection Authority is extremely strict. All this hardly corresponds to the actual situation in the Lithuanian economy and the issues of competition and business development. Bearing in mind a relatively small proliferation of SMEs in Lithuania and the entrepreneurship rates which are among the lowest in the EU, it is easy to assume that opportunities and advantages of direct electronic marketing must be taken into consideration. Legally, direct electronic marketing in Lithuania is almost identified with spam and is significantly restricted. Legal regulations correspond neither to the interests of business nor to the

interests of Lithuanian consumers to get relevant information (e.g. regarding discounts, prices, etc.) and are an obvious obstacle to the development of SMEs and an adequate informing of the public.

According to the State Data Protection Inspectorate, the above regulation of direct marketing is aimed at fighting spam and other undesirable direct marketing; however, it is not efficient enough, as sanctions for the violation of direct marketing rules are relatively mild, while the efficiency of such marketing and return on investment is high and compensates for direct risk. Moreover, strict legal regulation does not safeguard at all against direct electronic marketing originating from abroad. From the social-economic point it is also important because foreign entities (e.g. business in Scandinavian states) are successfully taking advantage of a more favourable legal framework regarding direct marketing and, therefore, have an advantage over Lithuanian business.

In conclusion, a strict and complex legal regulation of electronic marketing comes nowhere near eliminating the negative aspects of electronic marketing; rather it deprives SMEs of the possibility to take full advantage of the beneficial direct electronic marketing and undermines competition.

Best Practices for Using Direct Electronic Marketing by SMEs: How to Overcome Negativity?

The analysis of the Lithuanian legal regulations pertaining to electronic direct marketing shows that there have been no attempts to take into account the interests of SMEs. The unconditional requirement of a consumer's prior consent leaves no space for business interests and particularly for SMEs' interests, because the obtainment of such consent may be expensive and complicated (i.e. possible benefit from direct electronic marketing is largely outweighed) or even impossible (if a consumer does not realise the benefit he could derive from direct electronic marketing, i.e. does not see the marketing itself, the individualised offers, discounts, etc.).

Even if considering marketing directed to the existing clients of certain companies, only their own similar products and services can be advertised, thus restricting the marketing of business entities of the same group (which may be established exclusively for the purpose of business risk management), and the marketing of different products and services provided by the same business entity (even if they are complementary).

In the Lithuanian legislation direct marketing is treated as a business interest. A business or economic

interest may not be single-sided: on the one side, the seller wishes to sell what he has, on the other side, the buyer wishes to buy what he needs (Steponavičienė, 2006). As it has been already mentioned, while seeking to balance business and consumer interests in direct electronic marketing, it is impossible to avoid a clash between the advantages of direct electronic marketing to business and the possible abuse of it, likewise between a consumer's need for information and need for privacy. These needs must be balanced. It is also necessary to realise that pressure arises not due to the clash between privacy or personal data protection (as formal social values) and a possibility to provide/receive marketing communication (as an economic value). The social pressure is mainly caused by excessive and unlawful direct electronic marketing, spam, as well as by total disregard for person's privacy. Solely due to extreme frequency and social resonance of such phenomena we tend to impose tight restrictions on any direct marketing, including direct electronic marketing.

A balance is necessary at the level of personal interests, i.e. the same person wishes to receive information, to protect his privacy and to provide information about his products and services to others. When business does not have the possibility to provide and does not receive the required information, products and services are of lower quality, while their prices are higher. If legal risks in the processes providing and obtaining information are not reduced, the cost of products and services will become substantially higher, i.e. the risks will be shifted to consumers.

In most European states, including the Scandinavian states, direct marketing, as well as direct electronic marketing, is regulated in a much more liberal manner seeking to leave a possibility for both business and consumers to make use of the advantages of direct electronic marketing. The main regulation measures are the following:

- Regulation of direct marketing according to the opt-out principle (e.g. Sweden). In order to avoid the abuse of direct electronic marketing, opt-out registers of all consumers not wishing to receive direct electronic marketing messages may be compiled. Sending direct electronic marketing messages to a consumer registered in such a register is treated as a violation of law; however, sending direct marketing messages to the remaining part of consumers is allowed.
- More liberal regulations regarding the consumers' consent. It should be a legally unrestricted consumer prerogative to determine a balance between his economic and privacy interests. Therefore, it is expedient to unify the ways of possible refusal of consent in future (taking into account the fact that it might be difficult for a consumer to find a business subject to which his consent was previously given and contact it). State interference would both ensure protection of consumers' interest and provide transparency to business units.
- Self-regulation and codes of ethics are means of non-state social regulation which may be applied not only to direct marketing. The establishment of self-regulation and codes of ethics in direct marketing was proposed in 1985 in the Recommendation No. R(85)20 of the EU Committee of Ministers. Self-regulation would provide businessmen with a possibility to determine acceptable rules for the combination of the interests of both business and consumers. The abovementioned factors regarding the efficiency of direct electronic marketing and its acceptability to consumers could serve as a point of reference for creating such rules.
- Business-consumer partnership and active collaboration in respect of undesired direct electronic marketing, identification of abuse, ascribing certain privacy quality seals for suppliers of direct electronic marketing which comply with the codes of ethics.

It should be mentioned that the acceptability of electronic direct marketing is proportional to the extent of privacy invasion. The more forthright and personal direct electronic marketing is, the less it is acceptable, e.g. marketing by SMS messages or pop-up marketing is identified as extremely invasive and unacceptable, while direct electronic marketing by e-mail messages (in cases when a consumer has expressed his wish to receive them) is more acceptable to consumers (Elkelä, 2005).

Efficiency and acceptability of electronic direct marketing may be influenced by the following factors (Stone, 2007; Tapp, 2009):

- A consumer wishes to get marketing messages about products or services (e.g. for special discounts);
- Products or services offered are valuable or useful to a consumer;
- A consumer wishes to get products or services at a particular moment;
- A consumer receives marketing messages about the intended service in a convenient and unobtrusive form;

- Marketing is as less invasive as possible, e.g. a consumer is not required to react immediately, it does not invade his privacy (e.g. the consumer's desktop or operation system);
- The amount of marketing must not go beyond the limits of common sense (not more than 1 message per several days).

These factors should be the starting point for any successful electronic marketing campaign. Following such best practice would also help in reshaping the negative image of direct electronic marketing, which is currently overshadowed by spam.

The abovementioned measures and acceptability factors should be considered in order to create the possibilities for SMEs to take advantage of direct electronic marketing in Lithuania.

Conclusions

Summarizing the analysis, the following conclusions can be drawn:

1. Direct marketing has considerable economic value for businesses and particularly for SMEs. It is also beneficial to consumers and competition; however, simultaneously may affect personal privacy.

2. The analysis of the U.S. business experience shows that direct marketing is among the most efficient marketing channels; however, the analysis of the Lithuanian experience demonstrates that the advantages of direct electronic marketing are not considered while establishing the regulatory business environment and negative perceptions and strict regulations deprive the businesses of the possibility to take advantage of direct electronic marketing. Such a situation in Lithuania may negatively impact entrepreneurship, business environment, competition and juxtapose business against the public.

3. Best practice principles for acceptable direct electronic marketing focusing on consumer interests and convenience may both increase the benefit of such marketing to consumers and overcome negative perceptions. SMEs adopting these principles may uncover the value of the direct electronic marketing and minimise social risks.

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MAŽŲ IR VIDUTINIŲ ĮMONIŲ TIESIOGINĖS ELEKTRONINĖS RINKODAROS GALIMYBĖS

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Santrauka. Straipsnyje nagrinėjama elektroninė tiesioginė rinkodara, ypač jos taikymas mažose ir vidutinėse verslo įmonėse (MVĮ). Analizuojami tiesioginės elektroninės rinkodaros pranašumai ir neigiami aspektai, statistika, pateikiama išlaidų ir pelno analizė, ypač daug dėmesio skiriant jos potencialui ir galimam panaudojimui MVĮ. Aptariamos galimybės subalansuoti asmeninius privatumo ir ekonominius verslo interesus, taip pat identifikuoti galimybes tinkamiausiai panaudoti tiesioginės rinkodaros instrumentus MVĮ.

Nors tiesioginė rinkodara ekonomiškai naudinga ir verslui, ypač MVĮ, ir vartotojams, tačiau gali pažeisti asmens privatumą. Deja, dėl galimų privatumo pažeidimų dažniausiai visa tiesioginė elektroninė rinkodara yra tapatinama su neigiamais ir nepriimtinais socialiniais reiškiniais. JAV įmonių patirties analizė byloja, kad tiesioginė elektroninė rinkodara yra vienas efektyviausių verslo rinkodaros būdų, tačiau Lietuvos patirtis rodo, kad jos pranašumai nėra įvertinti ir neigiamas įvaizdis bei nepalanki teisinė aplinka trukdo jos plėtrai.

Straipsnyje apibendrinama geriausia praktika siekiant suderinti asmeninius privatumo ir ekonominius verslo interesus, sumažinti tiesioginės elektroninės rinkodaros rizikas. Siūlomi kriterijai, didinantys tiesioginės elektroninės rinkodaros efektyvumą MVĮ ir priimtinumą vartotojams, taip pat verslo aplinkos patobulinimai, pabrėžiantys verslo, taikančio tiesioginę elektroninę rinkodarą, savireguliacijos svarbą.

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CONCEPTUAL FRAMEWORK FOR FORESIGHT DEVELOPMENT

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Abstract. The article summarizes the current trends in the foresight development and investigates the methodology evolution, examples of good practice and future developments. The initial research idea was based on the methodological issues for e-government system implementation in Lithuania [5]. In order to model the future of e-public services, it is necessary to assess the scope of the factors influencing the system and decision-making, their importance and the level of technology. The article presents the results of the hierarchical cluster analysis used for expert group assessment in Lithuania.

I. Introduction

The process of globalization has a multidimensional interpretation. During the recent three or four decades the real world has dramatically changed. Science and technology achievements created new forms of research cooperation. The access to information led to socio-economic development. Close attention is paid to the foresight methodology development as an essential support for policy and strategy making at a supranational level. At the same time, globalization generates new problems which require new integrated policy responses. The advanced countries that have successfully raised incomes have visions for the future and are active participants in the world strategy development. At the same time, the globalization process influences the poverty in many countries. Global megatrends and national challenges create the contexts and backgrounds for taking strategic decisions. Transnational foresight exercises that can be considered as the first stage of foresight cooperation are the cases where transnational collaboration mainly focuses on foresight competence and network building (FORETECH, eFORESEE, Millennium Project 2050).

Due to a limited number of economic contexts and difficulties in comparing different methodological approaches, it is necessary to carry out an in-depth research into the aspects and importance of regional innovation, the importance of mutual interaction in multi-actor arenas of innovation policy, the impacts of multi-level governance, and the side-effects of non-regional policies in the context of global socio-economic trends. It is essential to enlarge the empirical basis of knowledge-based regional development strategy-making in order to make it possible to draw on as many different case studies as possible. Foresight activities and vision-building are important for understanding the mechanisms of multi-actor and multi-level regional governance, regional innovation, and for creating knowledge-based clusters. Experts from the Science and Technology Foresight Center and the National Institute of Science and Technology Policy (NISTEP, Japan) developed the methodology of foresight surveying for two countries, Japan and Finland, with recommendations for policy-makers.

The barriers to and the opportunities for trans-national foresight are directly linked to the selected focus area of technological domains, i.e. a particular sector, horizontal public functions or the whole national innovation system. The focus determines the perimeter to which the results will apply as well as the stakeholders to be involved. NISTEP has 30 years of experience in technology foresight; it has already conducted the 8th technology foresight survey in Japan in 2003–2004. The evolution of foresight methodology [j)] shows the theory development and improved policy making strategies. Four foresight scenarios were developed in the advanced studies. As a part of global foresight trends, e-government system introduced in Lithuania was used to develop a foresight methodology relevant for assessment. Due to a lack of developed foresight strategies in Lithuania, the investigation of digital public services is carried out by using integrated methods.

1. Foresight Levels

There are a number of sources in which the dimension of the levels [15, 21] (from the simple units to inter-dimensional, complex dynamic and socialized systems) is presented. The ambitious systems are defined as the sources of regional competition generation in the changing environment. Future research could provide the regional foresight tools. The European Foresight Monitoring Network (EFMN, created in 2004 under EU support) has promoted the cooperation and networking in science, technology and innovation (STI) in 2004-2007. In this period, over 1600 examples of foresight exercises were collected from all over the world. The data contained 1650 initiatives. The following levels of foresight initiatives are distinguished: national (covering one country), supranational (covering clusters of countries), and transborder (international by nature and not focusing on specific countries).

Table 1. The shares of foresight exercises from the EU27+ (2004-2007), %

National	Sub-national	Transborder	Supra-national	Europe
67	15	8	7	3

Source:[19]

EU27+ group includes 557 cases. Some 545 from the 27 European Union Member States (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom) plus 12 cases from Iceland, Norway and Switzerland [19].

National Foresight

Foresight at the national level has been used to address choices within the domain of STI as well as the impacts of science and innovation on the economy and society. At this level the focus is on the experience gained from the national Foresight exercises and new research methodologies. The time horizon used ranges from 15 till 50 years. To foresee the direction of future science and technology development during the period of 2000–2020, NISTEP used integrated methods. The foresight exercises had been collected through three rounds of strategic conferences. The attitudes of 2677 people including well-qualified personnel and experts from the public sector, private sector and disparate group of people were studied. Each conference aimed at eliciting expert opinions on the direction of future science and technology deemed to be of high importance for economic and social development of the country. The aim of the strategic conferences is also to build a network of industry-government collaboration which would enable an understanding of the changes occurring in business and an evaluation of research priorities. As a result of these studies, socio-economic visions were developed as well as recommendations for successful policy implementation were suggested. A conceptual illustration of Health and Lifestyle in Japan is presented in Picture 1.

Regional Foresight

Both supra-national foresight, covering more than one country, and sub-national foresight, covering a smaller region of a country or neighbour regions of multiple countries, are considered.

Supra-national foresight has been useful to promote joint analysis of common problems, detect opportunities for cooperation, identify complementary attributes, and define infrastructures needed, which are not feasible at the national level.

Sub-national foresight is the application of foresight methods, which involve (involving some combination of five essential elements — anticipation, participation, networking, vision, action) to inform and orient decisions that are taken at the sub-national level.

Picture 1. Conceptual illustration of Health and Lifestyle in Aged Society in Japan, 2020

Health and Lifestyle in Aged Society

People's power

Maintaining and Improving mental and Physical health

Social objective towards 2020 Everyone can live a desired social life with ensure safety and security, with cut experiencing loneliness

Fostering community Health services and industry

- **Remote primary care system**
- **Combined lifestyle support**
- **Electronics money and regional currency**
- **Social business**

Ensuring safety and Security in an aging society

- **Comprehensive community security system**
- **Save and low cost transportation**
- **Disaster information systems**
- **Barrier-free environments**
- **Monitoring**

- **Brain function research**
- **Mechanisms of determentia**
- **Systematic framework for diagnosis of determia**
- **Nutrion science for elderly improved OOL**
- **Employment opportunities for the elderly**

Education &Research Infrastructure

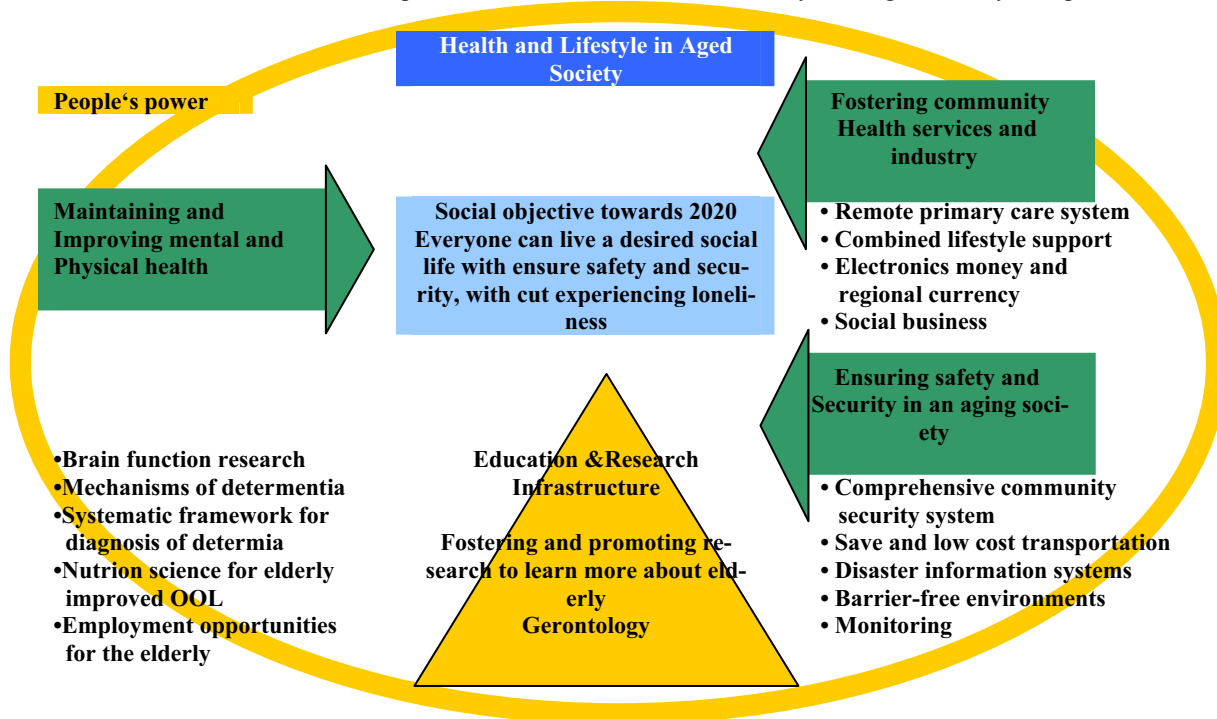**Fostering and promoting research to learn more about elderly Gerontology**

Sources: [10]

Regional Foresight

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Sub-national foresight is the application of foresight methods, which involve (involving some combination of five essential elements — anticipation, participation, networking, vision, action) to inform and orient decisions that are taken at the sub-national level.

Transnational Foresight

In this level national foresight activities are coordinated to implement efficient transnational programmes. The foresight programmes remain national and aim at valorising opportunities for exchanges in the different phases when it is deemed necessary and possible (exploiting "soft benefits") [3]. Each participant involved in the research consortium may have different motivations, aims and anticipated impacts.

The "hard" opportunities of transnational foresight are related to the sharing of the resources that are necessary to conduct a foresight exercise: gathering human resources, achieving economies of scale, and reaching critical mass are common benefits of international cooperation. The "soft" benefits are related to a particular field of foresight with the input of a wider range of opinions and expertise on the international context. The highest benefits appear in the "soft" items like sharing of information, improvement and setting of common foresight methodology, raising awareness, network effects, and reinforcing a common vision. Regarding the barriers to transnational cooperation, the survey revealed differences between countries, while at the same time overlapping results emerged. The barriers and opportunities to transnational foresight are directly linked to the variable "focus", such as a technological domain, a sector, horizontal public functions or a whole national innovation system. The focus determines the perimeter to which the results will apply as well as the stakeholders to be involved. Those foresight exercises with a focus on key technologies and sectoral innovation dynamics seem to be the easiest to implement in an international cooperation context. In contrast, trans-national cooperation in foresight will certainly be more difficult to apply in exercises that mainly aim to create national strategies like those related to innovation system efficiency or shared system strategies (Mauguen, 2007). The same report concluded that national priorities seemed to be the most prevalent barriers to cooperation in foresight. For instance, foresight exercises oriented towards priority setting are expected to confront severe barri-

ers, since national boundaries related to policy deci-sion-making will be prevalent. Thus, the report con-cluded that foresight cooperation is dependent on the coordination of research and innovation public poli-cies. The added value of transnational foresight will depend directly on the link to the policy it is sup-posed to inform. Therefore, the added value of the transnational foresight will be higher in the case where the policy is carried out at an international scale, or at least includes an important international component. Neither methodologies nor costs are perceived as major challenges. The real issues are related to the links to policy-making and to the par-ticipation of stakeholders in the foresight exercises. Nevertheless, the report concluded that it is interest-ing to see that to a certain extent transnational coop-eration could be seen as a way to overcome these challenges (Mauguen, 2007). International research co-operation provides the broader geographic scope, resource concentration and cost efficiency.

An example of the transnational foresight is the study "Foresight for Our Future Society", NISTEP and Tekes, 2007. From the methodological view-point, the study was innovative, as the key objective of the joint foresight project between Finland and Japan (Tekes and NISTEP) was to combine Delphi survey, an expert panel process and other foresight methods [10]. Another example could be ForSociety ERA-NET (Mauguen, 2007), in which anticipated benefits are grouped as "hard" and "soft" [3].

Picture 2. Conceptual illustration of Health and Lifestyle in Aged Society in Finland, 2050
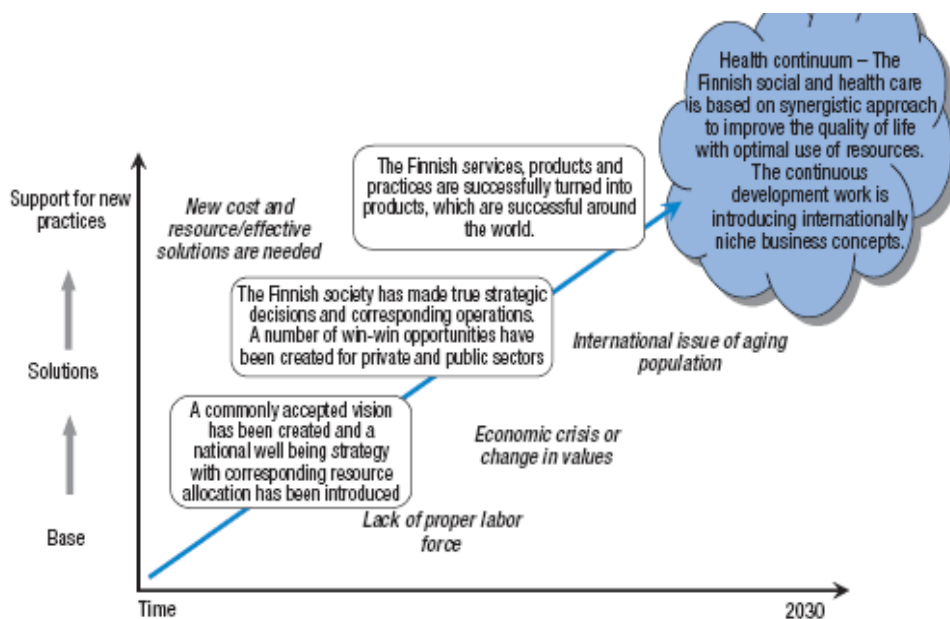
Source: [10]

The policy recommendations supported by con-cept and foresight results cover the tight relationship between the operations to support a healthy life style and the costs of institutional health care, businesses, research and development and innovation, etc. Other conceptual visions and policy recommendations were developed for industries and media sectors, to make steps on the path "towards the realization of a recycling society through the recycling and re-utilization of resources, i.e. atmospheric purification, the reduction of gas emissions contributing to global warming, the creation of new energy sources and the efficient use and reuse of resources, sustainable use of water" [10].

Sectoral and Corporate Foresight

The challenges faced by firms reflect the struc-tural changes taking place in the economy and soci-ety. A new global setting of the world economy is defining the framework for operation of the indus-trial sector both within the national boundaries and internationally. In this context, the corporate sector and industries use foresight to detect and prepare responses to such changes. The experience gained at the corporate and sectoral level, and main research and methodological issues are of utmost importance.

Picture 3. The common science and technology foresight track
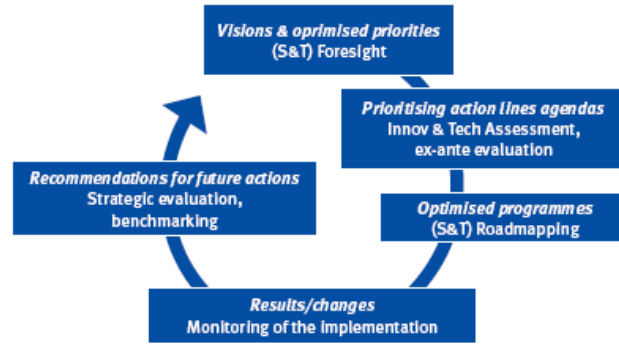
Source: [22]

Picture 4. International cases of foresight collaboration

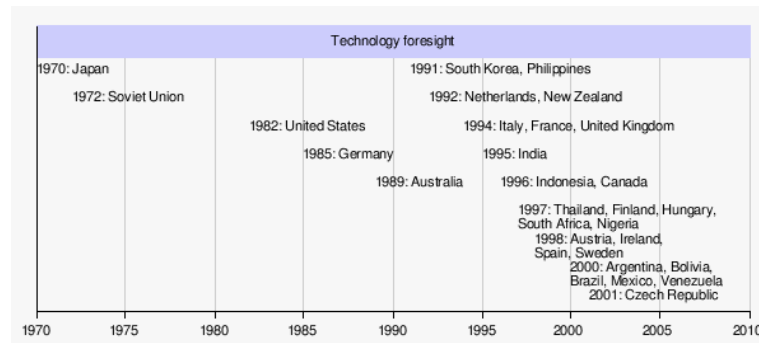International cases of foresight grow rapidly with support of EU funds. Today there are more than 2000 cases within the EFMN. In the terms of targets, the international foresight exercises have not presented any differences comparing with the European ones. The majority of the exercises have targeted the government agencies and departments, the research community and firms.

Regarding the barriers to transnational cooperation, the survey revealed differences between countries, while at the same time overlapping results emerged. The barriers and opportunities to transnational foresight are directly linked to the variable "focus", such as a technological domain, a sector, horizontal public functions or a whole national innovation system. The focus determines the perimeter to which the results will apply as well as the stakeholders to be involved. The foresight exercises with a focus on key technologies and sectoral innovation dynamics seem to be the easiest to implement in the international cooperation context. Transnational cooperation in foresight will change the communication technology and social world-class research infrastructures, integrated, networked and accessible to research teams from across Europe and the world. It is important to form research and innovation "clusters", which include "virtual research communities" that are mostly specialised in interdisciplinary areas and attract a critical mass of human and financial resources aiming at sharing knowledge effectively. The essential Foresight research limitation is a weak interrelation with the decision-making process as well as slight changes in understanding foresight methodologies.

2. Foresight Methodological Principles

Since 1930 the forecasting has created methods and tools for the world's future design. However, these methods were recognized and taken into account only after the Second World War. The evolution of terminology from the "forecast" and "future study" towards the currently used "foresight" emerged and was supported by UNIDO, the EU and actively promoted by ERC. What regards foresight methods, the methodological justification is still insufficient and there is a lack of methodological research. The following foresight methods are used: scenario analysis, i.e. descriptions of possible future situation in order to anticipate and prepare for upcoming developments and policy decisions; Delphi methods for collecting and analyzing of expert and non-expert opinion on specific issues; computer simulations for the representation of possible future situations through computer modelling in order to investigate how present developments might turn out in the future; Future-Oriented Tech-

nology Analysis: the   analysis of science and technology and innovation application and its impact on policy-making.[11, 14]

There is a growing international network of organizations and contributions, such as The Association of Professional Futurists, the World Futures Studies Federation, the European Foresight Monitoring Network, the OECD Future Group and others.

In Lithuania foresight activities have not yet been appropriately incorporated in strategic planning. However, the first steps towards promoting foresight methodology have been made. Since 2002, there have also been private initiatives: the Open Society Fund-Lithuania (Soros Foundation) organized the study "Lithuanian Future Scenarios: 2010-2020 Year"; in 2007, a study "Foresight for the Lithuanian Economy in the Light of Regional and Tendencies" was conducted by the Social and Economic Development Center.

3. Foresight Good Practice

There is great diversity in foresight methodology. In the examples of NISTEP the Delphi method is employed for a long-term strategy making; this shows the evolution of methodology. Foresight methodology has been improved several times in Germany. The overall process consists of several key steps:

- trend setting;
- trend consideration (panel discussion);
- future script development;
- implementation.

Since the EU adopted the Lisbon Strategy in 2000, the objectives of the EU as the most competitive and dynamic knowledge-based economy were defined, extreme attention was paid to the research and development of innovations. An important step of the European Commission was to propose a concept of European Research Area (ERA conception). One of the main objectives of this initiative is to bring together science, technology and social visions for the future. In 2002 the report "Thinking, debating and Shaping the Future: Foresight for Europe" was discussed by experts and the common opinion about the future input into the scientific activities to improve the strategic planning and policy development was expressed. At the same time, this foresight procedure was stated as a scientific methodology for innovations in education, for management improvement and policy flexibility. The methodology aimed at defining three key insight areas: (i)Thinking about future; (ii) Discussing about future, (iii) Creating the future. There are common methods used for foresight exercises. Table 2 shows the main groups and features of the methods used for foresight exercises.

Table 2. Comparison of quantitative and qualitative methods

Groups	Methods & tools	Advantages	Disadvantages
Quantitative Methods The future predictions based on mathematical and statistical data treatment.	• Extrapolation of time series • Probabilistic forecasting • Stochastic processes analysis • Regression analysis • Econometric models • Simulation modelling • System dynamics • Cross-impact analysis • Cost-benefit analysis • Input – output analysis • Game theory	• Information can be handled in consistent and reproducible ways, combining figures and comparing data. • Changes in scale and ratio can be examined. • Data is organised systematically to produce trend extrapolations and other forecasts. • Results are displayed in the form of tables, graphs and charts, which facilitate communication.	• Scarcely consider social and political variables. • Some phenomena are difficult to quantify. • Not everyone can work comfortably with statistical information. • Good quality data are often not available, or not sufficiently up-dated. • Some methods are highly complex and difficult to use.
Qualitative Methods The future predictions are based on intuitions and opinions of experts who posses reliable information and expertise about a specific issue.	• Opinion surveys • Experts interviews • Focus groups /• Expert panels • Delphi method • Scenario design • Iterative synopsis • Relevance trees • Morphological analysis • Catastrophe theory • Historical analogy • Incasting and Backcasting • Visioning	• Complex and uncertain situations can be tackled. • Stimulate creative thinking, supported by experts. • Do not require quantitative indicators.	• Cannot quantify future situations precisely. • Generate excessively speculative future visions. • The quality of the analysis depends on the expert's wisdom. • Not useful for anticipating short-term actions.
Complementary Tools	• Environmental scanning • Brainstorming • Mind mapping • Benchmarking • Critical technologies • SWOT analysis		

Table 3 shows a chronology of national and regional foresight activities, which are classified into those based mainly on Delphi and those based on other approaches, such as panels, scenarios or critical technologies exercises. In the third group several methods are combined.

This separation allows some of the international learning experiences to be traced. The best-known example is that of the "family tree" of Delphi surveys originating with the Japanese Science and Technology Agency's 30-year forecasts. The second sequence is that of critical technologies exercises, while the third one uses scenario-based methods [12].

Table 3. Selected chronology of foresight

Year	Delphi	Mixed	Panel/scenario/critical technologies
1970s	30 years in Japan		
1989		Ministry of Economic Affairs Netherlands	
1990	1st German		
1991 -			1st Critical Technologies USA
1992			Public Good Science Fund New Zealand
1993	1st South Korea		2nd Critical Technologies USA Technologies at Threshold of 21st Century Germany
1994	France Japan/Germany Mini Delphi	1st UK TF Programme	Ministry of Economic Affairs Netherlands
1995			100 Key Technologies France 3rd Critical Technologies USA
1996	Japan - German Delphi Austria		Matching S&T to Future Needs Australia Foresight Steering Committee, Netherlands
1997		ANEP Spain	Ireland
1998		TEP Hungary South Africa	New Zealand Sweden, 4th Critical Technologies USA IPTS Futures EU
1999 2000	2nd South Korea Japan 7th Survey	APEC Multi-economy Venezuela	2nd UK TF Programme FUTUR Germany National TF China; Brazil

The three generations of foresight are distinguished on the basis of research and development focus area, the economic rationales, actors and stakeholders, and other features. The First Generation Foresight rests in the domain of industrial and economic development. The Second Generation is related to the market perspective, while the Third Generation foresight focuses on combining STI with the socio-economic system and provides the arena for the necessary network connections. The First Generation foresight consists of technology forecasts. The Second Generation foresight combines technology and market perspectives, while the Third Generation foresight integrates technology, markets and the social dimension. The Third Generation activity implies the participation of social stakeholders and has an agenda of thematic, socio-economic problem-solving. In the current situation of meeting the challenges of globalisation, several exercises which began with a technology focus have come back with recommendations that focus upon the infrastructure for national innovation systems [12].

Table 4. A matrix of methods used in foresight exercises

Top 10	EU27 (485 cases & 1835 methods)	Trans-Europe (61 cases & 192 methods)	North America (109 cases & 328 methods)	Latin America (24 cases & 188 methods)	Asia (51 cases & 280 methods)	Africa (10 cases & 47 methods)	Oceania (15 cases & 35 methods)
1	Literature Review	Literature Review	Expert Panels	Other Methods	Expert Panels	Scenarios	Backcasting
2	Expert Panels	Scenarios	Futures Workshops	Expert Panels	Scenarios	Megatrend Analysis	Interviews

3	Scenarios	Expert Panels	Literature Review	Literature Review	Literature Review	Literature Review	Cittzen Panels
4	Other Methods	Futures Workshops	Technology Roadmapping	Environmental Scanning	Interviews	Futures Workshops	Questionnaire/ Survey
5	Futures Workshops	Brainstorming	Key Technologies	Brainstorming	Questionnaire/ Survey	Expert Panels	Megatrrend Analysis
6	Brainstorming	Megatrend Analysis	Scenarios	Questionnaire/ Survey	Brainstorming	Essays	Trend extrapolation
7	Trend extrapolation	Trend extrapolation	Megatrrend Analysis	Interviews	Delphy	Questionnaire/ Survey	Delphy
8	Delphy	Other Methods	Interviews	SWOT	Trend extrapolation	Modelling &Simulation	Scenarios
9	SWOT	Modelling &Simulation	Essays	Scenarios	Megatrrend Analysis	Trend extrapolation	Brainstorming
10	Interviews	Questionnaire/ Survey	Trend extrapolation	Structural Analysis	Modelling &Simulation	Other Methods	Expert Panels

4. E-government in Lithuania: a Methodological Approach

E-government development forecasting and management is sophisticated due to its close links to the IT and public administration fields. The process of implementation of the e-government projects involves several social groups: scientists, business and public administration representatives, who have different interests and unequal sets of values on information. The purpose of the modelling is to assess the factors influencing the system, their importance and technological level. E-government forecast is based on an integrated approach of information technology and public administration. Due to this inherent duality the e-governance arises the conflict in validation of experts' estimation. The research goal is to develop the methodology and measurement techniques which are based on the selection factors that influenced group behaviour linked to e-governance decisions. The setting of the main factors' system usually starts from the analysis of secondary literature sources. The initial attempt to identify the key factors most often produces a long list of factors that must be revised and combined in an adequate list (e.g., positions 25-30). For example, the EVPGL Project (e-government to citizens: the development of guidelines for determination of Lithuania to the use of foresight methodology) was supported by the Lithuanian State Science and Studies Foundation in 2008 as well as the eGovRTD2020 project. The preliminary analysis of the literature referred to the list of 32 factors that may affect the e-governance development in Lithuania. The total number of factors was decreased to 26 by experts and analyzed by cluster method. The model includes assumptions in order to avoid errors in the measurement scales.

All of these internal and external factors were divided into three groups:

1. Management factors of the e-government development process,

2. Factors caused by e-governemtn development process,

3. Factors influencing the changes in the e-government development process.

Expert groups worked in three areas of expertise: "Science" (7 experts) included various academic institutions, engaged in e-government surveys; "Business" (10 experts) included various business institutions in relation to e-government projects and their representatives; "Public Administration" (9 experts) included government and local public administration authorities.

Cluster analysis is an exploratory data analysis tool for solving classification problems. Average coupling method calculates all possible clusters pairs' average distance

$$d(r,s) = \frac{1}{n_r n_s} \sum_{i=1}^{n_r} \sum_{j=1}^{n_s} dist(x_{r_i}, x_{s_j}), i \in (1,\ldots,n_r),$$

$$j \in (1,\ldots,n_s)),$$

full coupling (Complete Linkage method) calculates the distance between the outermost points $d(r,s) = \max(dist(x_{r_i}, x_{s_j}))$, the connection between the unit closest points $d(r,s) = \min(dist(x_{r_i}, x_{s_j}))$.

Assumptions for cluster analysis were created. Data are interval in level or are true dichotomies for hierarchical and k-means clustering, though two-step clustering can handle categorical data. When at least

one variable is categorical, two-step clustering must be used.

The e-government system in Lithuania is implemented through the development of online public administration services. The process in still ongoing, and there are many positive results in health service system, municipal services, education system, e-

democracy development, etc. The methodological principals became important in order to support the country foresight development and for evaluation procedures. The common trends towards e-service implementation by different countries are shown in Picture 5.

Picture 5. Individual country ranking regarding full online availability
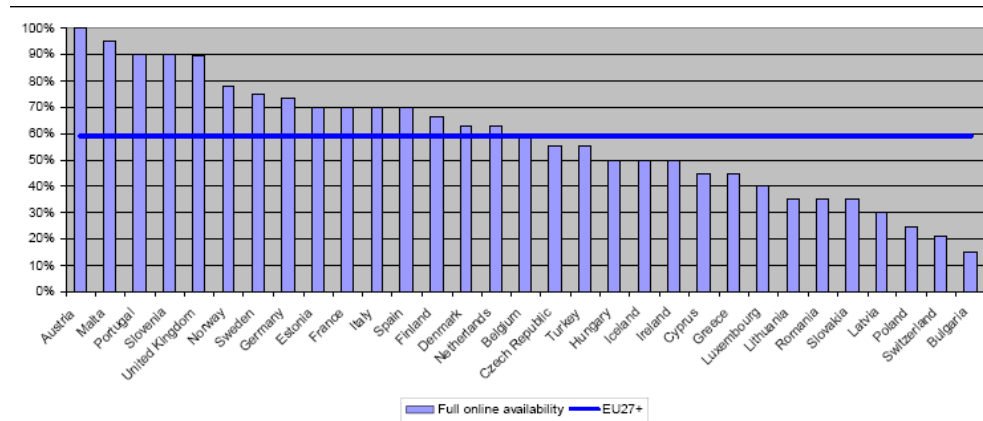
Source: eGovernment Benchmark Survey, 2007. [9]

The EU Commission developed the levels of e-service availability for separate countries. Full online availability in Lithuania is 35%, and the leader is Austria with 100% online availability. The National Portal of Lithuania scores 71% on an average for the EU27+ of 75% which is progressive in comparison with Lithuania's general standing. Although not all services are accessible, the personalization and targetisation are good. Usability still leaves room for improvement [9].

Conclusion

The research explored the foresight methodological issues in order to develop an understanding of the importance of foresight for socio-economic development, for moving towards a knowledgeable and innovative society, and for the ability to implement science and technology innovations. The e-government system implementation in Lithuania was used as a platform to identify effectiveness of hierarchical cluster analysis method for expert assessment.

The e-government system in Lithuania has been implemented through the introduction of online public administration. According to the EU Commission report, the availability of online services in Lithuania has reached 35%.

The methodological study of e-governance services was conducted using the integrated cluster analysis method for expert assesment. Expert groups of scientists, business and public administration rep-

resentatives, with different interests and scale of values conducted an evaluation of 26 factors affecting e-government solutions. The results show that the use of integrated methods for expert assesment could allow to develop recommendations for the strategic policy decisions.

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KONCEPTUALŪS ĮŽVALGŲ PLĖTROS PAGRINDAI

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Straipsnyje apibendrinti įžvalgų kūrimo etapai, tyrimų metodologijos evoliucija ir taikomi metodai. Tarpvalstybinis bendradarbiavimas ir tinklai formuoja naujos kartos įžvalgų modelius. Europos įžvalgų stebėjimo   tinklas (EFNM) katalogizavo daugiau nei 2 000 struktūrinių, regioninių ir transnacionalinių įžvalgų. Siekiant formuoti socialines ekonomines įžvalgas, kuriomis galėtų remtis ūkio politikos sprendimai, būtina išplėsti empirinius tyrimus, įvertinti naudingą regioninių įžvalgų patirtį.

E. valdžios sistema įgyvendinama teikiant viešojo administravimo paslaugas internetu. ES Komisijai parengtoje ataskaitoje e. paslaugų prieinamumo lygis Lietuvoje buvo įvertintas 35 proc.

E. valdžios paslaugų metodologinį tyrimą atliko ekspertų grupės taikydamos klasterinį metodą. Ekspertų grupės – mokslininkai, verslo ir viešojo administravimo atstovai, turėdami skirtingus interesus ir vertybių skalę, turėjo vertinti 26 veiksnius, darančius įtaką e. valdžios sprendimams. Tyrimo rezultatai rodo, kad taikant integruotus ekspertinius metodus sudaromos strateginius sprendimus remiančios rekomendacijos.

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AGENT-BASED STOCK MARKET SIMULATION MODEL

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Abstract. In this paper we propose an artificial stock market model based on the interaction of heterogeneous agents whose forward-looking behaviour is driven by the reinforcement learning algorithm combined with an evolutionary selection mechanism. We use the model for the analysis of market self-regulation abilities, market efficiency and determinants of emergent properties of the financial market. Novel features of the model include a strong emphasis on the economic content of individual decision-making, the application of the Q-learning algorithm for driving individual behaviour, and rich market setup. A parallel version of the model which is based on the research of current changes in the market as well as on the search for newly emerged consistent patterns and which has been repeatedly used for optimal decisions' search experiments in various capital markets is presented.

Introduction

In this paper we develop an artificial stock market (ASM) model, which could be used to examine some emergent features of a complex system comprised of a large number of heterogeneous learning agents that interact in a detail-rich and realistically designed environment. This version of the model is not calibrated to empirical data; therefore, at this stage the main aim of the present research is to offer, implement and test some new ideas that could lay ground for a robust framework for the analysis of financial market processes and their determinants. We believe that the model does offer an interesting framework for the structured analysis of market processes without abstracting from relevant and im-portant features, such as an explicit trading process, regular dividend payouts, trading costs, agent heterogeneity, dissemination of experience, competitive behaviour, agent prevalence and forced exit, etc. Of course, some of these aspects have already been incorporated in the existing agent-based financial models. However, the lack of a widely accepted fundament in this area of modelling necessitates the individual and largely independent approach, which is pursued in this study. What is more, an alternative, from this viewpoint, decisions management system in capital markets is analysed; the system is based on certain assumptions about the continuity of capital market behaviour and on newly formed features and can be efficiently used in various capital markets during the global financial crisis.

One of the most interesting features of ASM modelling is a relatively detailed modelling of the decision processes. In our view, agent-based models developed to deepen our understanding of the real world financial processes can only be fully utilised if a strong emphasis is put on the economic content of the model, i.e. individual behaviour and market structure must be based on clear and economically sound principles. Importantly, agents in our model exhibit economically appealing and forward-looking behaviour, which is based on adaptive learning or, more specifically, a combination of reinforcement learning (Watkins' Q-learning) and evolutionary change. To our knowledge, this is one of the first attempts to incorporate Q-learning algorithm into ASM models.

By conducting simulation experiments in this model, we aim to address some specific questions, such as market self-regulation abilities, the congruence between the market price of the stock and its fundamentals (the market efficiency issue), the importance of intelligent individual behaviour and interaction for market efficiency and functioning, and the relationship between stock prices and market liquidity.

1. Related Literature Review

The ASM research area is relatively new but there is a growing body of literature on the subject. There is a clear lack of a comprehensive literature review and classification of the existing models. Some popular models and ASM modelling principles are discussed in LeBaron (2006), while Samanidou et al. (2007) present a review of some agent-based financial models with the emphasis on econophysics. At the heart of ASM models is the interaction of heterogeneous agents which leads to complex systemic behaviour and emergent systemic properties. There are two broad classes of ASM models, namely, models based on agents' hard-wired behavioural rules (see Kim and Markowitz (1989), Sethi and Franke (1995), Lux (1995)) and models supporting systemic adaptation. The most prominent example of the latter category is the Santa Fe ASM model developed by Arthur et al. (1997) (also see Beltrati and Margarita (1992), Lettau (1997), LeBaron (2000), Tay and Linn (2001)). See Ramanauskas (2009) for a general discussion of agent-based financial modelling and the abovementioned models. In many models systemic adaptation is usually warranted by evolutionary algorithms, whereas individual agents' behaviour is very stylised and based on economic consideration directly. In contrast, in modelling financial market processes, we put a strong emphasis on individual behaviour and economic reasoning.

Lithuanian researchers have been interested in stock market analysis and modelling of investment strategies for more than a decade but the specific area of ASM modelling has not been systematically researched and, to our knowledge, no full-fledged artificial stock market models have been developed by Lithuanian researchers. Studies of investment strategies are conceptually most closely related to our research. Some of the most important studies of investment strategies must be briefly mentioned. Plikynas et al. (2002) made early attempts to use neural networks in stock market forecasting. Nenortaitė and Simutis (2005), Nenortaitė (2007) apply artificial neural networks and particle swarm optimization algorithms to develop stock trading strategies based on historical stock performance. Simutis and Masteika (2004) use fuzzy neural networks and evolutionary programming methods for creating expert systems for stock trading. Rutkauskas and Stasytytė (2008) implement risk stratification procedure to augment the standard risk-return paradigm of investment risk taking. Stankevičius (2001) uses the idea of self-organising maps for the formation of investment portfolios. A notable contribution by Plikynas (2008) is the development of a multi-agent trading system based on competing heterogeneous neural network strategies.

2. Description of the ASM Model

The present ASM model does not fully abstract from many important features of real financial markets that are usually excluded both from standard financial models and other ASMs. For example, just like in the real world financial markets, agents in this ASM model do not know the "true model" but try instead to adapt in the highly uncertain environment; they exhibit bounded rationality, non-myopic forward-looking behaviour, as well as diversity in experience and skill levels; the trading process is quite realistic and detailed; dividends are paid out in discrete time intervals and the importance of dividends as a fundamental force driving stock prices is explicitly recognised. The proposed ASM model embodies some new ideas about financial market modelling and provides an interesting generative explanation of the prolonged periods of over- and under-valuation. In this section we present the architecture of the artificial stock market in detail.

2.1. General Market Setting and Model's Main Building Blocks

The artificial stock market is populated by a large number of heterogeneous reinforcement-learning investors. Investors differ in their financial holdings, expectations regarding dividend prospects

or fundamental stock value. This ensures diverse investor behaviour even though the basic principles governing experience accumulation are the same across the population. The very basic description of agents' behavioural principles can be as follows. All agents forecast an exogenously given, unknown dividend process and base their estimates of the fundamental stock value on dividend prospects. These estimates are intelligently adjusted to attain immediate reservation prices. Agents explore the environment and accumulate the experience with the aim of maximising long-term returns on their investment portfolios but there are no optimality guaranties in the context of high uncertainty and complex interaction of agents.

As usual in financial market modelling, the modelled financial market is very simple. Only one, dividend-paying stock (stock index) is traded on the market. Dividends are generated by an exogenous stochastic process unknown to the agents, and they are paid out in regular intervals. The number of trading rounds between dividend payouts can be set arbitrarily, which enables interpretation of a trading round as a day, a week, a month, etc. Paid out dividends and funds needed for liquidity purposes are held in private bank accounts and earn constant interest rates, whereas liquidity exceeding some arbitrary threshold is simply removed from the system (e.g. consumed). Borrowing is not allowed. Initially, agents are endowed with arbitrary stock and cash holdings, and subsequently in every trading round each of them may submit a limit order to buy or sell *one unit* of stock, provided, of course, that financial constraints are non-binding. Trading takes place via the centralised exchange.

To facilitate the detailed model exposition, it is useful to break the model into a set of economically meaningful processes, though some of them are inter-related in complex ways. We will discuss these logical building blocks in the following subsections.

2.2. Forecasting Dividends

Expected company earnings and dividend payouts are the main fundamental determinants of the intrinsic stock value. We assume that all agents make their private forecasts of dividend dynamics. Dividend flows are generated by an unknown, potentially non-stationary data generating process specified by a modeller. The only information, upon which agents can base their forecasts, is past realisation of dividends, and agents know nothing about the stationarity of the data generating process. Hence, they are assumed to form adaptive expectations, augmented with the reinforcement learning calibration. We also allow for the possibility to improve a

given agent's forecasting ability by probabilistic imitation of more successful individuals' behaviour.

Agents start with finding some basic reference points for their dividend forecasts. The exponentially weighted moving average (EWMA) of realised dividend payouts can be calculated as follows:

$$d_{i,y}^{EWMA} = \lambda_1 \cdot d_y + (1 - \lambda_1) d_{i,y-1}^{EWMA}. \quad (1)$$

Here d_y denotes dividends paid out in period y (year) and λ_1 is the arbitrary smoothing factor (the same for all agents), which is a real number between 0 and 1. The subscript i on the averaged dividends in equation (1) indicates that they vary across individual agents. The differences arise due to different arbitrarily chosen initial values but over time, however, these exponential averages converge to each other. Also note that dividend payouts can be arbitrarily less frequent than stock trading rounds, e.g. if one trading period equals one month, dividends may be scheduled to be paid out every twelve periods and in equation (1) one time unit would be one year.

Exponential moving averages would clearly be unacceptable estimates of future dividends in a general case. Hence, their function in this model is twofold. Firstly, they provide a basis for further "intelligent" refinement of dividend forecasts, i.e. these moving averages are multiplied by some adjustment factors calibrated in the process of the reinforcement learning. And secondly, forecasting dividends relative to their moving averages, as opposed to forecasting dividend levels directly, make forecasting environment more stationary, which facilitates the reinforcement learning task.

The *n*-period dividend forecast is given by the following equation:

$$E(d_{i,y+n}) = d_{i,y}^{EWMA} \cdot a_{i,y}^{div}, \quad (2)$$

where $a_{i,y}$ is the agent i's dividend adjustment factor. These adjustment factors are gradually changed as agents explore and exploit their accumulated experience with the long-term aim to minimize squared forecast errors. Individual forecasts for periods $y + 1$, …, $y + n$ formed in periods $y - n + 1$, …, y, respectively, are stored in the program and used for determining individual estimates of the fundamental stock value.

2.3 Estimating Fundamental Stock Value and Reservation Prices

Quite similarly to the dividend forecasting procedure, agents' estimation of the intrinsic stock value is a two-stage process. It embraces the formation of initial estimates of the fundamental value, based on discounted dividend flows, and ensuing intelligent adjustment grounded on agents' interaction with en-

vironment. We refer to this refined fundamental value as the reservation price.

The initial evaluation of the future dividend flows is a simple discounting exercise. To calculate the present value of expected dividend stream, the constant interest rate is used as the discount factor. Moreover, beyond the forecast horizon dividends are assumed to remain constant. Under these assumptions, individual estimates of the present value of expected dividend flows are

$$v_{i,y}^{fund} = d_y + E\left(\frac{d_{i,y+1}}{1+\bar{r}} + ... + \frac{d_{i,y+n}}{(1+\bar{r})^n} + \frac{d_{i,y+n}/\bar{r}}{(1+\bar{r})^{n+1}} \right), (3)$$

where $\bar{r}$ is the constant interest rate. The last term in this equation is simply the discounted value of the infinite sum of steady financial inflows. These present value estimates are subject to further refinement.

To avoid excessive volatility of the estimates of the discounted value of dividend stream, they are again smoothed by calculating the exponentially weighted moving averages:

$$v_{i,y}^{EWMA} = \lambda_2 \cdot v_{i,y}^{fund} + (1-\lambda_2)v_{i,y-1}^{EWMA}. \qquad (4)$$

The role of these averages is very similar to that of the averaged dividends in the dividend forecasting process, namely, to provide some background for the reinforcement learning procedure and (partially) stationarise the environment in which agents try to adapt.

The second stage in the estimation of the individual reservation prices of the stock is the calibration based on the reinforcement learning procedure. For this we have to switch to the different time frame (in the base version of the model it is assumed that dividends are paid out annually, whereas agents can trade once per month). In a given trading round t, individual reservation prices $v_{i,t}^{reserve}$ are obtained from equation (4) by multiplying exponentially smoothed estimates of fundamental value by individual price adjustment factors, $a_{i,t}^p$:

$$v_{i,t}^{reserve} = v_{i,t}^{EWMA} \cdot a_{i,t}^p. \qquad (5)$$

In this context the individual reservation price is understood as an agent's subjective assessment of the stock's intrinsic value that prompts immediate agent's response (to buy or sell the security).

2.4. Making Individual Trading Decisions

Having formed their individual beliefs about the fundamental value of the stock price, agents have to make specific portfolio rebalancing decisions. In principle, they weight their own assessment of the stock against market perceptions and make orders to buy (sell) one unit of the underpriced (overpriced) stock at the price that is expected to maximise their wealth at the end of the trading period. We give a more detailed description of these processes below.

The individual reservation price reflects what investors think the stock price should be worth. If the last period's average market price p_{t-1} is less than agent i's reservation price today, the agent is willing to buy stock and pay at most $v_{i,t}^{reserve}$. Conversely, if the prevailing market price is higher than the agent's perceived fundamental, the agent is willing to sell it at $v_{i,t}^{reserve}$ or higher price. So its decision rule is like this:

If $v_{i,t}^{reserve} > p_{t-1}$ and $m_{i,t}^0$ is sufficient $\rightarrow$ submit limit order to buy 1 share at price $p_{i,t}^q$

if $v_{i,t}^{reserve} < p_{t-1}$ and $h_{i,t}^0 > 0$ $\rightarrow$ submit limit order to sell 1 share at price $p_{i,t}^q$

otherwise, make no order.

Here $h_{i,t}^0$ and $m_{i,t}^0$ denote, respectively, agent i's stock holdings (i.e. number of owned shares) and cash balance at the beginning of a trading round, $p_{i,t}^q$ is the quoted price to be determined below.

Agents, of course, aim at getting most favourable prices for their trades but they must take into account the fact that better bid or ask prices are generally associated with smaller probabilities of successful trades. The assumption that each agent is allowed to trade only one unit of stock in a given trading round has a very useful implication in this context – the probabilities of successful trades at all possible prices faced by a buyer and a seller can be loosely interpreted as the supply and demand schedules, respectively. So we further assume that these supply and demand schedules are estimated by the exchange institution from past trading data and constitute public knowledge.

Estimated probabilities of successful trades at given (relative) price quotes are computed as follows. Simply put, these estimated probabilities should indicate chances of successful trading at prices that are "high" or "low" relative to the prevailing market price (i.e. last period's average price). So the probability of a successful trade for a given price quote (relative to the benchmark price) is calculated from the past trading rounds as a fraction of successfully filled buy (sell) orders out of all submitted orders to buy (sell) at that price. Unfortunately, due to computational constraints the number of agents and successful trades is not sufficiently high to obtain reliable estimated probabilities in this straightforward way. For this reason we employ the following three-step procedure:

i) estimates of probabilities of successful buy and sell orders for every price quote are smoothed

over time by computing exponential moving averages;

ii) if there are no orders to buy or sell at a given price at time *t*, the exponential moving average estimates of successful trade probabilities are left unchanged from the *t–1* period;

iii) the scattered estimates are fitted to a simple cross-sectional regression line (with its values restricted to lie in the interval between 0 and 1) to ensure that the sets of successful trade probabilities retain meaningful economic properties.

As a result, we get a nice upward-sloping line, which represents probabilities of successful buy orders for each possible price quote, and a downward-sloping line for the sell orders case. At this stage agents have all the components needed to choose prices that give them highest expected wealth at the end of the trading round. Firstly, agent *i* estimates the expected end-of-period stock holdings (i.e. the number of shares) for each possible price quote *j*:

$$E(h_{i,j,t}^1) = h_{i,t}^0 + E(q_{i,j,t}) \cdot b_i \text{ for all } j \quad . \quad (6)$$

Here $E(q_{i,j,t})$ denotes expected number of shares to be bought or sold by agent *i* at any quotable price *j* (as was explained above, these numbers lie in the closed interval between 0 and 1). The indicator variable b_i takes value of 1 if the agent is willing to buy the stock or −1 if the agent is willing to sell the stock.

Similarly, agent *i*'s expected end-of-period cash holdings for each possible price quote *j* are

$$E(m_{i,j,t}^1) = m_{i,t}^0 + E(q_{i,j,t}) \cdot x_{j,t} \cdot (-b_i - c) + E(h_{i,j,t}^1) \cdot E(d_{i,t})$$
for all *j*. (7)

Here $x_{j,t}$ denotes possible price quote *j*, *c* is the fractional trading cost, and $E(d_{i,t})$ denotes the expected dividends, which are to be paid out following the trading round (this term equals zero in between the dividend payout periods). It is important to note that the interest on spare cash funds is paid, as well as excess liquidity (cash holdings above some pre-specified amount needed for trading) is taken away at the beginning of the trading period. This is reflected in $m_{i,t}^0$. Dividends are paid out for those agents that hold stocks after the trading round, as can be seen from equation (7).

Finally, agent *i*'s expected end-of-period stock holdings are valued at individual reservation price and each agent calculates its expected end-of-period wealth for every possible price quote:

$$E(w_{i,j,t}^1) = E(h_{i,j,t}^1) \cdot v_{i,t}^{reserve} + E(m_{i,j,t}^1). \quad (8)$$

Hence, agent *i*'s quoted price, p_i^q, is the price that is associated with the highest expected wealth at the end of the trading round:

$$p_i^q = \arg\max_{x_i} E(\vec{w}_{i,t}^1). \quad (9)$$

If several price quotes result in the same expected wealth, the agent chooses randomly among them. It is also important to note that in the process of the reinforcement learning, agents are occasionally forced to take exploratory actions. In those cases exploring agents choose prices from the quote grid in a random manner.

Market price determination and actual trading take place through a centralised stock exchange. The trading mechanism basically is the double auction system, in which both buyers and sellers contemporaneously submit their competitive orders to implement their trades. Agents are assumed to have no knowledge of individual market participants' submitted orders. The centralised stock exchange also produces a number of trading statistics, both for analytical and computational purposes. These statistics include the market price, trading volumes and volatility measures. The market price in a given trading period is calculated as the average traded price.

2.5. Learning and Systemic Adaptation in the Model

We assume that the agents' behaviour is driven by reinforcement learning since these learning algorithms borrowed from the literature on machine learning seem to be conceptually suitable for modelling investor behaviour (see, Bertsekas and Tsitsiklis (1996), Kaelbling et al. (1996), or Sutton and Barto (1998) for sound introductions to reinforcement learning). Agents take actions in the uncertain environment and obtain immediate rewards associated with these (and possibly previous) actions. A specific learning algorithm allows agents to adjust their action policies in pursuit of highest long-term rewards. It is a very desirable feature of any financial model that agents strive for strategic, as opposed to myopic, behaviour. This is exactly what reinforcement-learning agents do. On the other hand, it is the immense complexity of investors' interaction, both in real world financial markets and in the model that dramatically limits agents' abilities to actually achieve optimal investment policies or even makes the optimal investment behaviour outright impossible.

In our model we use a popular reinforcement learning algorithm, also known as the Q-learning, which was initially proposed by Watkins (1989). It is a temporal difference learning based on the stepwise update (or back-up) of the action-value function and associated adjustment of behavioural policies. The principal back-up rule is closely related to Bellman optimality property and takes the following form:

$$Q(s_t, a_t) \leftarrow (1 - \alpha) \underbrace{\cdot Q(s_t, a_t)}_{\text{Old estimate of } Q(s_t, a_t)} + \underbrace{\alpha(r_{t+1} + \gamma \max_a Q(s_{t+1}, a))}_{\text{New estimate of } Q(s_t, a_t)}. \tag{10}$$

Here s_t denotes the state of environment, a_t is the action taken in period t and r_{t+1} is the immediate reward associated with action a_t (and possibly earlier actions). Parameter α is known as the learning rate and γ is the discount rate of future rewards. Function $Q(s_t, a_t)$ is usually referred to as the action-value function (or Q-function) and it basically shows the value of taking action a_t in state s_t under behavioural policy π. More specifically, the action-value function is the expected cumulative reward conditional on the current state, action and pursued behavioural policy.

However, the so-called "curse of dimensionality" implies that a straightforward implementation of the basic version of this algorithm is rarely possible in complicated environments. Following the standard practice, we apply the Q-learning algorithm with gradient-descent approximation. Here we only describe specific variables that are used in the Q-learning algorithm.

As was mentioned before, there are two instances of individual agent learning in the model: learning to forecast dividends and learning to adjust perceived fundamentals. In the dividend forecasting case agent i learns to adjust the dividend adjustment factor, $a_{i,t}^{div}$ (see equation (2)). In each state there are three possible actions, i.e. the agent can increase the dividend adjustment factor by a small proportion specified by the modeller, decrease it by the same amount or leave it unchanged.

Due to the complex nature of environment, the state of the world, as perceived by investor i, must be approximated, and it is described by a vector of the so-called state features, $\vec{\phi}_s$. We choose four state features that are indicative of the reinforcement learner's "location" in the environment and summarize some properties of the dividend-generating process, which can provide a basis for successful forecasting. These features include the size of the dividend adjustment factor, relative deviation of current dividend from its EWMA (compared to the standard deviation), the square of this deviation (to allow for nonlinear relation with forecasts) and the size of the current dividend relative to the EWMA.

The forecast decision is taken at time y and the actual dividend realisation is known at forecast horizon $y + n$. Then agent i gets the reward, which is the negative of the squared forecast error:

$$r_{i,y+n}^d = -\left(d_{y+n} - E_y(d_{i,y+n})\right)^2. \tag{11}$$

Hence, the agent is punished for forecasting errors. The learning process is augmented by modeller-imposed constraints on dividend forecasts. The forecast is not allowed to deviate by more than a pre-specified threshold (e.g. 30%) from the current level of dividends. In that case, the agent gets extra-punishment and the dividend forecast is forced to be marginally closer to the current dividend level. Once the agent observes the resultant state, i.e. the actual dividend realisation, it updates its behavioural policy according to the Q-learning procedure.

In the case of individual stock value estimation, agent i also can take one of three actions: fractionally increase or decrease the price adjustment factor, $a_{i,t}^p$ (see equation (5)), or leave it unchanged. Analogously to the dividend forecasting case, the four state features are the price adjustment factor, the stock price deviation from its exponential time-average (this difference is divided by the standard deviation), the square of this deviation and the current stock price divided by the weighted time-average.

The agent observes the state of the world and acts according to the pursued policy. After the trading round, the agent observes trading results and the resultant state of the world, which enables the agent to update its policies according to the usual Q-learning procedure. In this model, the basic immediate reward, $r_{i,t+1}^p$, is simply the log-return on the agent's portfolio:

$$r_{i,t+1}^p = \ln\left(h_{i,t}^1 p_t + m_{i,t}^1(1 + \bar{r}^{monthly})\right) - \ln\left(h_{i,t}^0 p_{t-1} + m_{i,t}^0\right) \tag{12}$$

Recall that p_t denotes the market price following a trading round in time t and $\bar{r}^{monthly}$ is a one-period return on bank account. In order to ensure more efficient learning – just like in the case of dividend learning – constraints are imposed on the magnitude of price adjustment factors, and additional penalties are invoked if these constraints become binding.

The chosen specification of the reward function implies that the reinforcement-learning agents try to learn to organise their behaviour in order to maximise long-term returns on their investments. We could interpret agents in this model as professional fund managers that care about maximising clients' wealth, seek best long-term performance among peers and shun under-performance.

The model allows for optional alteration of agent behaviour via sharing private trading experience, competitive evolutionary selection and noise

trading behaviour. These options help enhance the realism of the artificial stock market and arguably augment the reinforcement learning procedure by removing clearly dominated trading policies implemented by individual agents and by strengthening competition among them.

3. Experimental Simulations

Like the majority of other ASM models, the model presented in this paper is based on a large number of parameters, and it is very difficult to calibrate the model to match empirical data. At this stage of the model development we do not attempt to do that. Instead, we assign reasonable and, where possible, conventional values to the parameters and assume very simple forms of dividend-generating processes. This enables us to determine the approximate fundamental stock value dynamics and study how the market stock price, determined by the complex system of interacting heterogeneous agents, fares in relation to stock price fundamentals. Even though the model is not calibrated to the market data, the results provide qualitative insights into market self-regulation, efficiency and other aspects of market functioning. In this section we examine these issues in more detail and report some interesting simulation results.

The simulation procedure is implemented by performing batches of model runs. Each run consists of 20,000 trading rounds (about 1667 years). Batches of ten runs repeated under identical parameter settings are used to generate essential data and statistics that are, in turn, used for analysis and generalisation. In every run, the first 5,000 trading rounds – as the learning initiation phase – are excluded from the calculation of the descriptive statistics. The simulation concentrates on altering the features of the reinforcement learning, interaction among agents and dividend-generating processes in an attempt to understand relative importance of intelligent individual behaviour, market setting and population-level changes for the aggregate market behaviour. Other model parameters are kept unchanged.

We start with the examination of the agents' ability to forecast dividends. Since dividends are driven by very simple data generating processes, it is not surprising that in the model version in which both reinforcement learning and evolutionary selection are enabled, agents are able to form very precise forecasts. The average dividend forecast error for this model specification is -0.1%, while the average absolute forecast error amounts to 0.4%. To assess the actual importance of the reinforcement learning behaviour for dividend forecasting, simulation batches with disabled reinforcement learning are run. In these runs agents neither learn to forecast dividends, nor try to optimise their portfolios, as their commensurate reinforcement rewards $r_{i,t+n}^{d}$ and $r_{i,t+1}^{p}$ are set to zero. In this case, the average forecast bias considerably increases to -0.8% and the average absolute error stands at 1.4%. In this no-learning case the average percentage of agents hitting the modeller-imposed dividend forecast bounds increases significantly, as compared to the enabled learning case. In other words, learning agents are able to effectively form "reasonable" forecasts, while non-learning agents are simply forced to remain within the pre-specified boundaries but perform much worse, taken on an individual basis. This leads us to a very natural conclusion that in the dividend forecasting process intelligent adaptation matters.

As the next step of our analysis we examine the dynamics of the market price in relation to the fundamentals. In this experiment fundamentals anchor the stock price dynamics to some extent, and the market price fluctuates in the vicinity of the perceived fundamental value The average percentage bias of market price from the fundamentals is low and stands at -1.6%. Nevertheless, the valuation errors are clearly autocorrelated, i.e. due to the market inertia and prevailing expectations, the stock price may be above or below risk-neutral fundamentals for extensive periods of time. For instance, runs of uninterrupted overvaluation stretch on average for 44 trading periods and an average length of undervaluation runs is 60 periods. By the same token, average market price deviations from the fundamental valuation are large relative to the price volatility. The enabled evolutionary selection option in the model ensures even wealth distribution among agents and active agents in each trading period (i.e. agents that have sufficient funds and/or stock holdings to trade constitute on average 89.7% of total population). Finally, the average fraction of agents whose adjusted fundamental valuations (reservation prices) fall out of modeller-imposed "reasonable" bounds is very low and stands, on average, at 0.1% of total population in a trading round.

It turns out that the above results strongly depend on the evolutionary competition assumption. It suffices to disable the evolutionary selection, and the average percentage stock price bias from the fundamentals boosts to 5.9% along with a dramatic increase in average overvaluation runs to 406. By the end of a simulation run, the number of inactive agents per trading round increases to 70-80%, and wealth, naturally, concentrates in the hands of the remaining 20-30% agents. There are some possible explanations to this overvaluation and wealth concentration. Such overvaluation can be, to a certain extent, associated with the model's feature that ex-

cess liquidity is simply taken away from the market, which means that the agents that tend to sell their stock holdings are more likely to consume their money and become inactive. In other words, those agents that highly value the stock tend to dominate in the market. Another interpretation is that agents performing worse are simply driven out of the market. Moreover, a diminishing number of active participants and a smaller degree of competition allows agents to concert their portfolio rebalancing actions in such a way that the market price is driven up, which leads to larger unrealised returns and thereby stronger reinforcement for the remaining active players. These results make sense from the real world perspective. The largest mass of investors want stock prices to be as high as possible (though possibly still compatible with fundamentals), and it is not in their direct interest to have prices that match fundamentals precisely.

We also perform simulations to examine the market's self-regulation ability. In particular, we want to know whether economic forces are strong enough to bring the market to the true fundamentals if they systematically differ from average perceived fundamentals. For this purpose, we introduce an arbitrary upward bias to the estimates of the fundamental value by adding an arbitrary term in equation (3). Then simulation runs are implemented for different model settings, with or without reinforcement learning. It turns out that the market is not able to find the true risk-neutral fundamentals. In the case of no-learning, stock prices tend to slowly grow larger than the perceived fundamentals. In the case of enabled reinforcement learning, agents tend to stick to the perceived fundamentals, and, as a result, the market price fluctuates around them.

The above results confirm that the market self-regulation mechanism in this model is weak. We do not find evidence of agents adjusting their perceived fundamentals so that the market price gets in line with modeller-imposed fundamentals or, say, the usually assumed risk-averse behaviour. On the other hand, it is not surprising. Well known puzzles of empirical finance and recent mega-bubbles suggest that after all markets may not be tracking fundamentals so closely. It can be the case that markets exhibit an inertia so large that even fundamentally correct investment strategies pay out only in too distant future and may not be applied successfully or act as the market's self-regulating force. The obtained results suggest that (not necessarily objectively founded) market beliefs of what an asset is worth are a very important constituency of its market price.

Our last but not least intention was to examine the relationship between the market price fluctuations and the financial market liquidity. This experiment also helps to shed light on the reasons for a

relatively loose connection between the market price and fundamentals. In this simulation run, the standard model version with reinforcement learning and evolutionary selection is used, while dividends are assumed to be deterministic and constant. It is notable that even in this environment market price fluctuations remain significant and trading does not stop. The clue to understanding this excess volatility may be the positive relationship between market liquidity and the stock price. Since unnecessary liquidity at an individual level is removed from the system, overall liquidity fluctuates in a haphazard way. Increases in market liquidity result in an increase in solvent demand for the stock and lifts its price. As can be seen from Figure 1, liquidity growth spikes are associated with strong price increases. The linear correlation between growth of money balances and stock price growth is found to be 0.32.

Figure 1. Typical relationship between stock returns and liquidityin a constant dividend case
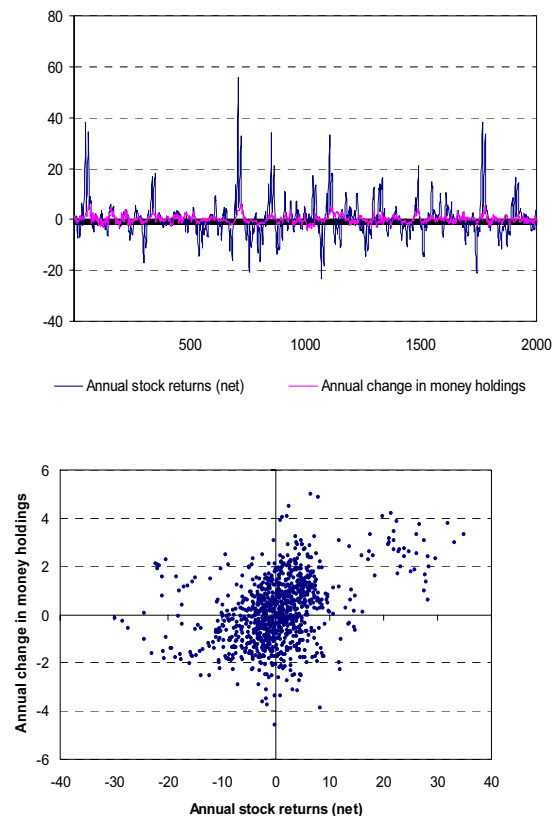
It should be noted that the latter experiment is devised so as to ensure that positive relationship between stock returns and investors' cash holdings is not linked to fluctuations in dividend payouts. This allows us to conclude that liquidity fluctuations affect the asset price in this case, and not vice versa. The evidence that market liquidity changes can move markets is very important for understanding the way liquidity crises, credit booms and busts (deleveraging), portfolio reallocations between asset

classes and other exogenous factors may affect stock markets.

4. A Short Presentation of Parallel Decisions Management System in Capital Markets.

In this section we apply a parallel decisions management system in capital and exchange markets as an empirical counterpart of the so-called double trump model, which at first was designed for decisions management in exchange markets and later repeatedly used in various capital markets. The description of the double trump model, its development and possibilities of application for decisions management in exchange markets can be found in Rutkauskas (2005, 2006, 2008a, 2008b), Rutkauskas and Stasytytė (2006), Rutkauskas, Lukoševičius and Jakštas (2006), and Rutkauskas, Miečinskienė and Stasytytė (2008). This approach has close linkages to financial management research conducted by Ginevičius and Podvezko (2008a, 2008b), and Rutkauskas and Stankevičienė (2006). The analytical framework also benefits from conceptual ideas on modelling principles developed by Buračas (2004), Žvirblis, Mačerinskienė and Buračas (2008).

The link of parallel systems with the main topic of this paper and the ability of market participants and the market itself to match with consistent patterns of market behaviour and decisions management could be described by the following circumstances:

- under the circumstances of financial instability, capital markets in a sophisticated but cognizable manner change the supply of possibilities for an investor, which is fully described by possibilities' efficiency, risks and reliability;

- investor (either individual or institutional) has a possibility to perceive the adaptation principles and means of his utility function in changing behaviour of the capital market;

- perception of decisions management strategies and criteria interdependencies becomes a presumption and a guarantee of successful investing;

- decisions are made in an almost fully artificial market, which is compared with real market data only by the core parameters. The space of stochastic processes is an adequate enough real market model.

The possibilities of parallel decisions management system will be illustrated by its application for the achievement of the highest possible growth of invested capital during the analysed period: 02-01-07 – 09.04.09, which also includes the most severe periods of global financial crisis. In general, using this system a broad monitoring is maintained, which includes about 30 various global markets, for the search of favourable decisions for capital growth. The search of favourable decisions was performed selecting the so-called pseudo-scenario, when a part of historical data, in this case, 40 days from the beginning of 01-01-07, is accepted as "real" historical data, and the following data is treated as "forthcoming", and, with regard to the latter, forecasting is being performed and portfolio rebalancing decisions are being made. Next, the results of the experiment in five countries' markets will be presented: UK, Germany and the U.S. In sections *a* of Figures 2 – 4 we see how a unit of invested capital was changing during the analysed period, and in sections *b* we see the change of real prices of the 6 stocks in portfolio.

Figure 2. The results of the experiment in UK
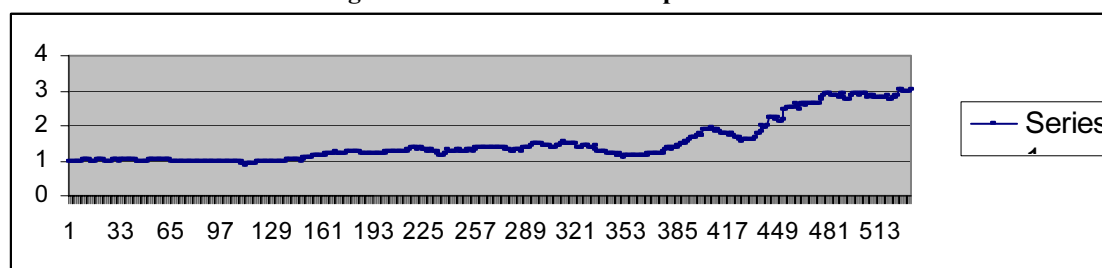
a) The change of a unit of invested capital
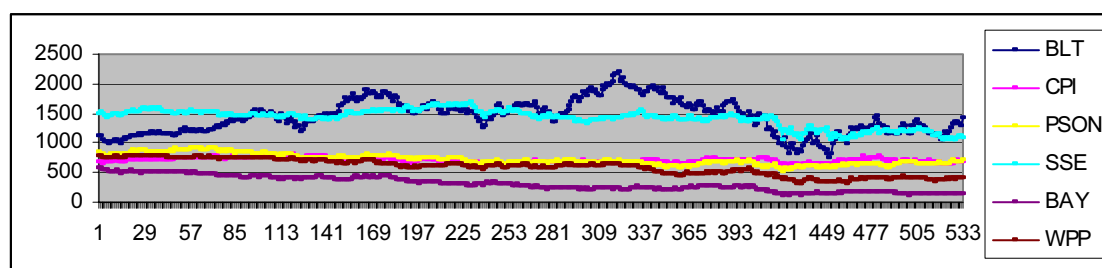
b) The change of real prices of stocks in portfolio

Figure 3. The results of the experiment in Germany
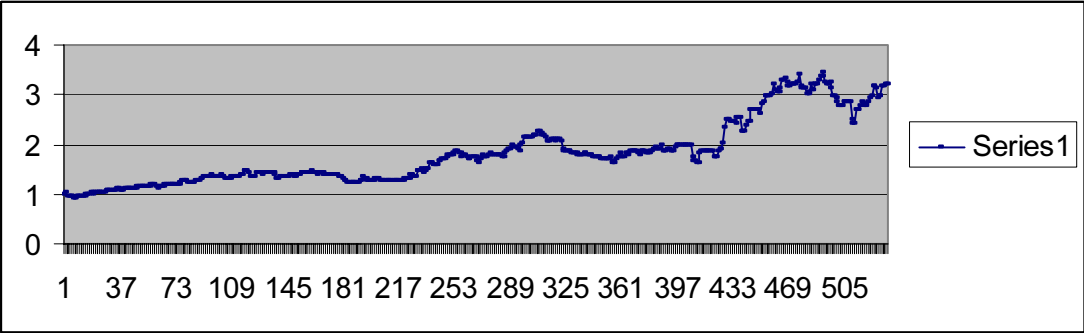
a) The change of a unit of invested capital
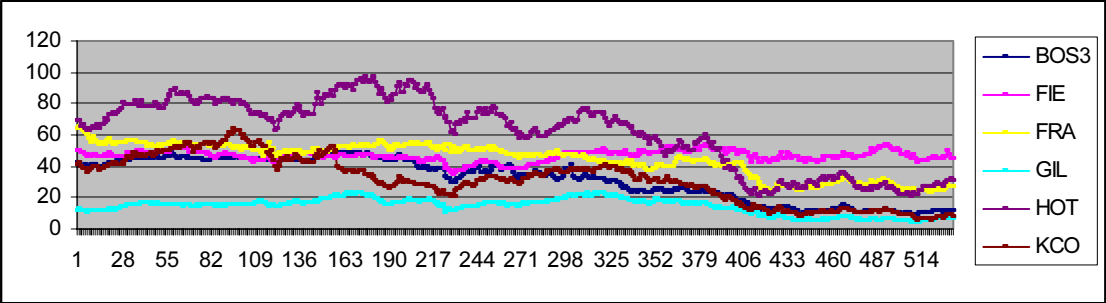
b) The change of real prices of stocks in portfolio

Figure 4. The results of the experiment in the U.S. (NYSE)
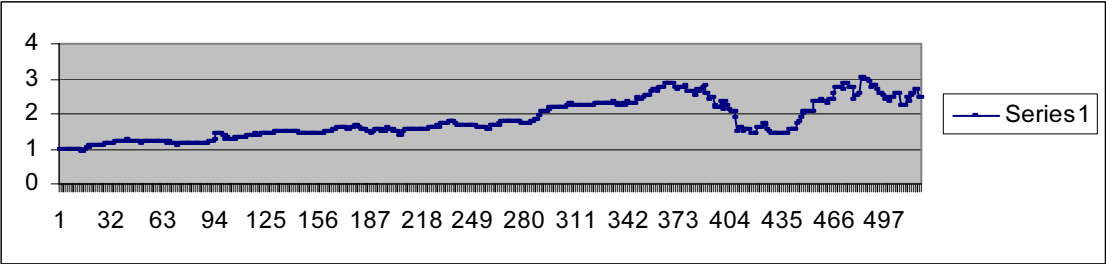
a) The change of a unit of invested capital
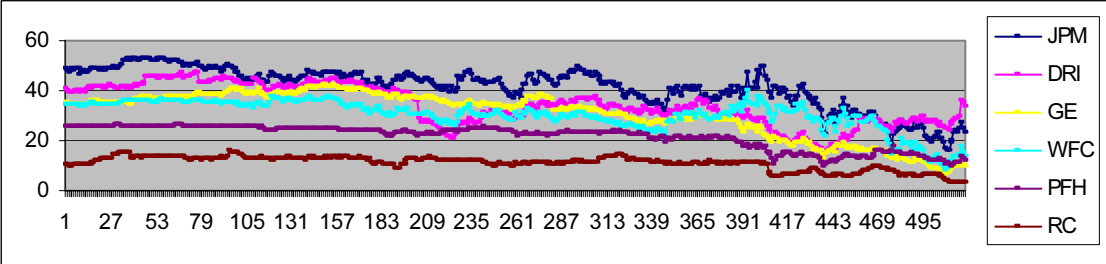
b) The change of real prices of stocks in portfolio

The growth of the initial invested capital is obtained with the help of the optimization (rebalancing) of portfolio structure. While rebalancing portfolio a fee of three basic percentile points was imposed in case of buying as well as selling a stock. This amounts to nearly 30% of the whole invested capital and more than 50% of the gross capital increase.

5. Concluding Remarks

In this paper we developed an artificial stock market model based on the interaction of heterogeneous agents whose forward-looking behaviour is driven by the reinforcement learning algorithm combined with an evolutionary selection mechanism and

economic reasoning. Other notable features of the model include knowledge dissemination and agents' competition for survival, detailed modelling of the trading process, explicit formation of dividend expectations and estimates of fundamental value, computation of individual reservation prices and best order prices, etc. At this stage of development, the model should largely be seen as a thought experiment that proposes to study financial market processes in the light of complex interaction of artificial agents that are designed to act in an economically appealing way. Bearing in mind the uncertain nature of the model environment, mostly brought about by this same interaction, strategies followed by artificial agents seem to exhibit a good balance of economic rationale and optimisation attempts. Quite a strong emphasis on the model's economic content distinguishes this model from other ASM models, which are most often based on evolutionary selection procedures and are sometimes criticised for the lack of economic ground.

Preliminary simulation results suggest that the market price of the stock in this model broadly reflects fundamentals but over- or under-valuation runs are sustained for prolonged periods. Both individual adaptive behaviour and the population level adaptation (evolutionary selection in particular) are essential for ensuring any efficiency of the market. However, market self-regulation ability was found to be weak. The institutional setting alone, such as the centralised exchange based on the double auction trading, cannot ensure effective market functioning. Even in the case of active adaptive learning, the market does not correct itself from erroneously perceived fundamentals if they are in the vicinity of actual fundamentals, which underscores the importance of market participants' beliefs for the market price dynamics. We also found a positive relationship between stock returns and changes in liquidity, i.e. there are indications that exogenous shocks to investors' cash holdings lead to strong changes in the market price of the stock.

Parallel decisions search system, which is presented in the paper, exploits only a part of the market, i.e. a certain amount of stocks. The system is based on an assumption about market behaviour cognition, but the main model of market behaviour is admitted to be a multi-dimensional stochastic process, the identity of which regarding particular market is achieved with the help of stock prices, market indices and macro-economic data. The application of an expert system allows us to state that even under the circumstances of a global financial crisis distinct investment strategies are available, which guarantee long-term capital growth rates much higher than the general growth of the market.

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AGENTAIS PAGRĮSTAS AKCIJŲ RINKOS IMITACINIS MODELIS

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Santrauka. Šiame straipsnyje pateikiamas dirbtinės akcijų rinkos modelis, pagrįstas heterogeninių agentų sąveika, kurią nulemia ekonominiai elgsenos principai, skatinamojo mokymosi algortimas bei evoliucinė agentų atranka. Šis imitacinis modelis vertintinas kaip struktūrizuotos analizės pagrindas, tiriant rinkos savireguliacijos galimybes, rinkos efektyvumą bei kylančias rinkos savybes lemiančius veiksnius. Lyginant su daugeliu kitų dirbtinės akcijų rinkos modelių, šiame modelyje ekonominei individų elgsenai ir individualiai adaptacijai skiriama gerokai daugiau dėmesio. Riboto racionalumo agentai šiame modelyje investicinius sprendimus grindžia ekonomine logika, t. y. vertindami tikėtinus diskontuotus pajamų srautus bei lygindami alternatyvių investicijų grąžas. Jie taip pat siekia tinkamai vertinti ateitį dideliu neapibrėžtumu pasižyminčioje aplinkoje bei atsižvelgia į kitų rinkos dalyvių veiksmų poveikį bendrai rinkos kainos dinamikai. Šis darbas yra vienas pirmųjų bandymų ekonominiu požiūriu įdomų skatinamojo mokymosi algoritmą (konkrečiau, Q-mokymąsi) dirbtinės akcijų rinkos modeliuose. Modelis taip pat pasižymi ganėtinai sofistikuota imitacinės rinkos struktūra.

Su modeliu atlikti imitaciniai eksperimentai, kurių metu buvo keičiami parametrai, lemiantys skatinamojo mokymosi, agentų tarpusavio sąveikos bei dividendus generuojančius procesus, siekiant įvertinti jų poveikį rinkos savireguliacijai, efektyvumui ir sisteminio lygmens dinamikai. Jų pagrindiniai rezultatai yra šie. Šiame modelyje akcijos rinkos kaina iš esmės atspindi rizikai neutralią fundamentaliąją vertę, tačiau galimi ilgi pervertinimo ir nepakankamo įvertinimo epizodai. Ir individualus mokymasis, ir populiacijos lygmens adaptacija yra esminės prielaidos imitacinės rinkos efektyvumui pasiekti. Rinkos savireguliacijos galimybės šiame modelyje yra silpnos. Imitacinėje rinkoje nustatytas teigiamas sąryšis tarp akcijų grąžos ir likvidumo (t. y. pinigų kiekio sistemoje) pokyčių.

Straipsnyje taip pat pateikiami preliminarūs bandymų taikyti analogiškus modeliavimo principus investicinio portfelio valdymui realiose finansų rinkose rezultatai. Jie patvirtina neblogas praktines šių modeliavimo principų taikymo perspektyvas.

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AN APPROACH TO THE EVALUATION OF REGIONAL INEQUALITIES: A CASE STUDY OF LITHUANIAN COUNTIES

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Abstract. The indicators for the evaluation of regional development processes are influenced by a great number of interrelated factors. While investigating sustainable or unsustainable growth, the relation between employment and workplaces, the alternation of the quality of life and the status of health, etc. must be taken into consideration. It is quite complicated to find an appropriate evaluation mechanism for the recognition of regional inequalities. As the alternation of the processes of restructuring and development is quite fast, new relationships, which are observed in the period of the contemporary crisis, influence new types of the consequences of economic development as well as the methods for its evaluation. The paper aims to assess the extent of regional inequalities by using an approach to the evaluation of some differences among developing regional areas based on the NUTS 3 level. The results of the application of the mentioned methodology are demonstrated by evaluating the processes of regional development in Lithuania. The application of the state-of-the-art scientific methods and tools allows to provide empirical evidence regarding the dynamic processes of regional development. The evaluation of statistical data allows to recognize the inequalities; econometric methods are used for the analysis of the changes of *per capita* incomes and their basic components as well as the level of labour productivity and employment rate. The proposed approach allows to evaluate the levels of inequality, especially by using the statistical data regarding the income growth in the Lithuanian regions, and the rise of labour productivity gap. Econometric models used to analyse the impact of the capital/labour ratio on labour productivity are discussed in the paper. Calculated technical progress parameters show that annual growth of technical progress is, in fact, the highest in leading regions with strong economies of agglomeration and technological development and that the Lithuanian regional policy is relatively ineffective in raising technological progress growth.

Introduction

In the modern theory of regional development a lot of emphasis has been put on the phenomena of localization and agglomeration that have an effect on private business decisions on investment in particular regions (Fujita and Thisse, 2002; Van Oort, 2002; Martin, 2002; Buračas, 2007; Mačys, 2008). Emerging economies of localization and agglomeration bear the key significance as they allow the local en-

terprises to gain profit from the advantages of such developments.

European directives have been introduced in the area to support the framework to tackle restructuring during the last two decades. The Council Directive 98/59/EC on the approximation of the laws of the Member States of the European Union (EU) relating to collective redundancies aims at regulating such redundancies and introducing special obligations for employers in terms of social dialogue and measures. The Directive 2002/74/EC relates to issues regarding social guarantee funds (salaries, benefits, etc.) for workers whose company has filed for bankruptcy or liquidation.

Empirical studies have been focused on the existence and determination of regional inequalities in the EU (Pagano, 1993; Button and Pentecost, 1995; Sala-i-Martin, 1996). A short discussion of recently published results regarding this issue would be valuable in order to gain some perspective. The basic factors for regional development that are usually found in the works of the adherents of the neoclassical theory are the following: capital, land and workforce (Cass, 1995). The definition of capital includes not only financial and material resources but also all human factors. It is in the neoclassical theory that regional development is determined by a constant growth of workforce and capital as well as technological changes within a given period of time. Over the past decades regional integration and disparities in the EU have been widely discussed in order to provide an empirical understanding of the processes.

The single existing tool to measure restructuring and display its statistics is the European Restructuring Monitor, created in 2001 by the European Monitoring Centre on Change. But the picture of these processes developed by defining six main types of restructuring (bankruptcy/closure, internal restructuring, merger/acquisition, off-shoring, relocation, outsourcing) is limited by its methods and the size of collective dismissals considered (Gazier and Bruggeman, 2008; Triomple, 2009).

The main long-term goal of Lithuania's national regional policy, coinciding with the regional policy of the EU, is the reduction of regional social and economic differences. Therefore, in this paper the assessment of the consequences of the underway regional policy, i.e. the inconsistencies of regional development, current convergence and its determinants will be presented.

The goal of the present research is to provide the assessment of regional inequalities by using an approach to the evaluation of some differences among developing regional areas based on the NUTS 3 level. The results are demonstrated by the evaluation of regional districts of Lithuania, i.e. counties.

1. The Issues of Regional Development Monitoring and Evaluation Possibilities

The neoclassical finding (Solow, 1956; Cass, 1965) is that in the poorer regions the output *per capita* should grow faster than in the wealthier regions, which gives rise to the so-called convergence hypothesis. Other things being equal, the premise of this hypothesis is that the possibilities for growth are greater in those regions that are not advanced. Several factors are indicative of convergence: migration of labour from poor to rich regions tends to increase salaries in the regions of departure and reduce them in the regions of destination (Barro and Sala-i-Martin, 1995). Moreover, the diffusion of new technology might result in spillover effects which benefit poor regions (Bergstrom, 1998).

In scientific literature various alternatives to check the convergence hypothesis are suggested. Two concepts are usually used in evaluating the pattern of regional differences: the speed of convergence (β-convergence) and the analysis of regional output *per capita* dispersion (σ-convergence). In estimating β-convergence, the "convergence equation" or the so called Barro (1991) regression is the chosen method that provides a cross-section of regions within countries with a growth rate of output *per capita* over a given period of time. Convergence is implied if the coefficient of initial output *per capita* is negative and statistically significant. The σ-convergence theory is based on time series analysis and focuses on the evolution of output *per capita* dispersion (Barro and Sala-i-Martin, 1991, 1992). Sala-i-Martin (1996) identified that σ-convergence is sufficient but not necessary for β-convergence. This suggests that the lack of σ-convergence is not an indication of the absence of β-convergence.

According to the endogenous growth theory (Romer, 1993, 1994, 1996; Lucas, 1988), countries or regions could not converge even in a world of constant returns and exogenous growth (as put in the neoclassical growth model), given that the countries or regions differ in a way they allocate their resources over time or that they do not have access to the same technology. This leads us to the conclusion that inequalities in regional development are not only a result of varying rates of capital accumulation, as the traditional Solow model concludes, but also stem from differences in technology. Thus, we need to take into account that productivity growth across regions differs mainly because of the presence of technological gaps or capital deepening effects (Romer, 1993; Bernard and Jones, 1996a, 1996b; Caree et al., 2000; Andrés and Boscá, 2000). Nonetheless, the creation of knowledge through learning is a pivot of endogenous growth formulation. Through the process of learning, the knowledge base

of a regional labour force becomes a continuous and internally created source of competitive advantage and monopoly power (Romer, 1990; Lucas, 1988). Such a mode of internal learning allows to establish a new infrastructure and, concurrently, enhance development. Through learning it is possible to envision how closed regional economic systems could survive, develop and sustain themselves (Stimson, Stough, Roberts, 2006).

In the theories of endogenous growth, the level of technical progress is considered to be a part of the production function under the label of "learning by making" or a "specific growth factor", which raises the overall productivity of other factors (Barro, 1991). This specific growth factor may be human capital defined as a totality of knowledge obtained from research and development. Unlike the neoclassical approach to regional convergence, in the endogenous theories technology plays the key role in determining divergence.

Endogenous development models are usually used to examine agglomerated but not metropolitan areas, which are comprised of small or medium-sized enterprises. Entrepreneurship, flexibility of productivity, the economies of the counties and other additional factors are typical of local economies, where all of the aforementioned characteristics work as a catalyst for the development process. There are quite a few options of the adaptation of this model (i.e. models of industrial districts, regional innovation systems) (Amstrong and Taylor, 2000; Iacoponi et al., 1995; Cooke et al., 2004; Ascheim and Isaksen, 2002). Industrial district is an example of the intensification in local industrial relations, which is a long-term process that forms indissoluble network of positive and negative external relations along with historic-cultural heritage. The regional policy must be concentrated on endogenous development, promotion of cooperation, development of regional innovation systems and preservation of local environment.

In Lithuania, though a small country, territorial differences of nature and society are rather pronounced. The period of economic transition highlighted the disparities of economic and social development. The goal to integrate into the EU accelerated Lithuanian regional policy-making. In this paper a region is perceived as a political and administrative unit (in between the national government and a municipality), which ensures endogenous and balanced development of the regional economies, increases international competitiveness and develops regional identity (Svetikas, 2004).

2. The Main Components of the Evaluation of Regional Inequalities

2.1. Possibilities of the Evaluation of Regional Convergence

During the last decades there was an increase in empirical research into the EU regional disparities and their convergence. To name few, there are Pagano's (1993), Button and Pentecost's (1995), Barro and Sala-i-Martin's (1995) and other papers that apply regression analysis for the investigation of regional disparities and convergence. The analysis is based on the neoclassical growth theory or, to be more precise, on the Sollow's approach, by which regional relations of productivity, expenditure factors and technological progress are investigated.

As already have been mentioned, this theory suggests that all the regions of equal pace in technological progress converge in the direction of a balanced income *per capita* model. Given that several regions undergo similar levels of production, technology, retrenchment and population growth, these regions will converge towards the same income *per capita* level.

There are two types of convergence: β-convergence and σ-convergence.

σ-convergence represents the common measure of income disparities. It gauges the dispersion of regional income in a given period of time. If the dispersion decreases over time, there is σ-convergence.

β-convergence may be observed only in the cases when the regions lagging behind start to grow faster than the leading ones, i.e. when GDP or regional income accrues faster in the lagging regions rather than in the leading ones. That may be exemplified by the negative ratio between the capital income growth and the capital income level at the initial point. The existence of β-convergence signals allow σ-convergence to be traced. The absolute β-convergence can be tested by the following (1) equation:

$$(1/T)\ln\left(\frac{Y_r^t}{Y_r^{t-1}}\right) = \beta_0 + \beta_1 \ln Y_r^{t-1}; \qquad (1)$$

Note: T is an interval of time under investigation from 0 to *n*;

$\dfrac{Y_r^t}{Y_r^{t-1}}$ is a vector, inclusive of regional income growth *r* at a particular moment *t*;

Y_r^t is a vector, inclusive of regional income *r* at a particular moment *t*;

Y_r^{t-1} is a vector, inclusive of regional income *r* at a particular moment *t-1*;

β_0, β_1 are coefficients.

The left-hand side of the equation represents the average annual growth *r* of the regional income in T years. The regions lagging behind show greater growth rate than the leading regions when $\beta_1 < 0$. That is, β-convergence becomes apparent.

As mentioned above, β-convergence occurs when the regions lagging behind start to grow faster than the leading ones. This is illustrated by a negative relationship between the growth of capital income and the level of capital growth in the initial period. σ-convergence is a general measure of income disparities. It measures the dispersion of regional income at a certain moment. If the dispersion decreases over time, the observation of σ-convergence process continues. Hereinafter β-convergence and σ-convergence throughout Lithuanian regions will be discussed.

As β-convergence exposes, the regions with the lowest level of GDP per employed person experienced the highest average GDP growth per employed person. Calculated β coefficients are as follows: in -0,058401 for the years 1995 – 2006, -0,041011 for the years 1995 – 2000, and -0,0149242 for the years 2000 – 2006. To draw the conclusions from the whole period, it can be alleged that β-convergence comprised 5,8 % annually, though in the period of 2000 – 2006 Lithuanian regional convergence slowed down significantly in comparison to the period of 1995 – 2000, when the overall economic performance of Lithuania was on the decline. The slower convergence may be explained by an increase in productivity and technology development

in the more evolved regions which allowed them to attract investment.

The σ-convergence analysis is based on econometric calculations. An unconditional convergence among all the regions was observed in the period of 1995 – 2006, which is precisely the reason for the analysis of σ-convergence, i.e. the analysis of the disparities of the measured GDP per employed person throughout the regions. By the same token, concrete regions grouped according to their strategies may be investigated. Such an analysis would reflect the rates of convergence in different regional groups.

2.2. Examples of the Evaluation of Differences in the Lithuanian Counties

The main source of data for the analysis of the Lithuanian regional economic condition is provided by the Department of Statistics to the Government of the Republic of Lithuania. Some of the very important indexes (i.e. GDP by counties) have been calculated since 1995 and annual data until the year 2006 is available. Meanwhile, other relevant data for the period until 2007 is available. Yet, in order to ensure the consistency of the research, the data of different periods (e. g. 1995- 2006) are analysed.

GDP is an index that reveals the economic level of a particular territory. For the present research the following definition of GDP is used: GDP is the total market value of all final goods and services produced in a country in a given year (e. g. equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports). The variation of GDP *per capita* within a particular territory for a period between 1995 and 2006 is presented in Figure 1.

Figure 1. The dispersion of GDP *per capita* by counties (Lith. *apskritis*) during the period of 1995 - 2006, in thousands of LTL (Source: data of the Department of Statistics of Lithuania)
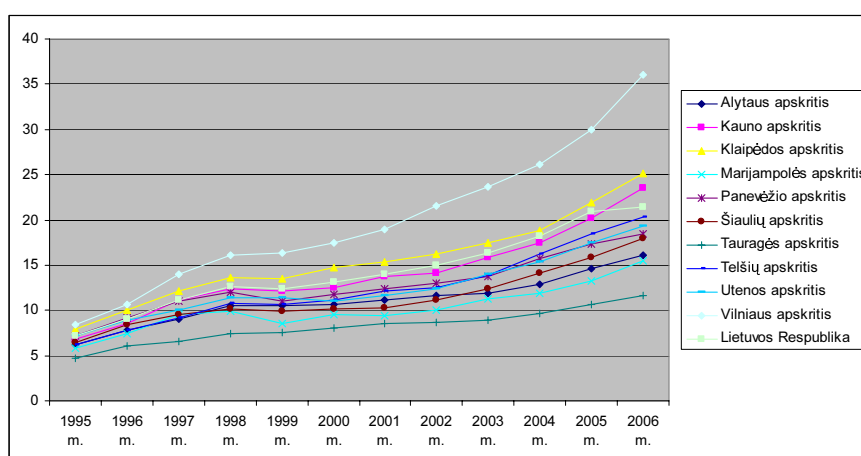
The highest GDP rates are observed in the counties of Vilnius and Klaipėda. GDP *per capita* in Kaunas County is very similar to the average GDP *per capita* in the Republic of Lithuania. It should be noted that the lowest GDP level is observed in the county of Tauragė. Only the counties of Vilnius, Klaipėda and Kaunas exceeded the average level of

GDP *per capita* in 2006 (68,2%, 17,7% and 9,8% respectively). GDP *per capita* in the counties of Tauragė and Marijampolė comprised less than 75% of the country's average, as a result, it could be claimed that these regions are the most lagging behind. This is depicted in Figure 2.
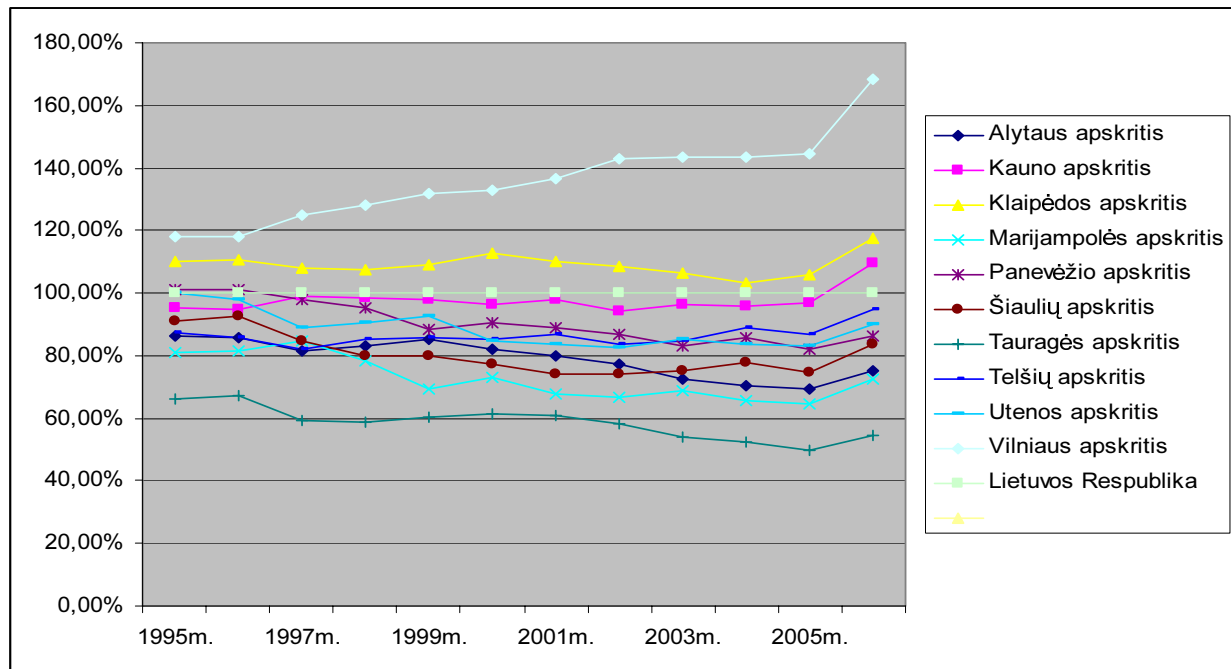
Figure 2. GDP *per capita* in comparison to the average (%) of the Republic of Lithuania (1995-2006)

Telšiai County is prominent for the most rapid growth of GDP *per capita* (excluding the three aforementioned rapidly growing regions). Namely, in the county located in central Lithuania an annual increase in GDP by 11,6% has been observed since 1995. However, such a growth was induced by the oil refinery of national importance; therefore, the evaluation seems more positive than it actually is in reality. In essence, the activity of the oil refinery encourages an increase in the level of economic development in Telšiai, but if the oil supply ceased, the results of economic performance would dramatically change. Therefore, the indexes of the Telšiai County should be greeted with caution.

GDP *per capita* is a combination of several components in which every single element is apt for an economic interpretation. In Table 1 the estimation of every single index is presented, where the benchmark is the newest average rate of GDP in Lithuania. It is obvious, that the divergence of the components of GDP *per capita* is widespread among the Lithuanian counties. The highest labour productivity (in comparison to the Lithuanian average) has been reached only in Vilnius County; the highest em-

ployment level is observed in the counties of Alytus, Marijampolė, Tauragė and Vilnius; the demographical factor is almost the same throughout the whole the country.

Table 1. Estimation of the components of GDP *per capita* in comparison to the Lithuanian average of the year 2006

Counties	GDP per employed person in comparison to the Lithuanian average, %	Level of employment in comparison to the Lithuanian average, %
Alytus County	75-100	>100
Kaunas County	75-100	75-100
Klaipėda County	>100	75-100
Marijampolė County	<75	>100
Panevėžys County	75-100	75-100
Šiauliai County	75-100	75-100
Tauragė County	<75	>100
Telšiai County	75-100	75-100
Utena County	75-100	75-100
Vilnius County	>100	>100
The Republic of Lithuania	100	100

The GDP *per capita* breakdown shows that its most important component is GDP per employed person. Generally speaking, competitiveness depends on productivity. At this point some conclusions may be drawn in order to understand why labour productivity is considered to be at the core of the competitiveness analysis. Concurrently, labour productivity, in its simplest expression, is an amount of resources necessary for the production of a certain unit. Thus, labour productivity is an important indicator of competitiveness but does not explain it. The distribution of labour productivity varies significantly throughout different counties in Lithuania. The counties of Vilnius and Klaipėda stand out due to their high productivity rate exceeding the national average, whereas, labour productivity rates in the counties of Alytus, Marijampolė and Tauragė are below 75% of the national average.

The growth of the general GDP *per capita* pertains to the growth of the components of GDP *per capita* within a certain period of time (i.e. the level of labour productivity, employment and demographical factor). The evaluation of the regional GDP *per capita* variations leads us to the conclusion that the growth of labour productivity and employment is positively correlated with the GDP *per capita*.

In the long-term perspective the level of employment adversely affected the counties of Kaunas and Panevėžys, meanwhile in the short-term perspective (2001-2006) it contributed to the growth of GDP in these counties. The decline in workforce (i.e. the demographical factor) had a negative influence on a number of counties (Kaunas, Klaipėda, Utena, Panevėžys, Telšiai). What is more, the demographical factor had a negative impact on Šiauliai County in the long-term perspective. In Table 2 the counties are arranged in a descending order based on the level of GDP *per capita*. Such a ranking allows to clearly distinguish the leading counties.

Table 2. The structural changes of the components of GDP *per capita* by counties, 1995 - 2006 and 2001 – 2006, %

Average annual shift, %	GDP per capita, LTL		GDP per employed person, LTL		Level of employment		Demographical factor	
	1995 – 2006	2001 – 2006	1995 – 2006	2001 – 2006	1995 – 2006	2001 – 2006	1995 – 2006	2001 – 2006
Vilnius County	14,5%	13,8%	14,5%	10,2%	0,1%	2,5%	-1,2%	0,3%
Kaunas County	12,0%	11,4%	12,1%	8,8%	-0,1%	1,2%	-1,2%	-1,1%
Telšiai County	11,6%	11,0%	11,4%	7,0%	0,2%	3%	-0,3%	-0,4%
Klaipėda County	11,3%	10,2%	12,2%	8,6%	0,1%	2,4%	-0,8%	-0,6%
Republic of Lithuania	10,6%	8,8%	12,2%	8,8%	0,1%	2,5%	0,4%	0,9%
Šiauliai County	9,9%	11,8%	10,6%	8,4%	0,2%	3,3%	-0,5%	0,4%
Utena County	9,5%	10,6%	9,8%	7,8%	0,1%	2,6%	-0,3%	-0,5%
Marijampolė County	9,4%	10,6%	10,4%	7,4%	0,4%	3,5%	0,7%	0,2%
Panevėžys County	9,4%	8,4%	11,2%	8,6%	-0,2%	1,6%	-1,8%	-2,1%
Alytus County	8,8%	7,2%	9,6%	5,4%	0,5%	4,4%	0,7%	0,1%
Tauragė County	8,7%	6,4%	8,0%	4,0%	0,9%	3,0%	1,1%	0,8%

While observing the data of two different periods (1995 – 2006; 2001 – 2006) and evaluating the structural changes of regional GDP per employed person in a given period of time and, it becomes apparent that in the general long-term period labour productivity increased more rapidly than in the recent years (2001-2006). It can be agreed that since 2001 the growth of labour productivity slackened. What is more, it should be born in mind that this element is one of the most important components of GDP *per capita* (the welfare measure) growth in the country. The differentiation is traceable in both short-term and long-term periods: the components of GDP *per capita*, such as labour productivity, em

ployment and demographical factor, vary in the degree of impact throughout the counties. In more dis advantaged areas labour productivity provides an explanation for a relatively low GDP *per capita* growth and, consequently, the levels of employment and demographical factor gain the upper hand in the situation (especially the ratio of employment and workforce and the ratio of workforce and population), which reveals the situation of the employed persons, the workforce and the whole population.

Figure 3 shows σ-convergence in Lithuania as well as in the regions with the highest and lowest GDP *per capita*.

Figure 3. Levels of σ–convergence during the period of 1995-2006 (Note: the leading regions are: Vilnius, Kaunas, Klaipėda, Šiauliai, Telšiai)
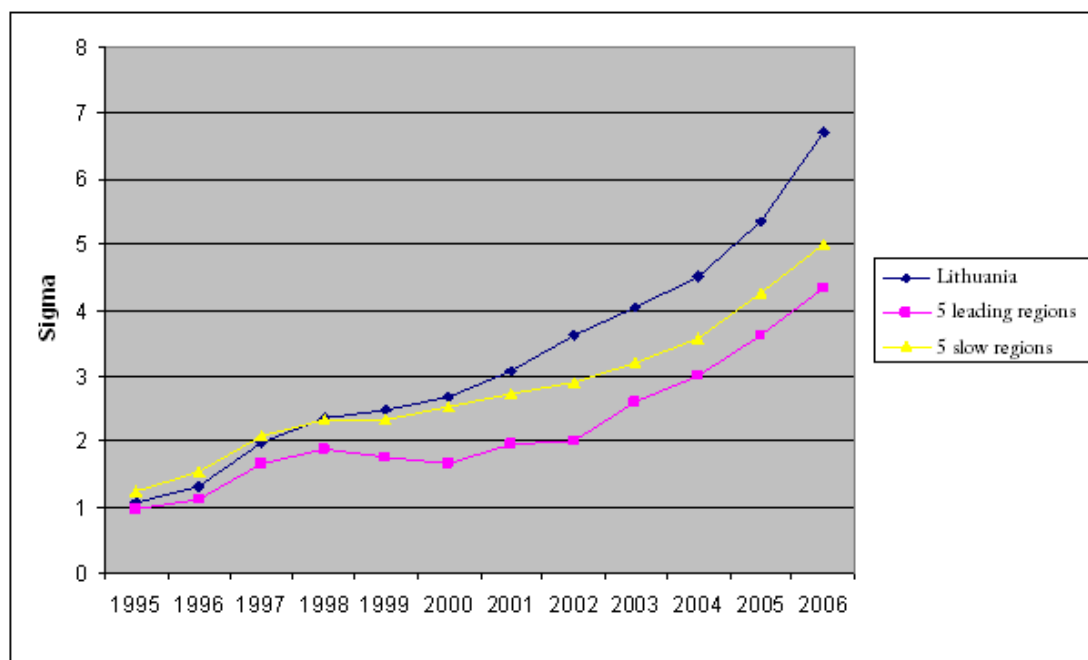
This research does not reveal σ-convergence in the context of the whole Lithuania, yet it proves the existence of the relation among the leading regions: in the leading regions a less widespread dispersion is observed in comparison to the regions lagging behind. However, in a given period of time σ-divergence is observed in both leading regions and regions lagging behind.

To conclude, noteworthy is the fact that even though in Lithuanian regions β-convergence was observed (i.e. the regions with the lowest GDP per employed person exceeded the national average), the presence of σ-divergence testifies the unabated gap among regions.

3. Factors of Regional Inequality in Labour Productivity

Often the GDP *per capita* is the most useful indicator to determine regional competitiveness, which, although not in its entirety, shows the average welfare of the regional population. In the following analysis, GDP has been broken down to its components, which is depicted in the equation (4)

(Ronald, 2002, p.36):

All the interpretations and their respective units are as follows (see the equation (4)):

• Labour productivity (GDP per employed person);

• Level of employment (the number of employed persons divided by the working-age population);

• Demographical factor (working-age population divided by the population at large).

The breakdown of the GDP *per capita* reflects the importance of two key components in the equation: GDP per employed person (which is almost the same as labour productivity) and overall working population in relation to the working-age population (i.e. the level of employment). Generally speaking, competitiveness depends on the levels of productivity and employment. At this point it becomes clear why productivity is at the core of the competitiveness analysis. By the same token, productivity, in its simplest meaning, is an amount of resources necessary to produce a certain unit. Therefore, productivity is the key indicator of competitiveness.

As it has already been established while discussing the divergence and convergence throughout

$$\frac{GDP}{Inhabitants} = \left(\frac{GDP}{Employment} \right) * \left(\frac{Employment}{Laybour\ Fource} \right) * \left(\frac{Laybour\ Fource}{Inhabitants} \right) \qquad (4)$$

Lithuanian regions, labour productivity plays the key role not only as the main component of GDP *per capita* but also as a stimulus for its growth. Consequently, the dependency of labour productivity on other factors will be investigated in this paper. According to the neoclassical growth theory, production depends on capital, workforce and the technology development in economics that can be characterized by the technological progress. All of the three factors have an effect on the function of production, whereas technology development is distinguished separately, as it is conditioned by capital and workforce. An econometric relationship between the three factors may be estimated (5):

$$Y = F(A, K, L) \tag{5}$$

Note: Y = Production; A = Technical efficiency or total factor productivity; K = Capital resources; L = Workforce.

This relationship may be embodied in Cobb-Douglas production function (6):

$$Y = A K^{\alpha} L^{\beta} \tag{6}$$

Note: α = capital elasticity parameter; β = workforce elasticity parameter; $\alpha + \beta = 1$.

When the technological progress increases gradually (in a constant growth rate), Cobb-Douglas production function is to be expanded by an additional variable, which represents technological progress. This is how the equation (7) is obtained:

$$Y = A e^{gt} K^{\alpha} L^{\beta} \tag{7}$$

Note: g = constant parameter of technological progress growth over time t.

When both hand sides of the equation are divided by workforce L and taken to the logarithm, the following equation (8) is produced:

$$\ln\left(\frac{Y}{L}\right) = \ln A + g * t + \alpha * \ln K + \beta * \ln L - \ln L . \tag{8}$$

Because $\alpha + \beta = 1$, if instead β we inserted $1 - \alpha$, contracted the similar members and settled right hand side of the equation, the following equation (9) would be produced:

$$\ln\left(\frac{Y}{L}\right) = \ln A + g * t + \alpha * \ln\left(\frac{K}{L}\right) . \tag{9}$$

If the variable of technological knowledge is added to the error of the model, the regression relationship between productivity per capital (or per employed person) and technological advance of every separate Lithuanian region and Lithuania in general is pronounced in the following equation (10):

$$\ln\left(\frac{Y_r^t}{L_r^t}\right) = \alpha * \ln\left(\frac{K_r^t}{L_r^t}\right) + g * t + \varepsilon_t ; \tag{10}$$

Note: $\dfrac{Y_r^t}{L_r^t}$ = vector, inclusive of regional work r productivity at a particular moment t;

$\dfrac{K_r^t}{L_r^t}$ = vector, inclusive of regional capital per employed person r at a particular moment t;

α = elasticity parameter of capital per employed;

g = constant parameter of technological progress growth;

t = period ranging from 0 to n;

ε_t = error of the model.

Regression models, constructed for every separate region and the whole country on the basis of this equation, would contribute to the determination of the dependence of work productivity on capital per employed person and on the factor of technological advance. If the derived relationships bore a meaning, the conclusion would be that increasing the capital and encouraging technological advance can help to augment regional productivity; what is more, the separate parameters would reveal their influence on the process.

Regression models derived from the equation (10) reflect the relationship between labour productivity and capital per employed person as well.

In this case study the sum of direct foreign and material investments is approximated to the material capital. Due to the fact that the analysis of material investments is based on diverse sources of data, a comparison with the previous annual data is not possible. Therefore, this paper is based only on the previous annual data. The Department of Statistics provides data regarding direct foreign investments in separate regions for the period 1996-2005; thus, the amount of information is restricted. The fluctuations of capital per employed person (1996-2005) are depicted in Figure 4. Apparently, the smallest investments were received by the counties of Tauragė, Marijampolė, Šiauliai and Alytus in 2004 and 2005. Thus, the regions lagging behind also receive the smallest share of capital *per capita*. The highest levels of investment are observed in the counties of Vilnius, Klaipėda and Telšiai. In 2005 the biggest share of capital *per capita* was observed in Telšiai County. The reason lies in the fact that in that year the level of direct foreign investment in Telšiai County was rather high (higher levels were observed only in the counties of Vilnius, Kaunas and Klaipėda), and the percentage of working population in this area was significantly lower. To summarize the analysis of the dispersion of capital per employed person in the Lithuanian counties, it can be claimed that the lion's share of investments is received by the leading regions, while the less developed regions attract less investment, consequently, this leads to the increasing gap between the counties.

Figure 4. Variation of capital *per capita* in the period 1996-2006 (in thousands LTL)
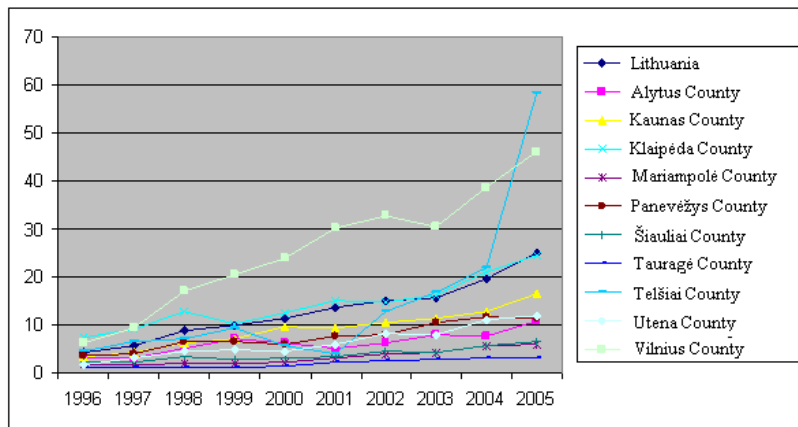
By using the above formula (10), regression relationship of productivity with capital and technological advance was obtained and adapted to the case study of the separate Lithuanian counties and the whole country (when regional data elements were embodied in the vectors). The results of the regression analysis are enlisted in Table 3.

Regression equations demonstrate how the labour productivity is affected by the change of capital per employed person and technological advance. Capital per employed person and labour productivity are expressed as a logarithm. The implication is that the capital coefficient indicates the percentage by which labour productivity would increase when capital per employed person augments by 1%.

Table 3. Results of the regression analysis of the data of the separate counties and the whole country (based on the 1995-2005 data)

Counties	Regression equations
Alytus County	$\log\left(\dfrac{BVP}{L}\right) = 9,08 + 0,29 * \log\left(\dfrac{K}{L}\right) + 0,03 * t$
Kaunas County	$\log\left(\dfrac{BVP}{L}\right) = 9,22 + 0,45 * \log\left(\dfrac{K}{L}\right) + 0,07 * t$
Klaipėda County	$\log\left(\dfrac{BVP}{L}\right) = 9,09 + 0,29 * \log\left(\dfrac{K}{L}\right) + 0,08 * t$
Marijampolė County	$\log\left(\dfrac{BVP}{L}\right) = 9,97 + 0,12 * \log\left(\dfrac{K}{L}\right) + 0,04 * t$
Panevėžys County	$\log\left(\dfrac{BVP}{L}\right) = 8,78 + 0,46 * \log\left(\dfrac{K}{L}\right) + 0,01 * t$
Šiauliai County	$\log\left(\dfrac{BVP}{L}\right) = 9,32 + 0,26 * \log\left(\dfrac{K}{L}\right) + 0,04 * t$
Tauragė County	$\log\left(\dfrac{BVP}{L}\right) = 9,44 + 0,1 * \log\left(\dfrac{K}{L}\right) + 0,03 * t$
Telšiai County	$\log\left(\dfrac{BVP}{L}\right) = 9,85 + 0,3 * \log\left(\dfrac{K}{L}\right) + 0,06 * t$
Utena County	$\log\left(\dfrac{BVP}{L}\right) = 9,56 + 0,1 * \log\left(\dfrac{K}{L}\right) + 0,06 * t$
Vilnius County	$\log\left(\dfrac{BVP}{L}\right) = 9,22 + 0,38 * \log\left(\dfrac{K}{L}\right) + 0,12 * t$
The Republic of Lithuania	$\log\left(\dfrac{BVP}{L}\right) = 9,54 + 0,15 * \log\left(\dfrac{K}{L}\right) + 0,05 * t$

The results of the research show that the augmentation of physical capital encourages the regional increase in productivity. Noticeably, the rise in the capital per employed person quite significantly influences the rise of labour productivity levels. The coefficients of the capital per employed person range from 0,10 to 0,45 in different counties. The analysis of the impact of capital per employed person (in per cent) on productivity brings us to the conclusion that the increase in capital per employed person mostly conditions labour productivity in the counties of Vilnius, Kaunas and Panevėžys. The most insignificant influence is traced in the counties of Telšiai, Tauragė and Utena.

What regards the impact of capital per employed person on labour productivity (in per cent), it could be said that the rise in capital has a significant positive effect on the growth of productivity levels in both leading regions and the regions lagging behind.

Technological advance is also significant for labour productivity; however, its impact is weaker in comparison to the impact of the capital per employed person. The coefficient ranges from 0,01 to 0,12. The calculated technical progress parameters show that annual growth of technical progress is, in fact, the highest in leading regions (Vilnius, Klaipeda, Kaunas) with higher agglomeration of economies and technological development. What is more, Lithuanian regional policy was proved to be relatively ineffective in raising technological progress growth.

To summarize the results of the regression analysis, it can be argued that the increase in capital positively and significantly affects productivity growth, regardless of whether the region is leading or lagging behind. Although the impact of technological advance on productivity is significantly lower than the impact of the capital per employed person, it still has a positive effect on the growth of productivity levels. The stimulation of the growth of these two indicators would allow to increase regional productivity.

Since technological progress is a significant indicator of increasing labour productivity, it is necessary to assess the factors that affect the growth of different parameters of technological progress. Once the technological advance has been evaluated, the exogenous variables (mainly factors of agglomeration economy) may be determined.

Conclusions

In the context of all counties, both employment and level of labour productivity have a relation to GDP *per capita*. This is mainly due to the fact that both indicators belong to the same cause of the economic growth, i.e. in more developed regions economies are more active, the levels of population activity are sufficiently high, and, consequently, these regions can be distinguished by their large workforce and remarkable labour productivity. Thus, labour productivity rather than employment occurs to be the key element of GDP. The increase in the number of labour market participants may have some influence in a short-term period, yet, even if migration is disregarded, there exists a natural limitation the continuance such an effect within a certain period of time. Hence, labour productivity stands out as the main component conditioning the growth of GDP *per capita*.

Remarks on the suitability of neoclassical theory to the case study of Lithuania: the regression dependency reflects a significant relationship between productivity and capital per employed person as well as the technological advance factor. Generally, productivity levels show a tendency to augment due to increases in both capital and technological development. Yet, the response to the changes of exogenous variables differs throughout the counties. Therefore, it should be born in mind that in order to raise regional productivity, both the encouragement of investments and the stimulation of technological advance should be taken into consideration. The technological advance strongly depends on human and physical capital, i.e. the numbers of the students of universities and other institutions of higher education as well as investments in academic research and development. Yet, in more comprehensive studies additional variables should be sought for in order to develop a more thorough understanding of the factors relevant to technological advance. Therefore, further investigations into the issue are necessary in order to reveal the influence of the increasing investments in academic research and development as well as the promotion of higher education.

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REGIONŲ NETOLYGAUS VYSTYMOSI VERTINIMO METODAS: LIETUVOS APSKRIČIŲ ANALIZĖ

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Santrauka. Regionų vystymosi procesus vertinantys rodikliai yra susiję su daugeliu tarpusavyje susijusių veiksnių. Norint tinkamai įvertinti regionų vystosi darnios ar nedarnios veiklos požymius, reikia nagrinėti tokius gana sudėtingus savo struktūra veiksnius kaip ekonominis augimas, užimtumo ir darbo vietų santykis, gerovės ir gyvenimo kokybės kaita, regiono gyventojų sveikatos būklės pokyčiai ir kita.

Norint rasti tinkamą regioninių skirtumų atpažinimo ir vertinimo sistemą, reikia spręsti gana sudėtingus rodiklių sąveikos, restruktūrizavimo ir plėtros procesų analizės uždavinius. Kadangi regioninio vystymosi procesų kaita nagrinėjamu laikotarpiu gana sparti, atsiranda nauji santykiai, kurie mus įpareigoja analizuoti veiksnius, darančius įtaką ir ekonominės krizės laikotarpiu. Nagrinėtina įtaka naujai atsirandančių santykių kaitai ir ekonominiam vystymuisi. Straipsnyje aptariami metodai, leidžiantys įvertinti regioninio vystymosi netolygumų mastą. Autoriai siūlo taikyti regionų vertinimo metodą, grindžiamą besivystančių regionų trijų lygių skirtumų lyginimo metodika. Šio metodo taikymo rezultatai pateikiami vertinant Lietuvos apskričių vystymosi procesus. Vertinant regionų plėtros procesus taikomos priemonės grindžiamos empiriniais ir dinaminiais daugiakriteriais statistiniais komponentais. Vystymosi netolygumai yra atpažįstami iš statistinių duomenų įvertinimų, taikant tam tikrus ekonometrinius metodus. Analizuojami pajamų, tenkančių vienam gyventojui, pokyčiai, jų struktūra, darbo našumo ir užimtumo lygis. Siūlomas metodas, naudojant Lietuvos regionų statistinius duomenis ir pajamų augimo, darbo našumo atotrūkio didėjimo, techninės pažangos rodiklius leidžia vertinti regionų vystymosi netolygumo lygį. Straipsnyje apžvelgiami užsienio investicijų, kapitalo pritraukimo faktoriai, darbo santykį, darbo našumą analizuojantys ekonometriniai modeliai. Gauti vertinimo rezultatai parodo pirmaujančių ir atsiliekančių regionų techninės pažangos skirtumus.

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INSTITUCINĖS APŽVALGOS
INSTITUTIONAL REVIEWS

PROBLEMS OF THE ADOPTION OF THE EURO IN LITHUANIA

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Abstract. The paper analyzes the possible consequences for Lithuania and other Eastern European countries after joining the European Monetary Union and adopting the single currency, i.e. the euro. The international importance of the euro, the advantages and disadvantages of the single currency are discussed. The experience of Slovenia and Germany is analyzed. The investigation has shown that the adoption of the euro did not have a considerable influence on the price level in Germany. Actually, the adoption of the euro caused a rise in some prices to a certain degree but this influence was insignificant. Due to the proper means applied, Slovenia also avoided a sharp jump in prices after the national currency was replaced by the euro. However, due to psychological factors the concerns about the increase in the prices after the adoption of the euro may become exaggerated. The strategy of the adoption of the euro in Lithuania is discussed with regard to the experience of other countries.

Introduction

The adoption of the euro and joining the European Monetary Union (EMU) still remains one of the most important tasks of economic policy in Lithuania. It has been anticipated that Lithuania and Slovenia should have become euro zone countries since 1 January 2007. However, by that moment the inflation rate in Lithuania slightly exceeded the set limit (0.1 %), and Slovenia alone joined the EMU. The situation in Lithuania in 2007 proved that the decision of the European Central Bank (ECB) was grounded, since Lithuania failed to meet the requirements regarding economic stability. Thus, the adoption of the euro in Lithuania was postponed. In order to select the proper strategy for the integration into the EMU, it is important to consider the advantages and disadvantages of a single currency as well as the economic potentiality of the country and to analyse the

experience of the countries that successfully joined the EMU. Since the experience of the functioning of the EMU in Europe is not so rich, more discussions on this point are expected in the future. The ways the adoption of a single currency can affect country's economy have not been much investigated in Lithuania, though this problem gets sufficient attention abroad. From foreign authors Benjamin (2007), Duisenberg (2002), Galatis, Tsatsaronis (2003), Gaspar (2004), Greenspan (2001), Hartman et al. (2003), Rose (2001), Shalder (2005), and others are worth mentioning. In Lithuania these problems are widely investigated only by Kropas and Kropienė (2005).

The purpose of the present article is to discuss the process of the adoption of the euro in Lithuania. The main task is to investigate the possibilities to adopt the euro in Lithuania with reference to the experience of other countries that successfully joined the EMU. Methods of the present research include

systemic analysis of scientific literature and the analysis and generalization of statistical data.

1. The Main Historical Moments in the Foundation of the European Monetary Union

The European integration process, the result of which is the foundation of the European Union (EU), is one of the most politically and economically significant processes in the entire history of Europe. Considering economic aspects, the establishment of the EMU was the most important task after the establishment of the EU. As early as in 1956 the idea of the establishment of the EMU was already discussed in the negotiations on the Rome treaty, and the monetary union formation plan was approved by the Maastricht treaty, signed on 7 February 1992. Two main moments in the process of the creation of the EMU should be mentioned. The first is the Werner's report in which he suggested creating this union until 1980, referring to the currency system consisting of the currency basket (ecu) and the exchange rate mechanism. The second is the Delors report, the main focus of which is on the plan for creating the EMU defined by the Maastricht treaty.

Formally, the Economic and Monetary Union has been existing since 1 January 1999, and the euro as a currency started functioning in the twelve states of the EU in 1 January 2002. The introduction of the euro ended the currency integration process which had lasted for 50 years. The euro became the key axis of integration. In the context of the international monetary system, the formation of the EMU is perhaps the most important event since the failure of the world monetary system that functioned on the basis of the Bretton Woods treaty. The first year of the functioning of the euro has shown that the single currency stabilized the fluctuation of interest, price, and exchange rates in a complicated environment of economic globalization. Noteworthy is the fact that the functioning of the EMU is based on new ideas: in the monetary policy of the EMU preference is given not to the stimulation of economic growth by the classical monetary policy means, but to the guarantee of long-lasting price stability.

In comparison to other monetary unions, the Euro project is an event of particular importance in the monetary history. Never before did a group of independent states refuse their national currency and, concurrently, retain political independence. This fact determines quite a new combination of macroeconomic policies, based on general values and following the subsidizing principles. A policy based only on national interests can be neither productive, nor stable enough. A policy based on a single currency has an effect on all the spheres of economics: the allocation of resources and revenues, the economic growth, as well as the labour, product, service, and finance markets. The adoption of the euro is significant not only in economic and political but also in psychological terms. National currency is an important symbol of national sovereignty. A voluntary change of national currency into the euro indicates the strengthening of the general European identity.

When on 1 January 2007 Lithuania was expected to join the EMU, the euro zone already consisted of 12 EU member states. In the same year Slovenia and later on Cyprus together with Malta and Slovakia joined the EMU; today it unites 16 EU member states.

2. International Role of the Euro

The introduction of the euro on 1 January 1999 was of great significance not only to the EU, but also to all the states in the world. Having replaced the national currencies of most EU member states, the euro was continuously gaining strength and, eventually, became one of the most important international currencies in the world. At present, the euro can be regarded as the second world currency, successfully competing with the U.S. dollar. The role of the euro as the basic and reserve currency is also increasing (The international role of the Euro, 2007). The euro being the basic currency, a wide spectrum of currency regimes is possible. One way or another, about 30 non-euro-zone states have pegged their currencies to the euro, though they make up a rather small part of the general gross world product (Benjamin, 2007). Some countries use the euro as the local currency (e.g. territories under the jurisdiction of France), currencies of other countries are pegged to the euro (e.g. Lithuania), yet another group of countries linked their national currencies to a currency basket, one component of which is the euro or its national denomination (e.g. Hungary, Ireland). One more group of countries (the Czech Republic, Poland, Slovakia) keeps to the policy of the controlled exchange rate. Thus, one of the outcomes of the establishment of the EMU is the internationalization of the euro. An obstacle for a more rapid spread of the euro is the so-called "snitching cots", i.e., the consumption of time and money for the transition to another currency.

The introduction of the euro was a powerful stimulus for the development of financial markets. During the first three years since the introduction of the euro, the financial turnover in the euro zone countries has grown more than twice in comparison to that of the national currencies. The single currency made it possible to optimally distribute the capital in the euro zone. Due to this, more participants could make use of a larger number of financial means, because in smaller states with different currencies there is no possibility to form the sufficient critical mass of using certain financial means.

Though the U.S. dollar remains the principal investment currency, its significance is declining, while that of the euro is increasing. The percentage of bonds and money market funds denominated in euro has grown from 18% in 1998 to 31% in 2004 in the international market, while the percentage of those denominated in U.S. dollars has decreased from 48% to 42% (Hartman, 2003). The Eurobond market is one of the target ones in the world. According to the data of banks, what regards international settlements, bonds issued in euros in 2004 made up 48% of all international bonds, while bonds issued in U.S. dollars comprised 34%. Bond markets of the EU and the U.S. governments are similar, but the bond market of the corporations of the latter is much larger. The main aspects that determine the international attractiveness of the euro as an investment currency are as follows: the integrated, so-called "deep" market in which a large amount of financial means can be purchased and sold without any influence on their price; a developed secondary market; a great variety of financial means; a high degree of market liquidity. After the adoption of the euro, the risk of exchange rate has disappeared and competition increased; this stimulates further integration of financial markets and increases their efficiency.

In recent years, the tendencies of integration and competition in international financial markets have been observed, because the world finance centers were competing for influence in international financial markets. The EMU and the euro precondition the strengthening of the positions of the EU as an international canter of finance in comparison with the U.S. and Japan. The adoption of the euro also had an effect on the domestic financial market of the EMU (Galati, 2003). After the introduction of the single currency, transactions in national currencies have disappeared in the states belonging to the EMU; so did the necessity of transactions for insuring against the exchange rate risk. Thus, the euro integrated and consolidated financial markets of the EMU states. The effect of the adoption of the euro

on financial markets is much stronger and faster than on the other fields of economy (Gaspar, 2004; 2003).

After the adoption of the euro, the fastest changes took place in the markets of short-term financial means, i.e. money. The euro stimulated the integration of the money market and the technological progress of settlements. As a consequence, there are no great differences in interest rates. The integration of long-term financial means markets required more time. Naturally, there also were some changes in the markets of shares and bonds; however, the changes were not as fast as in the exchange markets. The influence of a single currency on Eurobond markets manifests itself in three ways:

1) it expands these markets and increases their liquidity;

2) it invokes structural changes in the market, and

3) it transforms the state loan market.

There is no more currency risk in the euro zone; therefore, investors can pay more attention to the loan risk and its evaluation. The wider and more liquid market of Eurobonds becomes more and more attractive to investors even beyond the borders of the euro zone. The former national markets were small, non-liquid and, therefore, unattractive for large international investments. The effect of the euro on stock markets is weaker than on other segments of the financial market: the experience shows that issuers concentrate issues in the national markets that frequently become most liquid. Selection of a market is determined not so much by a currency as by other factors, e.g. geographical spread of the issuer's activity. The removal of currency risks has not essentially changed the relations among the issuers and their national markets. The adoption of the euro determined structural changes in the European markets of derived financial means and their expansion. The euro has a double effect on the markets of derived financial means. Firstly, the single currency diminished the variety of derived means, since some kinds of transactions have disappeared. On the other hand, due a decrease in the number of transactions, the competition between the EU derived financial means intensifies.

The adoption of the euro also invoked changes in the international monetary system stimulating currency integration in other regions of the world. The euro became the second currency in the world according to the size of the economies in which it is used as well as the size and liquidity of capital markets (Greenspan, 2001).

3. Influence of the Euro on the Economic Processes in the World

The adoption of the euro was very significant not only for the EU countries but also for all the countries in the world. One of the major advantages for countries joining the EMU is a positive effect of trade expansion, i.e. the so-called Rose effect (Rose, 2001). Andrew Rose has defined that trade flows between pair-countries that belong to a monetary union are on the average 100% greater than among the EU countries not belonging to a monetary union. It is also important that trade expansion does not take place at the expense of trading with other countries, i.e. it does not diminish the trade volumes. Empirical data of the EU also support the conclusions of these investigations. After establishing the EMU, its internal trade volume increased by about 10% in comparison with other EU member states. This effect is supposed to continue for as least 20 years, and the trade volume may increase by about 60%. Noteworthy is the fact that trade growth stimulates economic growth. It has been established that a trade increase by 1% determines an increase in the country's gross domestic product by 0.33 %. As estimated by the international currency fund, the adoption of the euro in the EU will determine the increase in the gross domestic product of up to 20 - 25% in the pending 20 years (Shalder, 2005).

By eliminating the exchange rate indetermination, the single currency diminishes risk and, thereby, determines a lower rate of real interest. The decreasing rate of interest, in its turn, stimulates economic growth. After the adoption of the euro, there is no expenditure related to the exchange rates between the euro and the national currency. This factor also influences the size of the gross domestic product. In the opinion of the Commission, the elimination of transactions costs may increase the EU gross domestic product by 0,25% - 0,5 %. Such an increase is not so little; what is more, this is not the only effect. The advantage of joining the euro zone is not one-sided. Positive impacts are experienced not only by the new EMU countries, but also by the countries in the entire euro zone. However, for the euro zone countries the advantages are greater. The use of the integration into the euro zone manifests itself via trade expansion, via the integration of the finance sector, and via the growth of the international role of the euro. It must be stressed that the integration into the euro zone provides superiority to a country, i.e. an opportunity to actively represent own economic interests by participating in the EU economic decision-making. It is the countries belonging to the euro zone that govern the principal economic decisions. The remaining EU countries have little possibilities to influence these decisions.

One of the arguments against the adoption of the euro is based on the Balassa-Samuelson effect: the growth of productivity in open sectors is more rapid than in the closed ones, since the former attract more foreign investments receptive to technologies. Increasing wages and salaries due to the growth of productivity enforce the growth in closed sectors too. In order to maintain the profit obtained, the prices in closed sectors must be increased. Thus, the Balassa-Samuelson effect means the growth of inflation within a country. As estimated by the International Monetary Fund, the Balassa-Samuelson effect can increase inflation by 1% – 2 % in the EU states, if they participate in the second exchange rate mechanism (Shalder, 2005).

The countries that pursue the classical monetary policy lose this independent economic policy means after joining the EMU. The Central European Bank pursues the monetary policy with regard to the situation of the entire euro zone without stressing the particularities of separate countries. Therefore, the common monetary policy can be regarded optimal in respect of separate countries. However, such deviations should not be considerable because the common EU internal market, free movement of communities, services, and capital also stipulate the common economic tendencies in all the countries of the EMU. This argument does not apply to those countries in which the monetary board model is applied or the currencies of which are pegged to the euro. These countries have no real monetary policy leverages; therefore, in this respect an entry into the EMU would not invoke any negative consequences.

The countries in which the monetary board model is applied acquire certain advantages in the convergence process, since the requirements for the exchange rate stability are realized automatically. However, the Board of Directors of the Central European Bank has declared an official opinion that the Board of Directors is not a substitute for the participation in the 2nd exchange rate mechanism (Duisenberg, 2002). On the other hand, in the opinion of many experts, the monetary board of directors and the obligatory two year participation in the 2nd exchange rate mechanism is the best exchange rate policy (Gulde, 2000; International Monetary Fund, 2004). It is of interest to note that the investigation performed by the experts of the International Monetary Fund has shown that economies of the countries with monetary management were growing much faster than the economies of other candidate-

member countries (Ghosh, 1999). Consequently, the mode of monetary management is a factor stimulating the convergence process.

If the majority of the countries of Eastern Europe were accepted to EMU today, they would not avoid of the price "shock", i.e. a fair jump in prices. Even the most developed Western and Eastern countries, e.g. Germany, have not avoided a certain increase in prices, though it was not considerable. The higher is the increase in prices, the lower are the economic indices (in comparison to the average indices of the majority of the developed countries). This rule especially applies to the level of prices and wages (salaries). The countries seeking to join the EMU must participate in the 2nd exchange rate mechanism at least for 2 years, under the requirements of the Maastricht treaty. It is possible to prolong the period; however, the experts agree that it is not reasonable since that can cause certain tension and impede an efficient activity of the monetary union. That is why the most reasonable solution is to join the 2nd exchange rate mechanism when a high degree of convergence is reached and the economic indices reach the EU average.

Psychological factors are also of utmost importance for the adoption of the euro. Just like the national anthem or a flag, the national currency is perhaps the most vivid indication of sovereignty. Loss of a right to issue the national currency can cause a negative attitude of the population to the adoption of the euro. In many cases, however, such an attitude is merely a psychological factor without any economic grounds, e.g. if the national currency is not so strong, its rate is unstable, or it is pegged to the currency of another country.

In summary, we can affirm that, in the terms of economics, the adoption of the euro undoubtedly causes more positive than negative effects.

4. Generalization of the Experience of the Countries that Successfully Joined the EMU

The experience of the countries that successfully joined the EMU is rather important to the countries of Eastern Europe seeking to join this union. The EU states that are not yet members of the EMU do not consider whether to adopt the euro or not, because,

subject to the Maastricht treaty, they undertake the obligation to become the members of the monetary union. On the other hand, introduction of the single currency would give these countries more advantages than disadvantages. It is important, however, to select the proper strategy for the convergence process.

An analysis of the experience of Germany can provide answers to some questions regarding the selection of the convergence strategy. Despite the fact that Germany is one of the most powerful European states, having a strong economy, fears regarding the adoption of the euro were not avoided. Most people expected an abrupt rise in prices, though economically such fears were not grounded. In fact, statistical data indicated a certain rise in prices after the adoption of the euro in Germany, but it was not as large as perceived by the mass media and the residents themselves. Besides, the rise in prices was conditioned by other factors not related with the adoption of the euro. The Federal Statistical Office of Germany has conducted an analysis and concluded that the adoption of the euro influenced the prices of several services and commodities; however, no notable influence on the common price index of users was observed. According to the data of the Federal Statistical Office of Germany (Fig. 1), the price level after the adoption of the euro has increased.

1. Fig. The dynamics of the price level in Germany (%) during 1996 - 2008
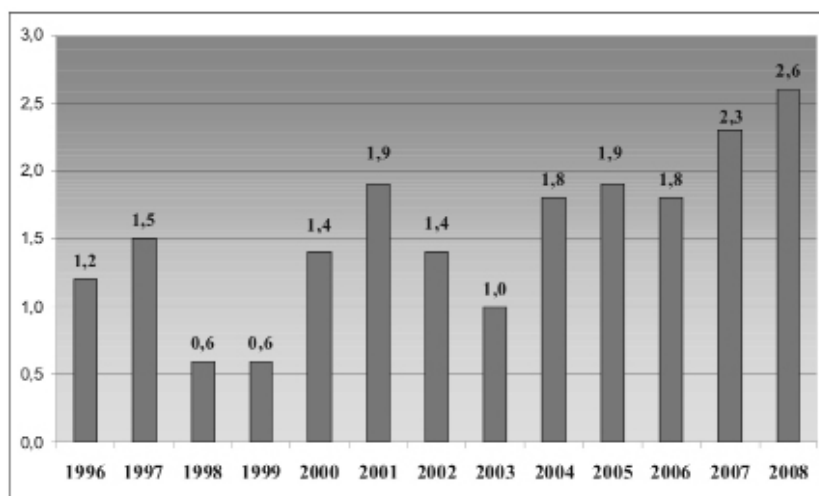
Source: http://www.destatis.de

In the period of 2002 – 2006 the highest inflation level was 1.9% (except for 2007), i.e. it did not exceed the limit set by the Central European Bank. The results of the investigation led to the following conclusions:

rounding up of prices when replacing marks by the euro has raised the price level to some extent;

the price of several goods and services, e.g. tickets to cinema theatres, chocolate, engine oil, services of hairdressing and chemical cleaning, has grown considerably;

on the other hand, the prices of some long-lasting goods (television sets, cameras) or some foodstuff (coffee beans, milk, butter) significantly decreased.

The analysis made by the Deutsche Bundesbank has shown that in two years after the adoption of the euro the price rise was stopped; however, a variety of prices increased considerably (http://www.bundes-bank.de).

Other factors, not related to the adoption of the euro, were much more significant. These are: reform of ecological tax in 2002 – 2004, health care reform in 2004 that conditioned the general rise in prices of services, increasing taxes for tobacco products. All these factors influenced the general increase of the price index. However, the greatest impact on the inflation level was made by the growth in fuel prices (gas, electricity, heating); fuel prices increased by 25% – 30% in the period 2002 – 2006. In 2007 and 2008 the price jump was determined by a further rise in the price for energy products and food. According to the Federal Statistical Office of Germany, common index of consumers' price increased by more than 10 % during this period (Fig. 2).

Psychological issues also must be considered in estimating the adoption of the euro as a factor of price rising. People subjectively estimate information on a certain economic phenomenon, and that estimation not necessarily corresponds to facts. Users tend to notice and stress price growth rather than price fall or its stability. It has been observed that even after 3 - 4 years since the adoption of the euro in Germany, people are still comparing prices in euros with the former prices in German marks. With regard to such a situation, the Federal Statistical Office of Germany decided to follow the honesty principle, i.e. to objectively inform the society about the changes in the price index, inflation level, etc. This strategy of communication proved to be effective and has been accepted in the international arena.

Slovenia was the first among the new EU members to adopt the euro and in 1 January 2007 it became the 13th member of the EMU. Lithuania also planned to join the EMU together with Slovenia; however, due to the inflation level that exceeded the set limit (only by 0,1%) such plans had to be postponed. Slovenia prepared to this event with great responsibility by considering the experience of other countries. First of all, in comparison to other Eastern Europe countries, economic indices in Slovenia have closely approached the European level; this ensured a smooth entry into the euro zone without any major economic shocks. Since March 2006, double price marking, i.e. in euros and in the national currency, has been introduced in Slovenia. The working people were informed about their wages and salaries in euros. An intensive society information campaign was carried out. About 500 enterprises signed a covenant not to raise prices. After 1 January 2007, the Consumer Association of Slovenia started blacklisting tradesmen and service providers. These blacklists included subjects who raised prices of commodities or services by more than by 6%. The society actively joined this campaign and their reports were an important additional source of information. All these measures made it possible for Slovenia to avoid a greater jump in prices after the adoption of the euro.

2. Fig. Growth of the consumers' price index in Germany (%) during 1991-2008
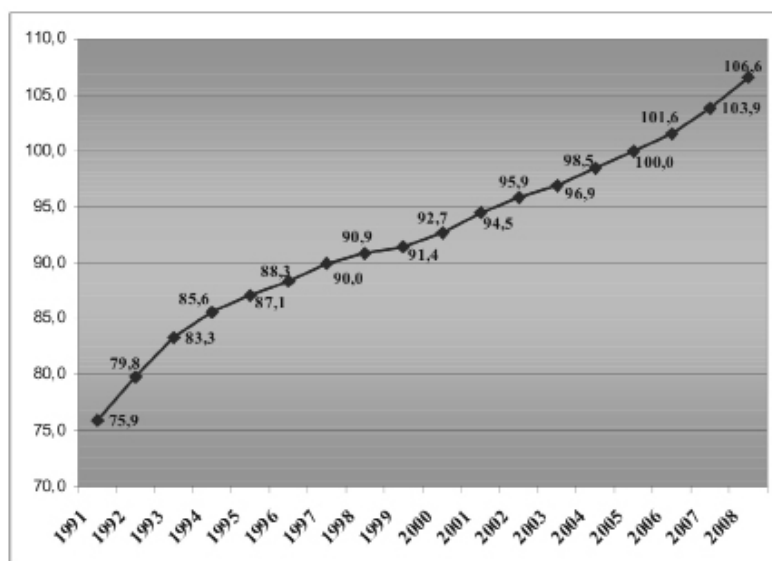
Source: http://www.destatis.de

4. The Principles of the Strategy of the Adoption of the Euro in Lithuania

The experience of the euro zone countries showed that an increase in prices for goods and services is probable in the initial stage of the process of the adoption of the euro due to possible attempts of businessmen and pro-

duction suppliers to round up prices in their favour. Such a situation is possible in Lithuania, as the litas is associated with the euro at 3.4528 to 1. It is very important to properly evaluate and prevent such a threat when the process of the adoption of the euro starts. The key role should be played by the Consumers Association and citizens, whose activeness and concernment are very important.

The Commission for the Coordination of the Adoption of the Euro in the Republic of Lithuania (the Commission) was formed in accordance with the Government Resolution No. 592 of 30 May 2005. The task of the Commission is to ensure proper adoption of the euro in Lithuania. Seven working groups have been set up to reach this task; the responsibilities of the groups included the preparation of the National Changeover Plan (The Plan) and proper familiarization of public with the Lithuania's Public Information and Communication Strategy for the Adoption of the Euro (the Strategy). The Plan and the Strategy started to be implemented on 25 April 2007. The aim indicated in the Plan is to establish the major elements of the changeover in Lithuania, to foresee the necessary measures for the protection of consumer interests, to ensure a smooth changeover process and public awareness. Working groups responsible for the preparation of the Plan consisted of the institutions of the Government of the Republic of Lithuania, the Bank of Lithuania and representatives from consumers', employers' and business associations assigned for the research of different issues related to the adoption of the euro in Lithuania. It is stated in the general provisions of the Plan that it establishes major elements and principles of the adoption of the euro and preparation for the changeover; responsibilities of separate sectors and necessary measures ensuring the protection of consumer interests are also indicated in the general provisions of the Plan. The Plan establishes the key elements of the adoption of the euro, its scenario and timetable. The plan also covers legal and institutional frameworks, rules for exchange and conversion of the litas into the euro together with the measures to be implemented in different sectors.

The Strategy uses the following principles as the basis of the changeover in Lithuania. Continuation principle means that all transactions with references to the litas will be further valid after the exchange of the litas into the euro. A value in litas will mean a value converted into the euro according to the irrevocably fixed conversion rate between the euro and the litas. Another principle is the protection of the consumers' interests which means that all possible measures will be taken in order to avoid abuse in recasting prices, wage, pensions, social payouts, etc. during the changeover process. The expenditure of the economic entities related to the preparation and adoption of the euro will be not reimbursed. The total costs of preparation for the changeover, i.e. for minting of euro coins, exchanging of litas banknotes and coins into euro banknotes and coins, restructuring of payment systems, etc. will be financed from the funds of the Bank of Lithuania. The expenditure of the Government institutions related to the adoption of the euro will be covered by the general assignations of the institutions.

The major aim of the Strategy is to ensure public awareness regarding the processes of the adoption of the euro and the consequent factors. The information about the impact of the single currency on national economy, principles of conversion of accounts, balances and social payouts from litas into euro, nominal of the euro banknotes, banknote security features and other changeover conditions will be provided by the institutions interested. The provided information should be sufficient and should properly and timely prepare the society for the changeover. Thus, the strategy of the adoption of the euro in Lithuania was developed taking into account the practices of the euro zone countries.

Conclusions

With reference to the results of the present analysis, the following conclusions can be made.

A single currency contributes to the stabilization of the economy. During the period of economic instability the euro plays the role of the financial anchor to the countries of the EMU. Today's economic processes show that the countries of the EMU are less influenced by the economic downturn and are the first to emerge from it. The reason for this is not only their general economic strength but also the stabilizing role of the euro. What is more, a single currency would be very contributory to the countries of Eastern Europe including Lithuania emerging from the economic downturn.

The statistical analysis of the price level dynamics in Germany shows that the adoption of the euro did not have a significant effect on the prices. Though this conclusion is not applicable to the countries with a weaker economy; price shock is inevitable for them due to the existing conditions for the adoption of the euro. Thus, the Maastricht criteria set out for the candidate countries are absolutely fair as by meeting it candidate countries would increase their economic index to the European level and smoothly integrate into the euro zone.

The Lithuanian currency board model could be considered as an advantage in this case, as it automatically meets one of the Maastricht's criteria: the stability of the national currency in relation with the euro. Joining the euro zone is seen as one of today's major tasks for Lithuania; therefore, it is expected that the present currency board model will not be rejected before joining the EMU. Consequently, this means that the litas will not be devaluated even though opposite opinions on this issue also exist.

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EURO ĮVEDIMO PROBLEMOS LIETUVOJE

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Straipsnio tikslas – įvertinti galimus euro įvedimo Lietuvoje padarinius bei išnagrinėti būtinas priemones eurui įvesti, įvertinus užsienio šalių, sėkmingai įsivedusių eurą, patirtį. Straipsnyje aptariama euro reikšmė tarptautinių finansų rinkų plėtotei bei bendros valiutos pranašumai ir trūkumai. Nagrinėjama Vokietijos ir Slovėnijos patirtis įsivedant eurą. Remiantis statistikos duomenimis analizuojama kainų lygio dinamika Vokietijoje, nustatant įvairių veiksnių įtaką infliacijos augimui, tarp jų ir euro įvedimo įtaką kainų lygiui. Aptariama Lietuvos strategija įsivedant eurą.

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THE ANATOMY OF A GLOBAL FINANCIAL CRISIS

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Abstract. The article deals with the fundamental reasons of the formation of global crises as well as their consequences. In spite of different economic and social conditions under which crises occurred during various periods of history, particular features common to all crises are revealed. The situation of Lithuania in the context of the global crisis is discussed. Social inequality and the absence of moral-ethical values are considered as factors determining the occurrence of the global crisis of today. The measures to overcome the crisis suggested by the European Union are discussed. Two major points in the process of dealing with the financial crisis are emphasized in the European action plan: the first one is restructuring the banking system and the real sector; the second point emphasizes the importance of joint actions of the 27 Member States of the EU.

Introduction

All over the world economic and financial analysts, politicians, publicists, experts and government representatives investigate the reasons for the global financial crisis, which began in 2008 and transformed into an overall economic crisis.

Widely known world economists approach the situation differently. Some of them cannot find reasonable explanations for its occurrence and claim that an impossible thing happened. However, they still believe in the strong power of market self-regulation (A. Greenspan, M. Friedman, L. Balcerowicz) and expect that the market itself will balance the situation in the future. On the contrary, the other panel of economists (J. Stiglitz, G. Soros, L.Thurow, K. Schwab, J. Sacks) treat the current case as a failure of the neo-liberalism doctrine and the monetary economic model.

However, it is clear that the world market as the most effective means of allocation of resources cannot properly regulate itself. It must be subject to supra-national and national adjustment and constant-

ly kept under control. As a consequence, a question arises: how and to what extent?

In order to find an answer, it is crucial to understand the reasons for the crisis.

1. Fundamental Causes of the World Economic Crisis

There are a number of articles by various academics and analysts providing different judgment on the reasons for the current crisis as well as its character and factors. However, in general, two groups of factors that influenced the financial crisis are distinguished. Firstly, there are structural factors which allowed the crisis to develop and spread by creating favourable conditions, and secondly, there are cyclic factors which have, in fact, caused the crisis.

Structural factors are the following[1]:
- a considerable growth of the role of capital markets (non-bank financial institutions) in the financial intermediary activity and a growing complexity of financial markets;
- enhancing uncertainty of the financial markets;
- intensity of the globalisation process;
- inadequate quantitative methods of risk evaluation employed in decision-making;
- the surplus of savings in a number of countries (particularly in China) as well as the redistribution of assets and income to the exporters of consumer goods;
- over-reliance on the success of the market self-regulation mechanism;
- excessive use of new and complex financial instruments; it transferred all the possible risks to the international level and reduced the transparency of the markets [2].
- and the most significant - inadequate and old-fashioned structure of the world finance supervision and regulation due to which the volume of the general loan and credit risk has sharply increased;

Cycle factors involve[3]:
- too low interest rates for non-risky assets in the course of all the periods of the leading world economies (the U.S., the European Union, Japan). Yet, a higher U.S. interest rate could have reduced fund supply for real estate credits; however, it must have been foreseen. Furthermore, after the first signs of the crisis the increase of the interest rate would have worsened the situation and the state economy would have been depressed;
- insupportably low margin of the credit risk for all the instruments;
- the bank system being under a low level of regulation and poor supervision. This credit structure is developing, dynamic and constantly introducing new derivative investment products of high complexity. The risk of these products must be estimated as well as a constant control over new instruments and institutions distributing them must be kept.

In our opinion, **three fundamental groups of the reasons** for the global crisis could be distinguished.

The first is the cyclic development of the world economy and the national economies of the developed countries as well as the increasing synchronicity of these processes in the major world economic centres such as the U.S., the EU and Japan. It is evident that globalization processes shorten the cycle as well as the duration of the phases of the global economic boom and stability.

The first indications of the current crisis of the global economy appeared in 2001 after a sharp fall in fund exchange indexes. Namely, this period is considered to be the end of the economy boom which is linked to the receptive global computer and communication market, including the mobile phones market. In 2001 a stormy growth in the mentioned markets stopped and the economic boost turned into the phase of decline. On the eve of economic recession, central banks of various countries in the world started applying the classical means to maintain economic activity, i.e. reduction of the interest rates. In addition, fund supply was increased. If by that time the global economy had experienced a recession of an average duration cycle, these means would probably have been sufficient to stimulate the economic growth. However, under the circumstances of a long-term decline of technological development, the "cheap money" policy fostered the appearance of speculative soap bubbles in stock and real estate markets as well as the increase in the volume of fictitious and speculative capital.

The second is the emerged global financial system which does not meet the modern requirements and conform to the present realia; further-

1   Daianu D.; Lungu L. (2008). *Why is this financial crisis occurring? How to respond to it?* ALDE conference material, [accessed on: 15-01-09]. Available from: http://www.alde.eu.

2   McCreevy, C. (2008). ALDE conference material, [accessed on: 07-01-09]. Available from: http://www.alde.eu.

3   Daianu D.; Lungu L. (2008). *Why is this financial crisis occurring? How to respond to it?* ALDE conference material, [accessed on: 15-01-09]. Available from: http://www.alde.eu.

more, it is unable to self-regulate. Globalization is one of the most complex phenomena of the global economy and is little investigated as a finance innovation. Presently, the negative aspects of globalisation are quite obvious. Globalisation relies on a single prevailing currency, i.e. the U.S. dollar. It is archaic as it ignores even the most cardinal changes in the financial sphere; it is neither able to prevent the rising finance disproportions and asymmetry nor manage the constantly rising risk of speculative (virtual) operations. The existing financial system is considered to be faulty as the extent of financial processes is inconsistent with the usage of economic resources.

Basically, these processes stimulate the formation of the policy of a global monopoly and do not promote competition in the sphere of financial capital. In other words, dependence on a single dominant currency is a threat to the entire global economy. The U.S. exports dollars worldwide and imports capital. The dollar emission is unlimited. During the World Economic Forum in Davos in 2009 the President of France, N. Sarkozy, expressed concern about a situation when a single state dictates terms to the whole world. He emphasized that a shift from a unipolar world to a multi-polar one is necessary.

The third group of reasons includes social factors, such as increasing social polarization, social-economic inequality, and a crisis of moral-ethical and spiritual values.

In many liberal-minded countries a considerable attention paid to business has caused an increase in social inequality and an unprecedented stratification even in the developed countries. During the recent years this problem has been becoming particularly relevant. Social-economic inequality has lead to the crisis. In the EU this was noticed earlier; therefore, the EU announced being responsible for the social policy in the globalization process.

During the World Economic Forum in Davos in 2009 a message was sent inviting the members of the global community to return to moral values. Business must serve the society, not vice versa.

A number of world economists, experts, politicians (the well-known financier George Soros, German Chancellor Angela Merkel, Director of Institute of Europe Russian Academy of Sciences Prof. Nikolai Shmeliov, famous Polish economist Grzegorz Kolodko and others) emphasize that the global crisis first of all exists "in the heads". Even more, it is the crisis of moral-ethic, cultural and spiritual values; this crisis manifested itself in a disordered system of personal and social values, such as personal identity, family institution, professional attitude and many others. Fundamental human values, such as honesty, kindness, propriety, sympathy, sense of responsibility, patriotism, service to homeland, had lost their significance.

Without culture in the society there is no morality. Poor morality means poor (ineffective) economy. If no common sense of morality exists, laws are ineffective in politics, economy, and in the social sphere; science and innovations cannot progress either. A low level of morality, an increase in criminality and corruption make fruitless the efforts and attempts to improve the situation in the spheres of economy and politics, public life, education and science, international economic relations and business. In the context of a crisis, social justice as well as moral, spiritual and cultural values are of particular importance.

2. Economic Development Cycles

In the theory of economy it has been established that economic growth consists of periodical cycles which differ from each other in duration and intensity. Crisis is one of the phases of economic cycle during which plenty of business enterprises are unable to remain in the market and go bankrupt, the
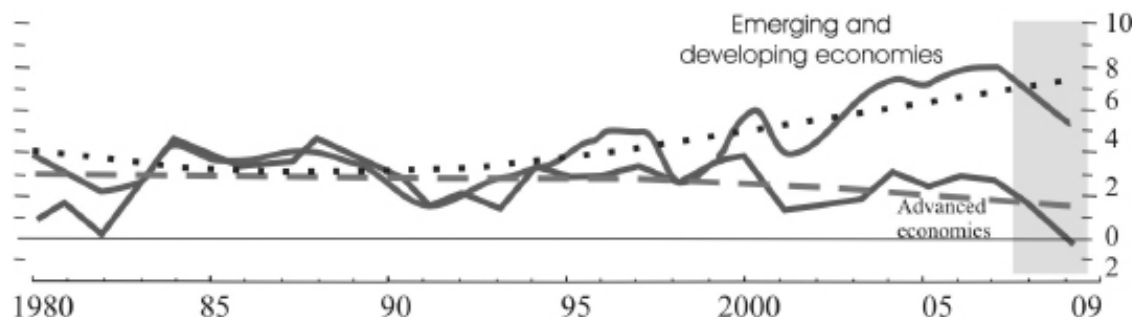

Figure 1. Real GDP growth and the trend (percentages)
(Source: http://www.imf.org/external/pubs/ft/weo/2008/update/03/index.htm#table1)

state collects less revenue to the budget, the level of unemployment increases, the income of the entire population is reduced, the output of production (GDP) and its variation factors are changing. Traditionally, the following major production factors are distinguished: capital fund, labour, and general efficiency of production factors (or technological progress). The most significant GDP declines in the world were reported exactly during the periods of financial crises, i.e. during the financial crisis in Asia (1997), the Russian crisis (1998) and the forecast recession of the recent years (2008-2010) when the global financial markets have been hit by the global financial crisis (Figure 1).

However, every crisis has some aspects in common with other crises as well as its own peculiar features and outcomes. The current crisis has paralysed the activity of the developed financial markets, ruined the expectations of investors and forced world governments to reconsider the trends of fiscal and monetary policy. Moreover, the crisis has attracted attention to the state regulation of economy.

Recently, the issues of problematic financial systems and instability of markets became particularly relevant. The changing situation of financial markets is being analysed and economic indicators of the world countries are being projected in order to find out the causes of the financial crisis, to foresee the potential consequences, to construct a strategy for overcoming it as well as to identify means to prevent such crises in the future.

To properly evaluate the causes and the processes of the current crisis, the stages of its development as well as the possibilities to overcome it, historical considerations and detailed analyses of the reasons for the major previous crises (Table 1) are of utmost importance.

Although the abovementioned crises occurred in different periods of time, under different economic and social circumstances and due to different reasons, they share some general features, such as low interest rate, high liquidity, an increase in financial flows, weak supervision and regulation of financial institutions. Review of the historic events provides us with significant clues about the policies of supervision institutions of the financial markets and central banks. These policies are considered to be ill-timed and insufficiently effective. The subprime mortgage crisis which emerged in the U.S. involved the economies of numerous countries worldwide and pointed to the global nature of the financial system; what is more, the question of the safeguard of financial system stability was raised, concern regarding the need to reform the global financial system and

Period of the Crisis	Causes	Consequences
The Great Crash, 1929-1933	Unbalanced economic growth. Inadequacy of demand and supply of commodities in the market	New rules for stricter control and regulation of the monetary policy of financial institutions
„Black Monday", 1987	Variant comprehension of the investment strategy and the market	A dramatic slump in stock market
The Asian Crisis, 1997	Unbalanced Asian economic growth, speculative currency flows	Increased interest rates, reduced budget deficit, devaluated currency of Asian countries
The Russian Financial Crisis, 1998	Large capital flows from the country, decline in raw material prices and growing debt	Devaluated rouble, plenty of enterprises went bankrupt; the policy of the domestic debt was revised
The Dot-com Bubble, 2000	The US intensive economic growth and high expectations caused a boom in the IT stock market	Bankruptcy of the majority of IT companies, the U.S. economy slowing
Terrorist attacks, September 11, 2001	Terrorist attacks against the U.S.	Slowing economy of the U.S.
Enron Scandal, 2001	Conflict of interests. Falsified financial reports	Systematic impact on creditors, banks, other companies.
Global crisis, 2008-2010	Real estate "bubble" collapsed. Subprime mortgage crisis	Bankruptcy of financial institutions, recovery of world economy

Table 1. The causes and the consequences of the global crises (Source: designed according to Daianu and Lungu, 2008)

consider the level of the state influence to the market economy was expressed.

The current crisis, similarly to the previous crises, has been caused by a huge difference between paying back and capital input as well as the irresponsible borrowing[4]. According to the International Monetary Fund (IMF), the current crisis, which started in 2006 in the segment of subprime mortgages in the U.S., is the most significant financial crisis of this century and will be the most costly throughout the history[5]. The previous crises had more domestic (local) influence, whereas the present one has dramatically expanded and, of course, its anticipated volume will be much larger and the consequences will be more serious. The question is: how could it happen that the increase by 3 per cent in deferred subprime mortgage, which enhanced the problematic credit part by 34 million dollars, was able to balance out the U.S. financial system with the turnover of 57 billion dollars and, in addition to that, caused the global financial crisis? (Dodd, 2007)[6].

It should be stressed that global and social crises are a characteristic feature of organic market development. The history of such crises dates back to the 17th century when a sound market system developed and, needless to say, crises are unavoidable in the future.

The first classical economic crisis hit in 1823. Since then crises have been occurring regularly every 15-20 years; eventually they became an object of academic research. In the post-war period crises were more frequent and until 1990 they used to occur in every decade. However, the last two cycles of the years 1993-2000 and 2003-2008 show a tendency for crises to become shorter in time, i.e. the duration of a stable global economic growth cycle is reducing.

Thus, a crisis is regarded as a market system phenomenon because financial system loses its balance due to slumping production volumes. Financial sector also reacts to that.

In the Lithuanian market economy the current crisis is the second (after the crisis of 1998-1999); whereas it is the third considering the conditions of globalization.

Actually, the first crisis was the collapse of the Soviet system which was followed by a dramatic de-

cline of economy in many post-Soviet countries as in 1990 GDP dropped by 40 per cent in comparison with the previous years. Furthermore, a powerful economic crisis hit Eastern and Western Europe as well as the U.S. in 1992-1993. The cycle of economic rise lasted for a period of 1993-2000 in the main economic centres, i.e. the great triad (the U.S., the EU and Japan).

In 2001 the U.S. economy, similarly to the economies of the EU countries, entered into a new economy decline cycle. Dramatic economic crisis of the U.S. coincided with the tragedy of 11 September 2001. In fact, it was the second global crisis. In 2002 a slow economic growth started and the economy entered the stage of rise.

6 years passed and the world experienced a financial and economic shock again. However, globalization processes obviously shorten the global economic cycle and the duration of boom and stability phases.

After the Asian crisis in 1997 a general conclusion was drawn regarding the limitations of the liberal monetary ideology. Liberal monetary model was believed to be the most suitable for highly developed and emerging countries, meanwhile developing countries with rapidly growing economies were expected to implement the Keynes's policy, i.e. to strengthen the state role and increase budget expenditure. But the latter global crisis raised doubts about the first thesis: due to the process of globalization, the international neo-monetarism as a methodology of economic policy became inapplicable.

In the U.S. and the EU rapid measures were taken to improve the situation of financial credit institutions as well as industry and business companies. These measures were the classical anti-crisis policy instruments of Keynes's theory: tax reduction, stimulation of production, activation of economic processes, increasing of employment and, generally, improvement of the population's situation. The decisions of separate countries and all the measures taken change the overall system of global finance, thus, it undergoes a quality change.

In consideration of the cyclical economic development it is important to emphasize that the situation of separate states is ambiguous. The world economy has already been demonstrating its cyclical development for two centuries, while the strategies of economic development of separate countries are being projected on the basis of the concept of constant economic growth and macroeconomic stability. It is essential to point out that Lithuania is not the only country having no strategies and programmes to deal with cyclic economic fluctuations. This allows

4   Daianu D.; Lungu L. (2008). *Why is this financial crisis occurring? How to respond to it?* ALDE conference material, [accessed on: 15-01-09]. Available from: http://www.alde.eu.

5   International Monetary Fund. (2008). World Economic Outlook, [accessed on: 03-01-09]. Available from: http://www.imf.org/external/index.htm.

6   Dodd, R. (2007). Sub-prime: Tentacles of a crisis. In: *Finance and Development*, 44(4).

to make a conclusion that one of the inner reasons of the Lithuanian economic crisis is the disregard for the cycle, especially while designing the long-term economic development strategy.

Therefore, while projecting strategic plans first of all potential crises should be considered, period cycles in the global and national economies should be identified and investigated. Also an answer should be found to such questions as, for example, why the world economy is linked to the phases of rise and decline. Secondly, the features of national economy should be identified; this, actually, enables to evaluate the probability of a crisis in the country. And only then preventive measures should be taken in order to avoid negative consequences of the crisis or to reduce it to a minimum. If these problems are not solved, the following crisis will strike in the same unexpected way.

Why did the crisis start in the American real estate market? Construction of private houses is an important economic sector as well as an essential part of the whole social policy in the U.S.. On the basis of a comparatively stable real estate development during the recent years, the government exercised a target economic policy in this field by providing the population with comparatively easy access to bank credits via mortgage system.

The collapse of Fannie Mae and Freddie Mac shocked the whole American society. The assets of these mortgage banks comprised approximately 6 billion U.S. dollars. It is clear that without the state's interference the extent of their crisis would have been much larger.

The second shock for Americans was the collapse of such major investment banks as Lehman Brothers (operated for 160 years) and Merrill Lynch (operated for more than 100 years) which belonged to the top 5 of investment banks. As the extent of their activities was particularly large all over the world, the decrease of their share value influenced the whole global financial system.

The U.S. government and the representatives of the financial sector were forced to take an active position. The government took prompt and decisive action.

Thus, Lehman Brothers was partially nationalized. In order to avoid its inevitable bankruptcy multi-million sums were allocated from the Central American Bank, i.e. the Federal Reserve System. Besides, insurance guarantees were taken under the state's control.

However, the expansion of the crisis continued further. In a few days the third wave hit the world's biggest investment group, American International Group Investments (AIG). The companies of the group managed assets of U.S.$ 753 billion all over the world (in more than 60 countries) and had control over credits and mortgage loans of U.S.$ 300 billion.

The bankruptcy of such a gigantic unit could have destroyed the global financial system and the U.S. government could not allow that to happen. The group was partly nationalized applying the same scheme as in the case of Fannie and Freddie. Furthermore, a chain of investment banks' bankruptcies continued and they were also saved by the state. Actually, all these banks were nationalised. The government projected a financial system rescue plan, the so-called Paulson plan. Under the provisions of the plan, the government required the U.S. Congress to allocate U.S.$ 900 billion for the abovementioned objectives.

The plan was approved after debates and substantial amendments. The government of the President of the U.S. G. W. Bush received the "green card" for the financial-bank system to be reorganized with much interference of the state.

It is important to emphasize that, unfortunately, all the actions taken to secure the giant American financial system failed to save it from the deepening economic recession. The economy growth stopped and the majority of companies continued to face considerable problems.

In the process of the crisis the financial sector experienced huge losses.

Several key consequences of the current financial crisis can be distinguished. First of all, the U.S. financial sector has lost its status and has changed beyond recognition. Secondly, massive bank bankruptcies, their merging and artificial salvations have developed mistrust in the financial sector in general. It had negative influence on the interest rates and tariffs of the company mortgage security. It became popular to invest into state treasury bills, precious metals and etc., rather than search for safe investments in the financial markets. A deepening financial crisis stimulated a more rapid deceleration of the U.S. economy: real estate prices decreased, unemployment increased.

The recent financial crisis spreading beyond the U.S. has clearly demonstrated the tight interdependence of globalization and financial system. The financial crisis has paralyzed the movement of money flows and has impacted the slowdown of the global economy.

Table 2. Financial sector losses, U.S. $ billions (Source: http://www.bankofengland.co.uk/publications/fsr/2008/index.htm)

	Outstanding amounts	Losses April 2008	Losses October 2008
The United Kingdom			
Prime RMBS – Prime residential mortgage-backed securities	346,8	14,7	31,3
Non-conforming RMBS – Non-conforming residential mortgage-backed securities	70,1	3,9	13,8
CMBS – Commercial mortgage-backed securities	59,3	5,5	7,9
Investment-grade corporate bonds	808,6	83	155,4
High-yield corporate bonds	26,9	5,3	11,8
Total		112,7	220,3
The United States			
ABS (c) – Home equity loan asset-backed securities	757	255	309,9
ABS CDO – Home equity loan ABS collateralised debt obligations (CDOs)	421	236	277
CMBS – Commercial mortgage-backed securities	700	79,8	97,2
CLO - Collateralised loan obligations	340	12,2	46,2
Investment-grade corporate bonds	3308	79,7	600,1
High-yield corporate bonds	692	76	246,8
Total		738,8	1577
EURO Area			
RMBS - Residential mortgage-backed securities	553,4	30,7	55,6
CMBS – Commercial mortgage-backed securities	48,6	4	5,9
CLO - Collateralised loan obligations	147,3	9,7	32,6
Investment-grade corporate bonds	7613,3	405,8	919,3
High-yield corporate bonds	250,3	41,6	108,5
Total		492,1	1122

3. The Issue of Social Inequality and a Crisis of Moral-ethical Values

Usually an economic crisis is perceived as the decline of macroeconomic indicators in the national and international economy caused by internal and external reasons. However, bearing in mind numerous factors determining the instability and disbalance of macroeconomics, attention should be paid to the amount of receivable income which affects the overall macroeconomic demand. The majority of working people are employees who receive salaries. In recent years GDP (or national income) growth has mainly been conditioned by the profit growth. It appears to be a natural trend and the market drive. But such disproportional income distribution causes an increase in social-economic inequality in the developed and emerging countries.

In Europe the unemployment rate has been increasing during the recent 20 years and has exceeded 10 per cent. In the U.S. during the last 25 years a huge income distribution was observed, i.e. a gap between the wealthy and the poor which show a tendency to rise. Income of two thirds of Americans (mainly representatives of the middle class) decreased by 20 per cent, while only 20 per cent of the wealthy felt an increase in income. During the recent decade the real wages in Latin America decreased by 50 per cent.[7] Thus, serious social problems emerged.

According to Henri Guano, former chief commissar of the French plan, a high rate of unemployment, a sense of insecurity and instability, stagnation of purchasing power, tight burden of taxes for the middle class households, social exclusion are the aspects that have been prevailing in France during the last 15 years. Actually, fiscal and budget dogmatism has been depressing France for more than 15 years. It should not be surprising because the present orthodox policy priorities are the fight with inflation and deficit reduction, but not the stimulation of economic growth or the creation of workplaces.

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7   Rakauskienė, O. G. (2006). *Valstybės ekonominė politika*. Vilnius: Mykolo Romerio universitetas.

Even in such a socially-oriented country as Germany a rising tendency of social inequality is very distinct. According to experts, during the period of recent 20 years social-economic inequality has been as high as it is at the present moment.[8]

Professor Louis Emery (former special adviser of the U.S. Bank for Reconstruction and Development) is surprised by the reports and selection of economic indicators provided by the Organization for Economic Co-operation and Development (OECD):

> *Should economy be measured by macro financial indicators (such as inflation, budget deficit and the interest rate), hence the economy state may seem rather optimistic, however, taking into consideration other macroeconomic indicators, e.g. unemployment, a level of criminality, income distribution, economy itself might appear quite in a pessimistic light.*

The global crisis made the governments to reconsider the events of the past and take into account the social function of a state. For instance, the German Chancellor Angela Merkel is in favour of rehabilitation of social economy and socially balanced market principles across the world and Europe. In her speech during the summit of Christian Democrats in Stutgard (2008) the social market economy was interpreted as a panacea for the global financial crisis, as food encouraging affected citizens' trust in economy and politics. The Chancellor spoke about the strengthening of social market as "a magic mixture which today is more valuable than in any other time"[9].

In the World Economy Forum in Davos (January, 2009) Angela Merkel expressed the same attitude emphasizing the idea of the "realization of the happy medium between socialism and capitalism, and to strengthen the role of the state in order to handle and manage the crisis processes, whereas the global economy should be regulated". In addition, she suggested establishing the UN Economic Security Council.

In the contemporary fast-changing world there is an increase in discussions regarding the directions of the contemporary state regulation, the extent of the state interference and its social functions.

Certainly, a mere following of history does not guarantee a successful management of the crisis. The actual economic conditions call for adequate stabilizing measures. However, it is obvious that a growing society polarization where the middle class disappears (or becomes rather scarce) is the key

reason of the crisis; this phenomenon must receive sufficient attention of the state since it fosters social tense as well as society cataclysms (social threats) and may disturb economic growth.

Investigation of the social market economic theory and practice should be an essential part of the state's anti-crisis plan.

A considerable income distribution in Lithuania (Coefficient decile Cd=10) is one of the most important issues. Unless it is successfully dealt with, no long-term strategies or mid-term programmes will be realised. Lithuania should have its own economic model designed considering the Lithuanian history, mentality and identity, nature, social and economic conditions, and other country-specific features; such a model would facilitate the stabilization of the economy at the present moment and help to find a successful way to secure a long-term economic growth.

Material and financial propaganda in the formal economic doctrine of the XX – XXI centuries encouraged the depreciation of cultural, moral-ethic and spiritual values.

It is obvious that big capital business models and radical attempts to refuse market regulation contradict the concepts of social justice, equality and democracy, ruin traditional ethics and morality, turn a human being into a slave of money, deny the importance of individuality and personal freedom.

There is misconception of morality in the society; boundaries between the good and evil disappear. Individual pragmatism, cynicism and self-benefit orientation prevail. A cult of cruelty, aggression and violence is forming amongst the youth; senses of sympathy and humanity disappear.

According to sociologists, psychologists and church representatives negative moral-ethical principles are constantly spreading and influence all the strata of society. It has an impact on the behaviour of the whole society and family. The main reason for alcoholism, drug addiction, high rate of criminality and suicides in Lithuania is considered to be spiritual vanity, loss of sense of life, vague moral and ethic values. Actually, this is a pay for consumer ideology, the cult of material welfare, a shortage of spirituality and loss of ideals.

Moral standards are important criteria, in other words, they are regulators of economy and politics. Eternal cultural values should be respected in Lithuania and regarded as a vital objective. One of the main purposes is to re-establish a full-fledged Lithuanian culture comprising both material and spiritual values. Only following this way corruption would be prevented, the ethical level of state servants would

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8   http://www. neblog.econ.

9   http://www. neblog.econ.

be increased and at the same time economic efficiency would be raised.

4.   The Financial Crisis and Global Risks

According to Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, this financial crisis is identified as the crisis in an interconnected world.[10]

Over the past 18 months, a crisis that began in a small segment of the US housing market evolved into a global credit crisis of systematic proportions. After the demise of Lehman Brothers and the near-collapse of AIG in September 2008, credit markets became dysfunctional and capital flows that had already slowed ground to a halt. As global banks continued to reduce leverage, the impact of the crisis began to engulf households and businesses around the world. By the end of 2008, most advanced economies were simultaneously in recession for the first time since World War II, reducing growth prospects in emerging markets due to lower demand for export goods. As a consequence, global growth is expected to remain below potential in 2009 and 2010.

The speed at which these events unfolded was unprecedented. Panic was identified as an element of the anatomy of a systemic financial crisis that in this case exacerbated pressure on asset prices and induced contagion effects to the rest of the financial system and around the globe. In this sense, 2008 served as a reminder of how the world and its risks are highly interconnected. Contagion not only arises through linkages in trade and finance, but also through the often complex interaction of risks that increases uncertainly and renders decisions more difficult.

The collapse of asset prices marked only the beginning of a complex chain events that exposed numerous systemic vulnerabilities and triggered other risks and potentially adverse developments. The salient risks likely to affect the global economy through 2009 include:

a.   Deteriorating fiscal positions. The U.S., United Kingdom, France, Italy, Spain and Australia are all already running high deficits. Massive government spending in support of financial institutions and growth are threatening to worsen fiscal positions that are already precarious in many countries. The convergence of this decline with rising health and pension costs in industrialised economies due to demographic trends will place further fiscal pressure on governments.

b.   A further significant reduction in China's growth. The decline in export demand has led to a substantial reduction in China's overall economic growth, increasing considerably the risk of a hard landing that would stress the financial system and could generate social tensions within China and beyond as other economies face similar declines. Over recent years, China built up nearly U.S.$ 2,000 billion in foreign reserves to prevent the renminbi appreciating. Although starting mid-2007 China began to allow a moderate appreciation, the trend reversed towards the end of 2008 with the rapid rise of the U.S. dollar relative to most other currencies.

c.   Continued depreciation of asset prices. Although global equity markets have declined on average by more than 50% in a very short time, the vicious circle between falling asset values, write-downs and attendant pressure on the capital position of financial institutions and continued deliver aging appears to be unbroken. This vicious circle is now affecting manufacturing, services and households around the world and the credit crunch has generated a substantial weakening of economic activity and growing credit losses.

d.   Deflation replaces inflation as a key concern. The impact of high energy and food prices in combination with rapid credit growth were strongly linked to concerns about inflation. A year later, uncertainty in the financial sector, falling asset prices, poor credit conditions, weak demand and rising unemployment could create a deflationary spiral. However, the short-term risk of deflation must be seen in the context of a long-term inflation risk caused by the large monetary stimulus in pursuit of financial and economic stability and the risk posed by the growing public debt. Economic history is littered with periods during which governments reduced their debt burden through inflation.

As Professor Klaus Schwab underlines, 2009 will be a year of learning the lessons of the financial crisis; a year where its reach in terms of time and scope becomes more evident; a year that calls for a new financial architecture to be shaped. At the same time, it will be a year that will test the resolve and willingness of world leaders to collaborate and take action to move beyond this crisis. The global risks landscape is a crowded one and the window of opportunity we have to address some of the largest challenges of our time is narrow.

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10 Global Risks 2009. (2009). World Economic Forum, [accessed on: 12-01-09]. Available from: www.weforum.org, p .9.

5. European Union Responses

The EU Chair, the President of France N. Sarkozy initiated the so-called "anti-crisis" summit of the EU Member State leaders in Paris (September, 2008) where he proposed a European market stabilization plan. The plan anticipates the formation of the General European Fund (EUR 300 billion) to protect problematic European companies.

On 11-12 October 2008 in Washington the summit of Finance Ministers of the Group of Seven (G7) took place. A 5-point plan to restore confidence and restore credit markets was approved:

- To reach a common understanding of the root causes of the global crisis;
- To review actions that countries had taken and will take in the future to deal with the current crisis and strengthen growth;
- To agree on common principles for reforming their financial markets;
- To launch an action plan to implement those principles (ministers were asked to develop further specific recommendations that would be reviewed by leaders at a subsequent summit);
- To reaffirm their commitment to free market principles.

These general principles signal a transition of the whole financial system into a new direction of development.

Several practical solutions allowed to reconstruct the entire architecture of financial system. The essence of these reforms comprises three measures.

The first. The U.S. Federal Reserve System, European Central Bank, Swiss National Bank announced the elimination of any barriers to increase the national bank liquidity by April, 2009. The Bank of Japan also joined them.

The second. The abovementioned banks announced the first auctions at once.

The third. European Central Bank announced three auctions with unlimited funds of U.S.$ until the year 2009 (whereas the traditional policy always limited it). This measure is of great importance.

At the same time, EU Member States approved their national plans to save the financial system by means of subsidizing it. For that purpose the United Kingdom allocated U.S.$ 980 billion, Germany – U.S.$ 643 billion, France – U.S.$ 540 billion, Italy – U.S.$ 200 billion, Japan – U.S.$ 150 billion, Sweden -U.S.$ 120 billion, Russia allocated U.S.$ 4 billion for Iceland.

It is possible to conclude that these global financial managing principles change the global financial system fundamentally. The main regula-tion instrument nowadays is not the market or its actors but countries and their financial decisions.

This proposition is supported by the European action plan to deal with the financial crisis which was approved by the European Commission on 29 October 2008. In this plan the international financial crisis is treated as a real challenge for the EU.

Two major points in the process of dealing with the financial crisis are emphasized in the European action plan. The first one is a wider approach to overcoming the financial crisis in Europe: it is necessary to focus not only on rebuilding the financial and banking system but on the real sector as well. The second point stresses the difference between joint actions and an individual approach to monetary economic model. It was emphasized in the European action plan that the European banking system must be stabilized. However, as reported in the Communiqué, it is not enough. Since the financial crisis has spread very widely and had an impact on the whole economy by hitting, first of all, the household sector, real estate and labour market as well as business, special attention must be paid to the real sector of economy, to employment and social impact, to the acceleration of the reform and investment.

Europe's strength lies in its solidarity and its ability to act together. All Member States will be affected, albeit in different ways and to different degrees, and it is likely that unemployment will increase, demand will fall and fiscal position will deteriorate. Acting jointly means a more effective and credible response. In contrast, if each Member State acts alone, their efforts will fall short. There is also a risk of unwelcome spill-over effects on other Member States.

The EU should build on this success and decide to tackle the next stages of the crisis in a united, co-ordinated manner turning these challenges into opportunities; adding selected short term measures to the Lisbon Strategy for growth and jobs. This paper sets out a three part approach which will be developed into an overall EU recovery action plan/ framework:

- A new financial market architecture at the EU level;
- Dealing with the impact on the real economy;
- A global response to the financial crisis.

Formation of a new EU finance architecture concentrates on the following measures: steering the European financial sector out of crisis and ensuring reinforced regulation and supervision. In particular, there is a need for continued strong support for the financial system from the ECB and other central banks; a rapid and consistent implementation on the

bank rescue plans established by the Member States; decisive measures to limit the spread of the crisis across Member States.

To make the implementation of these measures possible, it is vitally important to reconstruct the bank system and transfer it to the private sector in the future. The EU has to redefine the model of regulation and supervision of the financial system. For that purpose the so-called Group of Jacque de Laroush consisting of well-known economists was established.

In this context **the Stability and Growth Pact** was adopted.

The Stability and Growth Pact provides the right policy framework, balancing short-term stabilisation needs and long-term structural reform requirements, notably supporting the adjustment process. Implementation of the Pact should ensure that any deterioration of public finances is accompanied by structural reform measures adequate to the situation, while ensuring that sustainable positions are being restored. Budgetary policies should draw fully on the degree of flexibility permitted by the Treaty and the revised Stability and Growth Pact and should take into account the following principles:

- Fiscal policy should be maintained on a sustainable course, anchoring expectations of an ordered resolution of the crisis;
- Country-specific differences in fiscal room for manoeuvre should be considered, conditional on strong and credible national budgetary institutions and medium-term budgetary frameworks;
- The level of ambition of the structural reform agenda should pay particular attention to those reforms that strengthen resilience and enhance sustainability over the long run;
- Reforms supporting demand in the short run should be timely, targeted and temporary.

Countering the effects of unemployment by offering Member States the possibility of reprogramming funds under the European Social Fund to support measures to quickly reintegrate unemployed into the labour market:

- Reviewing the effectiveness of the Globalisation Adjustment Fund;
- Helping the unemployed to start up a new business quickly and cheaply;
- Monitoring the impact of the crisis on different sectors affected by structural adjustments and using the scope offered by the State Aids regime to enable timely, targeted, and temporary support where appropriate;

- Pursuing flexure: in particular active labour market policy, tax and benefit reform, and reinforced matching of skills and jobs. The situation is likely to be particularly difficult at the lower end of the labour market, making it particularly important to ease the unavoidable restructuring and provide income and targeted social protection support.

In order to reduce the risk of a recurrence of financial crises in the future, a series of measures to reform the global financial architecture should be pursued. These should relate broadly to the following areas:

- Strengthening the international consistency and quality of regulatory standards, including implement reforms (as reflected in the ECOFIN roadmaps and FSF recommendations) and extend them at global level;
- Strengthening international coordination among financial supervisors;
- Strengthening macroeconomic surveillance and crisis prevention, bringing together macro- and micro-prudential aspects, enhancing financial stability and developing early warning systems; and
- Further developing the capacity to deal with financial crisis and resolution capacities, at the national, regional and multilateral levels.

The European action plan against financial crisis must be implemented in consideration of the principles of efficiency, transparency and accountability, representation of European Member States.

This crisis is a possibility for the EU countries to unite their actions and to make certain steps towards recovery. The EU has to show to 27 countries and European institutions that cooperating and working as a unit may lead to the welfare of all EU citizens.

Conclusions

1. Three fundamental groups of the reasons for the global crisis could be distinguished: the first, the cyclic development of the world economy and the national economies as well as the increasing synchronicity of these processes in the major world economic centres, i.e. the U.S., the EU and Japan; the second, the emerged global financial system which **does not meet the modern requirements and is unable to self-regulate**; the third, social factors, such as increasing polarisation of the world countries and societies, growing social economic inequality and a crisis of moral-ethical values.

2. The financial crisis is identified as a crisis in an interconnected world. A crisis that began in a small segment of the U.S. housing market evolved into a global credit crisis of systemic proportions. The impact of the crisis began to engulf households and business around the world. The most advanced economies (the U.S., the EU and Japan) were simultaneously in recession. As a consequence, global growth is expected to remain below potential in 2009-2010.

The speed at which these events unfolded was unprecedented. "Panic" was identified as an element of the anatomy of a systematic financial crisis.

Contagion of financial crisis not only arises through linkages in trade and finance but also through the often complex interaction of risks that increases uncertainly and renders decisions more difficult. The salient risks likely to affect the global economy through 2009 include: deteriorating fiscal positions, a further significant reduction in the world's (and China's) growth; continued depreciation of asset prices and deflation as a key concern.

According to the world analysts 2009 will be a year of learning the lessons of the financial crisis, a year that calls for a new financial architecture to be shaped.

3. The global financial management changes the financial system fundamentally. The main regulation instrument nowadays is not the self-regulating market and its actors but countries and their financial decisions. Two major points in the process of dealing with the financial crisis are emphasized in the European action plan/framework. The first one is a wider approach to overcoming the financial crisis in Europe: it is necessary to focus not only on restructuring the banking system but also on the real sector. The second point emphasizes the importance of joint actions of the 27 Member States of the EU.

To reduce future risk of a crisis, the following global finance architecture measures must be taken: formation of the new financial market architecture at the EU level, dealing with the impact on the real economy and a global response to the financial crisis.

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PASAULINĖS FINANSŲ KRIZĖS ANATOMIJA

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Santrauka. Straipsnyje nagrinėjamos fundamentinės pasaulinės krizės susiformavimo priežastys bei jos pasekmės. Pasaulinės ekonomikos istorijoje krizės kildavo ne tik esant atitinkamoms ekonominėms-socialinėms aplinkybėms, bet ir veikiant tam tikriems bendriesiems veiksniams, kurie ir atskleidžiami straipsnyje. Nagrinėjama Lietuvos padėtis pasaulinės finansų krizės kontekste. Be kitų priežasčių, išskiriamos socialinės nelygybės ir moralinių-etinių vertybių stokos problemos, turėjusios didžiulės įtakos krizės atsiradimui. Straipsnyje taip pat vertinamos Europos Sąjungos priemonės, skirtos kovai su krize. Europos veiksmų plane išskiriami du esminiai dalykai: pirma, siekiant įveikti krizę būtinas ne tik bankų, bet ir realiosios ekonomikos sektoriaus restruktūrizavimas, antra, pabrėžiama visų 27 ES valstybių narių bendro veikimo svarba.

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INFRASTRUCTURE FACILITIES AND SUPPORT FOR STABLE DEVELOPMENT

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Abstract. A complex and systematic analysis of the world experience is carried out. The experience of Russia in the field of the development of innovative systems possessing specific characteristics, inherent in national institutes, features of historical development, the transformation and self-organising of national systems under the control of the state are considered. The author generalises world and domestic experience in the formation of an infrastructure and presents the perspectives of the use of mechanisms of state-private partnership in the sphere of innovations in national economies. The level of human and scientific and technical potential and its modern development in Kazakhstan is studied, possible ways of the increase in and the realisation of the given potentials from the position of an incentive system are presented, the role of the state and its functions in a context of development of the human and scientific and technical capital is considered.

JEL classification: O180, O200.

Introduction

In Kazakhstan (R.K.), the Strategy of Industrial and Innovation Development of the Republic of Kazakhstan for 2003-2015 provides for the creation of the conditions for the development of: innovation and high-tech and science intensive industries in the medium and small-scale business due to the acquisition of equipment and technologies by leasing, the widespread franchising, and the cooperation of the small-scale business with large-scale enterprises. To activate a real innovation process, the Program of Formation and Development of the National Innovation System for 2005-2015 is being implemented by the R.K. Government [10]. The National Innovation System is subdivided into the following four subsystems:

1) Scientific potential,
2) Innovation business,
3) Multilevel innovation infrastructure. This is a system consisting of interrelated production, consulting, educational and information structures that provide and ensure conditions to realize innovation activities. The innovation infrastructure includes the following elements: national and regional technoparks, business incubators, venture funds, etc.

4) Financial infrastructure is a subsystem intended for a complex financing of research-and-production and educational processes in the field of innovation and technological development. It is based on the combination of different mechanisms of direct and indirect state support of innovation business and infrastructure.

The Program of Formation and Development of the National Innovation System lays emphasis not just on the acquisition of equipment and the transfer of advanced technologies from abroad, but, first of all, on the production application of domestic developments. Thus, appropriate measures to increase the efficiency of the training of technicians

in domestic and foreign research institutions and institutions of higher education are being taken in the R.K..

The analysis of the world practice proves that the national innovation systems have, as a rule, a number of specific characteristics peculiar to the national institutions, the features of historical development, and the transformation and the self-organization of national systems under the state control. The control is intended for a further development of the regulatory basis and the matching with new conditions of such development, for the formation and improvement of the mechanisms of financing and the stimulation of innovation processes, and the adaptation of institutional structures to the changing conditions. An important line of development of the National Innovation System is to form the so-called network economy. The basis of such economy is the transnational corporations and small venture firms serving such corporations. The state support for the small innovation business promotes the said transnational corporations.

1. Russia's Experience

Let us consider the experience of Russia included in the **BRIC (**Brazil, Russia, India, China**)** group. Three stages can be mentioned in creating a national research and innovation complex in Russia (R.F.). [11, p.18-20].

The first stage (1992–1996) consisted of forming the regulatory basis of science and mechanisms of the adaptation of science to the market conditions. During the initial period of market changes appearing due to the collapse of financing, urgent measures were taken to preserve the major constituents of the scientific and technical complex, first of all, of the abstract science. At the same time, it was necessary to provide a basis of market mechanisms for the distribution of budgetary funds. The main normative document was the law of science and the State Scientific and Technical Policy.

The second stage (1997–2000) was the development of a concept and a plan for the reformation of the Russian science. The basic work in that field was carried out in 1997 and was related to the stabilization of economy and a substantial increase in the financing of science. The concept sets forth views on the reformation of the scientific and technical sphere. The plan was not implemented due to the crisis of 1998, but its basic approaches were preserved in the developed Fundamentals of the R.F.

Policy for Development of Science and Technologies as approved by the R.F. President on 30 March 2002.

The third stage of the said reformation (since 2000 until now) may be characterized as the transfer from the phase of survival to that of development. At this period, measures are being taken to prepare normative documents that determine development of the whole research and innovation complex including both scientific and innovation components. A perspective model of the state sector of science has been formed including organizations of public academies of sciences, reformed public research centres built by the principle of the head branch institutes, research and planning organizations and design bureaus for double and special purposes, scientific organizations controlling the performance of particular functions imposed on the federal bodies of executive power, and scientific organizations within the institutions of higher education. A Strategy for the Development of Science and Innovation in the Russian Federation until 2015 has been approved where the main problem of the Russian sector of research and development is emphasized; the problem arises due to the fact that the rate of growth and structure of this sector do not meet the needs of the society, the national security and the rising demand on the part of the business/enterprise sector for advanced technologies. The purpose of the strategy is the formation of a balanced sector of research and development and an effective innovation system that ensures technological modernization of economy and an increase in its competitiveness. The strategy of development of the Russian scientific and innovation complex is determined by a number of factors having a national economic importance. The factors are included, first of all, in the concept for a long-term social and economic development of the country, where a combination of the advantages of Russia (as a powerful player in the energy industry) with a transfer to the innovative development is underlined. To solve the set tasks, one should:

- build a management system for the scientific and innovation complex adequate to the market conditions subject to the Russian specificity;

-develop an infrastructure of innovation activities and mechanisms of the state support of innovations;

-develop methods of the distribution of exclusive rights to research and development subject to the fourth part of the R.F. Civil Code;

-make effective approaches to the stimulation of innovation activities and the transfer of technologies;

-form and put into practice a training model for managers and specialists for the applied scientific and technical and innovation activities, which would be

adequate to the market needs;
-build a multilevel system of training and the generation of inclination to the innovation activities (infant schools → school → institution of higher education → occupational refresher).

The Practice of Kazakhstan

Similar tasks (but with more difficulties in their performance) should be considered in the R.K. So, a section of the Civil Code devoted to the matters of research activities (for stimulation of innovation activities) should be discussed. The generalization of the world and domestic experiences in creating the infrastructure allows us to judge on the perspective use of the mechanisms of the public-private partnership.

The main point of our proposal is to use the abovementioned mechanism of the public-private partnership in the innovation sphere within the national innovation system. Here it is important to make a proper choice since each form of such partnership has its advantages and disadvantages (see Table 1). There has been no uniform interpretation of the public-private partnership in the innovation sphere in the R.K. legal system until now, and no official definition is suggested in the statutory acts.

Table 1. Basic advantages and disadvantages of the most commonly used forms of the public-private partnership

Forms of partnership	Description of forms of partnership	Advantages	Disadvantages
Service provision contracts	A private company is only authorized to maintain a state-owned facility (maintenance, process supervision, repairs)	A possibility to make professional technical appraisal by the private sector	It is undesirable if a substantial improvement in maintaining a facility occurs in case of a weak general management of the infrastructure available
Management & maintenance contracts	A private company manages a facility bearing responsibility to the state for the management and is given remuneration on the results of its operation	Benefits of the efficiency of management	Acquisition of benefits may cause difficulties since the state is still liable for investments
Operation & maintenance contracts	A private company takes the state-owned property on leasing, is liable for it, earns profit, and pays leasing payments	Commercial risk is borne by the private sector, which increases efficiency	An appropriate administrative structure is required as the state is still liable for investments
Research engineering and/or development contracts	A natural or legal person carries out research engineering and/or development, getting remuneration on the results of its operation	Risk is borne by the private sector, which stimulates research activities	A reliable regulatory mechanism and state investments are required
Contracts for designing, construction, financing and operation	The state transfers a facility for a period fixed by a concession agreement, and a company bears risk not only for its operation and maintenance, but for investments. Upon the expiry of the term of the agreement, the facility shall be returned to the state.	A company seeks to increase efficiency of its investments	A reliable regulatory mechanism and state investments are required
Contracts for construction, ownership and operation	A facility is transferred for an uncertain period. Such contracts differ from privatization as the responsibility for service provision is still borne by the state. Thus, the state may at any time terminate such contract.	A company seeks to increase efficiency of its investments	A reliable regulatory mechanism is required
N o t e – completed by the author with reference to [2. p.11, 12]			

We propose the following definition: *public-private partnership in the innovation sphere* is a peer partnership of legal and natural persons in the state and private sectors of economy on the mutually beneficial contractual terms to implement the key innovation objectives of the society.

The choice of a form of the public-private partnership depends on the purposes pursued under a particular project and on the distribution of responsibility as per the duties of ownership, operation, risk and investments. Table 2 systematises the forms of the public-private partnership subject to these duties.

We have determined above that the key factor of economic growth is human capital.

Table 2. Distribution of responsibility in different forms of the public-private partnership

Forms of public-private partnership	Ownership	Operation & technical support	Capital investments	Commercial risk	Period of validity
Service provision contracts	State	State & private sector	State	State	1-2 years
Management & maintenance contracts	State	Private sector	State	State	3-5 years
Operation & maintenance contracts	State	Private sector	State	State and private sector	8-15 years
Contracts for research engineering & development, designing, construction, financing and operation	State & private sector	Private sector	Private sector	Private sector	20-30 years
Contracts for construction, ownership and operation	State & private sector	Private sector	Private sector	Private sector	Not fixed
N o t e – Completed by the author with reference to [2, p. 12]					

State of the Human Capital in Kazakhstan

What regards the level of development of the human capital, the R.K. is among the average-developed countries holding 79th place by the world rating with **IHDP (**Index of human development and potential**)** equal to 0,774 [6, p. 284]. The qualitative composition of the R.K. population is characterized by highly qualified labour resources represented by research fellows and instructors of institutions of higher education. There are also cadres of the top and medium structural units in the industry, the sphere of the state control and private companies. We have succeeded in the preservation of the scientific and technical potential by organizing national scientific centres and providing the state support to the Academy of Sciences and higher education institutions. This potential is the creator of high technology and science intensive industries. For the

time being, the scientific and technical sphere lags in the transfer to the market basis, though there are necessary conditions: a legislative basis is created, necessary program documents are prepared and an appropriate legislative basis is developed. Thus, the Concept for Integration of Research Institutions and Institutions of Higher Education with Science Intensive Industries provides for the creation of an applied sector of science existing on the basis of the laws of market economy as well as for the creation of "point" centres of science intensive industries of the fifth process structure [3].

However, these science intensive industries of the fifth process structure have not been created until now. Even in Almaty where about 45% of the total intellectual potential of the country are concentrated, contribution of the fourth process structure does not exceed, according to the most optimistic estimations, 25-35%, and the third structure dominates (about 50-60%), the contribution of remains at the level of

5-10%. The fifth process structure is generated with difficulty. On account of the incompleteness of the reproduction contour, science intensive products of this structure are manufactured in single pieces of low quality and for a high cost [18]. In those regions, where there is no scientific and technical potential, the situation is worse. However, here one may act by establishing particular science intensive enterprises, i.e. branches and subdivisions of the R.K. national scientific centres. Then one can form clusters. The cluster approach can radically change the content of the industrial policy, as here the traditional division into branches fails.

The Kazakhstan model of education is being developed according to the State Program of Development of Education in the Republic of Kazakhstan for 2005-2010. Subject to Article 12 of the R.K. Law of the Republic of Kazakhstan On Education, the following multilevel structure of education is in force:

- pre-school education and teaching,
- elementary education,
- basic secondary education,
- secondary education (general secondary education, technical and vocational education),
- post-secondary education,
- higher education,
- post-graduate education [12].

Adults are taught in educational institutions, and also in legal entities having structural subdivisions that realize additional educational programs. There are different ways to obtain higher education: full-time courses, instruction by correspondence and evening courses as well as remote courses and external studies. Educational institutions of the R.K. higher education system are divided into three types: classical university, specialized university or academy as well as institutes referred to as the institutes of higher education of a university type.

One of the functions of the credit system of education is to apply an interstate quality assurance system for education services, as the system is one of the basic elements of the Bologna Process. In the world practice, the educational programs (curriculums) of institutes of higher education have to be certified for the quality of services rendered. In Kazakhstan, internal and external assessments of the quality of education are being applied; standardized assessment means and instruments that determine a level of the progress of students are improved; organizational structures are set up. The system of the state grants and credits gives positive results: admission of entrants is protected from corruption.

The following two key problems in the system

of higher education exist:

- Disbalance of the manpower training structure in the context of specialities. As a result, there is an excess of specialists of liberal education and a lack of technical education specialists;
- Low quality of training of specialists due to the ineffective state control.

Economics and law are the basic disciplines in private institutes of higher education.

In case of a low population and an average birth rate, the health of people is of great importance for the economic growth. Unfortunately, the state of the health protection in R.K. leaves much to be desired, i.e. the protection of health and the reproduction of population are not ensured. The birth rate acquired a positive tendency only in 2002 (227117 infants) and in 2005 (278977 infants, while in 2001 221487 infants were born) [4, p. 202].

The legal basis for the R.K. health protection system includes the Law on Health Protection in the Republic of Kazakhstan of 19 May 1997, Law on Health Protection System of 4 July 2003, the State Program of Reformation and Development of Public Health in the Republic of Kazakhstan for 2005-2010 of 13 September 2004 [13, 14, 19]. To realize the State Program of Reformation and Development of Public Health in the Republic of Kazakhstan for 2005-2010, target transfers are provided for. The problem is not in developing such transfers. The current target transfers are allocated to provide particular categories of citizens, who are treated as out-patients, with medicines on preferential terms.

At the Alma-Ata Conference of the WHO in 1978, the first medical aid system in the USSSR was acknowledged as the most thought-out and was recommended to all countries for implementation. At that time R.K. held the first place worldwide regarding the number of doctors per one inhabitant (40,0 per 10 000 persons). Even in 1996, the index was 35,3 doctors per 10 000 persons, which was higher than the similar indices in Great Britain (25,9) and the U.S. (28,8). During the years of the crisis, there was a tendency of reduction in the number of doctors (33,9 doctors per 10 000 persons in 1999). Such a situation was regarded as an approach to the world standards. Then, when the private sector became engaged in the Public Health system, there has been a growth since 2000. The index was 55,5 doctors per 10000 persons in 2005 [1, p. 82].

Now the first medical aid system is the basis of the WHO's Strategy "Health to everybody" and the main instrument in reforming national health protection systems. Many countries applying the principles of the first medical aid system have suc-

ceeded in developing health protection. According to the WHO's experts, up to 90% of the population in the advanced countries are mainly treated in the institutions of the first medical aid system and the network of such institutions increases.

Presently, more attention is paid to the rural health protection. A clear relation is seen between the state of health of the rural population and the economic growth in agriculture. Earlier rural inhabitants were given medical aid through occupational medical examinations once a year. The lack of prospects, low wages and bad living conditions deprive doctors of any motivation to work in the countryside. In the course of optimization, the number of rural medical institutions was reduced, a part of them was reorganized into rural ambulance stations and medical assistant's and obstetrician's stations. The situation was threatening to the national security of the country [5, p. 13].

In the National Report on the Human Development for 2005 two important factors that threatened the stable human development in the country were emphasized. They were related to the following changes in the structure of economy:

1) Almost a fivefold reduction of the share of agriculture in the GDP, as related to 1990, affects the capabilities of development of agricultural regions that requires further measures for the development of the agricultural food complex of the country, and of the production and social infrastructure in the countryside;

2) The expansion of the raw material industry in Kazakhstan threatens the economic security and prevents a stable economic development of the country. A level of expenses for education and health protection in percentage to the GDP is 1,5 – 2 times lower than that of 1991 and of the level in the advanced countries and a number of countries of transition economy; that sets a task of a further increase in the expenses of the state budget for these two major spheres of the human development [8, p. 29].

We think that by 2030, IHDP (Index of human development and potential) of Kazakhstan shall be reaching the level of 0,96 - 0,97. At present, Norway and Iceland have such level being listed in the first and the second position in the rating made by the program of development of the organisation of the incorporated nations. For this purpose, investments are required in the TCP (the target complex program) of the social sphere (education, public health, preservation of the environment and others).

Scientific and Technical Potential of Kazakhstan

The scientific and technical potential is important for the industrial and innovation development. The scientific and technical potential includes many components: research-and-production infrastructure, volumes of financing of research engineering, quantitative and qualitative cadre potential of science and many others. In 2008 there were scientific 421 organizations in the R.K.. The number of such organizations increased mainly due to the establishment of small enterprises. At the same time, a number of organizations in the scientific and technical sphere greatly reduced the scope of research, and some organizations suspended their scientific activities completely (Table 3) [16, p. 458]. The number of employees engaged in scientific research was 16304 at the end of 2008. The cadre potential is concentrated in the institutions of higher education, the national research centres and academic institutes. For the last five years, there is a stable tendency for increase in the number of individuals engaged in research, mainly in the non-state sector.

The basic provisions of the concept for the increase in efficiency of the use of human capital under the conditions of the industrial and innovation development are as follows [15, p. 307-325]:

- Development of a human being as a purpose and means,

- Social and political stability,

- Stable economic growth based on the innovation changes, the ecologically safe nature management, and the entrance into the world economic system.

Under the conditions of the global competitiveness, countries modify their man power continuously. The main requirement is to redistribute resources to the human capital improvement programs. The R.K. exports natural raw materials; that does not require a high qualification of employees. In order to develop the human capital, a set and a structure of incentives with regard to the manufacturers and the consumers must be suggested. In the market economy such incentives may be described in terms of prices. However, the prices are only a part of the incentive structure. Besides, such barriers are of importance as they exclude participation in some markets and cases of economic activity without any intermediation and an explicit assessment (for example, work of housewives producing goods and services not estimated) are nor considered.

Table 3. Basic indices of the state and the development of science in Kazakhstan

Scientific Organizations	2001	2002	2003	2004	2005	2006	2007	2008
The number of organizations having conducted research, total	259	267	273	295	390	437	438	421
Internal costs for research and development, in millions of KZT.								
In % to GDP	0,22	0,24	0,25	0,25	0,28	0,24	0,21	0,22
Fixed assets of the organizations involved in research and developments, in millions of KZT.			9037,3					
The number of the personnel involved in research at the end of the year, persons			16578	16715	18912	19563	17774	16304
N o t e – Designed by the author with reference to [20, 21]								

Non-price aspects of the incentive system are of great importance. It is important because the existing incentive structure in the R.K. is concentrated towards the objective of reception of investments for minimum interest; this does not allow for a successful human development. So, here the obstacles to the increase in the efficiency of the human capital exist as well. Generally, at the national level, the efficiency of the human capital would increase if the highly skilled labour remuneration was fair. Discrimination restricts the labour market, and well-paid and desirable jobs are available for the privileged minority, while some groups of people constrained to do the low-paid and undesirable work. Discrimination restricts choices and possibilities. The incentive structure leads simultaneously to the ineffective use of labour and the unequal distribution of income. The greater part of manpower, especially in small towns and villages, have insufficient means of subsistence, sometimes get no remuneration. Thus, radical changes in the optimization of the ways of the state budget redistribution are required. Expenses for education, health, and occupational safety shall be considered as means of the human capital development. All this is impossible without the active participation of the state, the civil society and the people themselves. The state must increase the amounts of investments in research, education, health and ecology. This can be achieved through:

- The reduction of investment programs that make no contribution to the human development;
- The redistribution of budget funds in favour of the programs covering the maximum number of people;
- The uniform distribution of resources per large groups of the population, (instead of their concentration in the small ones) that will result in a higher rate of return on investment in future;

- The refusal of a complex and expensive social security system peculiar to the advanced countries, as in R.K. it is oriented mainly towards the urban population and is beneficial to the urban elite, i.e. it is not justifiable within the concept of the human capital development;
- The proper monitoring of an idea of selectivity in social expenditure in favour of the concept of the human capital development human potential development.

The formation of a contingent of the highly skilled manpower is connected with the mastering of knowledge of nanotechnologies. At the same time, one should remember the role of universities in the preparation of highly qualified instructors for work in primary and secondary education.

The development of electronic education provides for large educational capabilities. Therefore, the Internet is indispensable to the rural places. The electronic education strategy, its formats, curriculums and certification documents promotes a further employment of graduates and development of villages. At the same time, electronic education increases the inequality of opportunities, since it is not available to everybody [7, p. 211-216.]. In this respect, one should use remote education within reasonable limits. Since students are not physically present in education institutions, instruction by correspondence should be developed. One must develop the Internet education standards and make available free internet to the backward regions and the unemployed.

The rate of return on educational investment is attractive as benefits are high and costs are low. In the public health, emphasis should be shifted from the hospitals to the first medical aid programs, from the therapeutic medicine to the preventive one. The budget redistribution in order to allocate larger resources to the development of public health

and education has a positive influence. However, financing from the budget usually is not enough for the achievement of a proper level of the human capital development. It should be combined with the use of internal reserves.

The state ensures that the human capital is developed using organizational and economic mechanisms. As is well known, the state is a system of governmental, quasigovernmental and nongovernmental organizations that regulate activities of the society. All political, economic and legal actions of the state (budget), regional (tax), scientific and technological, monetary and credit, and demographic policies, etc. impart the human capital. The problem is to determine the scope of the state's intervention in the human capital development.

The Role of the State in the Control of Economic Growth

It is impossible to quantitatively determine the role of the state in the control of economic growth. The need for the re-comprehension of the role of the state and its functions in the context of the human capital development is still urgent. As a proof of it, there is a report of the World Bank specially devoted to the discussion of the role of the state in the world development [22]. The World Bank has changed its opinion about the role of the state regarding two issues: development without the support of the state and an auxiliary role of the state. They are close to each other and supplement each other. The state creates public goods. These goods are conventionally divided into the following three groups. The first group includes creation and matching a new order, which provides the operation of the national economy in combination with the formation of the civil society. The objective of the second group is to create material and cultural conditions for a stable economic growth by developing economic and social infrastructure, i.e. transport, communications, education, science, and public health. The objective of the third group is to replenish the shortages of the market mechanism. An increase in the role of the state can be reached through the following four measurements and processes: differentiation of its functions, integration of the society, institutionalization of power and universalization of the state as a supreme form of organization of societies on a global scale [15, p. 323-324].

At present, the reformation of the processes of the state control of the human development is based on the participation concept where the right to such participation is one of the basic human rights set forth in the General Declaration of Human Rights (Article 21, Part 1). The involvement of citizens in the process of the state control is especially important, where decisions concern the compliance with the human rights and freedoms. A peer dialogue between the population and the state is a form of the control of activities of governmental bodies by the population. Thus, participation of the population in such control is important detail for the development.

The R.K. research-and-production associations and the non-governmental organisations carry on their activities guided by the experience of the foreign countries; that can be explained by the lack of traditions of the functioning of public organisations. Such research-and-production associations and the non-governmental organisations unite the most active part of the population with a higher level of education. Economic problems are dealt with by approximately 15% of all research-and-production associations and the non-governmental organisations; remedial problems are dealt with by 8%; problems of gender inequality and those of children and youth are dealt with by 14%; medical problems, and those in the sphere of culture, arts, science and education are dealt with by 13%; problems associated with social support and invalids are dealt with by 7%; problems regarding social initiatives are dealt by 6%. Such distribution strikingly differs from the U.S. where 25% of research-and-production associations and the non-governmental organisations operate in the sphere of social service provision, 19% in the sphere public health, 14% in the sphere of culture, 12% in the sphere of charity, 10% in the sphere of assistance and development, 9% in the sphere of religious activity, 6% in the sphere of education, 5% in the sphere of conservancy [17, p. 46]. The level of the development of the civil society is evaluated by the two basic indices: a) membership in trade unions, b) the number of nongovernmental organizations. The first index is determined in percentage to the total number of manpower in non-agricultural sectors. In Sweden it is 77%, in Iceland 71%, in Finland 60%, in China 55%, in Hungary 52%, in Slovakia 52%. The maximum number of research-and-production associations and the non-governmental organisations are 3551 in France, 3505 in Germany, 3388 in the United Kingdom, 3257 in Italy, 3203 in the Netherlands, 3116 in Spain, 2685 in the U.S., 2122 in Japan. In the CIS countries, the numbers are much lower: 474 in Belarus, 1752 in the Russian Federation, 274 in Kazakhstan, 890 in the Ukraine, 130 in Kyrghyzstan. The lowest numbers are in Iran,

Eritrea and the Maldives [9].

The increase in the human capital level shall become a strategic direction of the activities conducted by research-and-production associations and the non-governmental organisations. In order to fully use human resources it is desirable to refer to the experience of Russia. In the R.F. this factor is realized as "national projects". The main point of such national projects is to create a modern and effective human development system. The following two groups of arrangements may be mentioned in the national projects: the allocation of additional budget resources to increase labour remuneration to the employees of the respective branches and the implementation of structural reforms in the respective sectors. The two mentioned groups cannot be separated from each other: it is politically risky and economically ineffective to solve one task ignoring the other. However, the risks that events will develop just as planned are rather substantial. The increase in the salaries of doctors and teachers, investments and equipment, and other budget decisions are a necessary but insufficient condition for the implementation of a national project. The implementation of the social sector reform should not result in an increase in the budget expenditure, that is to say, the first step turns to be the last one. Moreover, an increase in financing without structural reforms is brings negative results. A higher salary will lead not to the renewal of personnel but to the cadre conservation.

To prevent that, one should put efforts to implement the structural social reform. The principal criteria, according to which the actions of the government in any country can be evaluated, are as follows: economic growth and increase in the living standard of the population.

Conclusion

Thus, the analysis of the world practice proved that national innovative systems, as a rule, possess a number of specific characteristics regarding the national institutes, features of historical development, transformation and self-organising of national systems under the control of the state. Management is directed towards the perfection of is standard-legal base and its reduced conformity with new conditions of development, towards the formation and perfection of mechanisms of financing and stimulation of innovative processes, adaptation of the structures to varying conditions. The important direction of development is the formation of so-called network economy. The basis of such economy are the multinational corporation and the

small venture firms serving these corporations. Thus the state support of small innovative business results in multinational corporation support. Problems of insufficient innovative activity are relevant for the R.K.. The key problem in the realisation of the given policy is concerned with questions of the perspectivity of the use of mechanisms of state-private partnership. The essence of the offer investigated in the present paper is the analysis of the use of the mechanism of state-private partnership in innovative sphere, as a part of national innovative system. It is necessary to make a correct choice since each form of partnership has its own advantages and drawbacks. In the R.K. legal system till now there has been no uniform understanding of the state-private partnership in innovation activity, and no official definition of is provided in statutory acts. Thus, the following definition is offered: *public-private partnership in the innovation sphere* is a peer partnership of legal and natural persons in the state and private sectors of economy on the mutually beneficial contractual terms to implement the key innovation objectives of the society. This partnership is based on equal rights of legal and natural persons of the state and private sectors of economy and on mutually advantageous contractual conditions with respect to the decisions regarding the key innovative problems of a society. In conclusion, it is necessary to emphasize the all-rounded use of the mechanism of state-private partnership in innovative sphere, as a part of national innovative system. Reforming the processes of a state administration by human capital development is based on the participation concept, where the right to participation is one of fundamental laws of the person. The systematic approach to efficient control of the development the human capital includes not only the reform of the system of public service, but also the reorganisation of the processes of the development and realisation of the decisions adequate to the requirements of social development.

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INFRASTRUKTŪROS PASLAUGŲ SUBALANSUOTA PLĖTRA

Asel Talapovna Uskelenova

Straipsnyje analizuojama infrastruktūros paslaugų subalansuota plėtra ir parama jai remiantis Kazachstano pavyzdžiu. Straipsnio autorė pateikia nacionalinės inovacijų sistemos dedamąsias: mokslo potencialą, verslo inovacijas, inovacijų infrastruktūrą, finansų infrastruktūrą. Straipsnyje aptariama Rusijos patirtis atskirais etapais kuriant nacionalinį tyrimų ir inovacijų kompleksą. Analizuodama Kazachstano patirtį kuriant inovacijų sistemą, autorė akcentuoja viešojo ir privataus sektorių partnerystę, aptaria šios partnerystės formas ir atskirų formų atsakomybę. Straipsnyje taip pat analizuojama Kazachstano žmogiškojo kapitalo būklė, atskleidžiamas šalies mokslinis techninis potencialas, diskutuojama valstybės vaidmens ir jos funkcijų klausimais vystant jos žmogiškąjį kapitalą.

Uskelenova Asel Talapovna holds the degree of Cand. Econ. Sci., is a senior lecturer of political science and social and economic disciplines. She has more than 30 publications in various journals in the Republic Kazakhstan, the Kirghiz Republic, the Russian Federation and has participated in a number of international conferences on regional economy.

Uskelenova Asel Talapovna – ekonomikos mokslų daktarė, išspausdino daugiau kaip 30 straipsnių Kazahstano, Kirgizijos bei Rusijos moksliniuose leidiniuose, dalyvavo tarptautinėse konferencijose regioninės ekonomikos tematika.

EKONOMINĖ INTEGRACIJA: TEORIJA, ES POLITIKA IR PROCESAI

(Violetos Pukelienės vadovėlio recenzija)

Violeta Pukelienė, VDU profesorė, vadovėlį „Ekonominė integracija: teorija, ES politika ir procesai" rengė apie dvejus metus, sistemizuodama mokslines publikacijas, statistines ir temines ataskaitas. Nemažos apimties – 340-ies puslapių vadovėlį autorė suskirstė į tris atskiras dalis: 1) regioninės ekonominės asociacijos globaliojoje ekonomikoje; 2) Europos ekonominė integracija XX a. 6–10 dešimtmečiais vykstant ES plėtrai; 3) liberalizavimo ir reguliavimo ekonomika ir politika Europoje. Vadovėlis skirtas besimokančiai ir norinčiai tobulėti auditorijai. Autorė atliko mokslinį tyrimą – analizavo globalizacijos sampratos evoliuciją ir formų įvairovę. Pirmoje knygos dalyje nagrinėjami ekonominės globalizacijos proceso aspektai: internacionalizacija, liberalizavimas, universalizacija, modernizacija, deteritorizacija; sisteminamos ekonominės prielaidos ir raida. Sukaupusi patirties regioninės ekonomikos klausimais autorė savo knygoje analizuoja prekybos liberalizavimo pasekmes, laisvosios prekybos zonų kūrimąsi ir konkurencingumo pokyčius darbo rinkoje gamyboje vykstant integracijai.

Antroje knygos dalyje pateikiama ekonominės integracijos procesų raida po Antrojo pasaulinio karo. Ši dalis – vertinga susisteminta Europos Sąjungos šalių raidos apžvalga integracijos sąlygomis, nagrinėjama EB plėtros ir ekonominės krizės sąsaja. Aktyviausias Europos rinkų integracijos laikotarpis – devintasis dešimtmetis, paskatinęs bendrosios rinkos formavimosi procesą. Šios integracijos pasekmes autorė skirsto pagal sektorius ir efektus (Šumpeterio efektas, technologinio atotrūkio efektas, dinamiškieji efektai). V. Pukelienės darbe pateikta ekonominė klubų teorija, taikoma formuojant ES ir įvairius kitus pasaulinius susivienijimus, grindžiama Rytų ir Vakarų integravimo paradigma.

Liberalizavimo ir reguliavimo santykis ekonomikoje bei politikoje nagrinėjamas trečioje V. Pukelienės knygos dalyje. Knygoje daug kas siejama su pasekmėmis: „Europos ekonomikos sistemos, kurios paskirtis skatinti konkurenciją, būdingas bruožas – kintanti valstybės intervencija". Autorė apžvelgia atskirų sektorių pokyčius dėl bendros ES politikos. Europos konkurencijos, prekybos ir transporto politika analizuojama remiantis Europos Komisijos dokumentais. Daugiausia dėmesio vadovėlyje skirta dabartiniams ES integracijos procesams, biudžeto formavimui, Pinigų sąjungai, ES ekonomikos valdymui. Autorė pateikia naudingas tolesnio atskirų temų ir problemų tyrimo nuorodas.

Nors knyga parašyta akademine kalba, mažai atspindinčia nacionalinį identitetą, V. Pukelienei pavyko suteikti dėstymui savitą braižą – dėstant ir interpretuojant lyg ir žinomus dalykus, daromas poveikis skaitytojui. Taip, Lietuvos ekonomika galėjo plėtotis įvairiomis kryptimis, tačiau ekonominės integracijos raida paskatino orientavimąsi į liberalios ekonomikos modelio politizuotą modifikaciją.

Knygos pasirodymas Lietuvoje yra reikšmingas įvykis dėl kelių priežasčių. Pirma, vadovėlis išmokys skaitytojus sistemingai analizuoti globalizacijos procesus, kurie turi esminį poveikį Europos ir pasaulio šalių gyventojų gerovei. Antra, tokio pobūdžio vadovėlių Lietuvoje nėra. Trečia, vadovėlį tikslinga versti į kitas kalbas, praplečiant skaitytojų auditoriją.

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INTELLECTUAL PROPERTY PROTECTION IN FOREIGN TRADE
(Review of the textbook of A. Laurinavičius)

The concept of intellectual property is quite new in the Lithuanian legal system and there is no sufficient relevant literature available. The objective of the textbook of Prof. Dr. Alfonsas LAURINAVIČIUS is to present certain aspects in connection with the protection of intellectual property rights. The textbook is meant for students and practitioners exploring international, regional and national legal systems. The author of the textbook examines the legal regulation of intellectual property rights; special attention is paid to trademarks and the organization of their protection.

In the chapter "Globalization and Protection of Intellectual Property Rights" the author analyses foreign trade policies and their relations to intellectual property rights, examines the most important international agreements. The activities and the structure of the most important world organizations that assure the protection of intellectual property rights (World Customs Organization, World Trade Organization, World Intellectual Property Organization) are discussed.

A more in-depth analysis of the protection of intellectual property rights in the European Union is presented, some examples of judgments of the European Court of Justice in the cases dealing with brand names in the European Economic Area are discussed. The author describes the legal system of the European Community and the principles of the Common Market.

A special subchapter is dedicated to the discussion of the Lithuanian institutions responsible for the protection of intellectual property rights. In a separate chapter the history of the Lithuanian Customs (even since the 16th century) is described in detail, the complete structure of the Lithuanian Customs and its development is presented. The activities of the Lithuanian Customs related to the protection of intellectual property rights are analysed. In addition, the author analyses the importance of the protection of intellectual property. Furthermore, the customs blueprints and risk management are studied.

In summary, the book contains a vast amount of useful information. The formulated hypotheses may serve as guidelines for further scientific investigations. The book meets the requirements for high school textbooks, it is well designed and comprise many valuable components, e.g. tasks for self-analysis, illustrative schemes, etc. Visual elements are successfully employed to accentuate important information. Every chapter is ended with control questions. In the final part of the textbook the key concepts and definitions as well as abbreviations are listed. What is more, comments on the tasks for self-analysis are presented.

The textbook is a valuable resource to students as well as to practitioners which seek comprehensive knowledge on the protection of intellectual property in foreign trade.

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TARPTAUTINIŲ KONFERENCIJŲ ATGARSIAI
FROM INTERNATIONAL CONFERENCES

THE SVERIGES RIKSBANK PRIZE IN ECONOMIC SCIENCES IN MEMORY OF ALFRED NOBEL 2009

Economic governance: the organization of cooperation

Elinor Ostrom has demonstrated how common property can be successfully managed by user associations. Oliver Williamson has developed a theory where business firms serve as structures for conflict resolution. Over the last three decades these seminal contributions have advanced economic governance research from the fringe to the forefront of scientific attention.

Economic transactions take place not only in markets, but also within firms, associations, households, and agencies. Whereas economic theory has comprehensively illuminated the virtues and limitations of markets, it has traditionally paid less attention to other institutional arrangements. The research of Elinor Ostrom and Oliver Williamson demonstrates that economic analysis can shed light on most forms of social organization.

Elinor Ostrom has challenged the conventional wisdom that common property is poorly managed and should be either regulated by central authorities or privatized. Based on numerous studies of user-managed fish stocks, pastures, woods, lakes, and groundwater basins, Ostrom concludes that the outcomes are, more often than not, better than predicted by standard theories. She observes that resource users frequently develop sophisticated mechanisms for decision-making and rule enforcement to handle conflicts of interest, and she characterizes the rules that promote successful outcomes.

Oliver Williamson has argued that markets and hierarchical organizations, such as firms, represent alternative governance structures which differ in their approaches to resolving conflicts of interest. The drawback of markets is that they often entail haggling and disagreement. The drawback of firms is that authority, which mitigates contention, can be abused. Competitive markets work relatively well because buyers and sellers can turn to other trading partners in case of dissent. But when market competition is limited, firms are better suited for conflict resolution than markets. A key prediction of Williamson's theory, which has also been supported empirically, is therefore that the propensity of economic agents to conduct their transactions inside the boundaries of a firm increases along with the relationship-specific features of their assets.

Governing the commons

Many natural resources, such as fish stocks, pastures, woods, lakes, and groundwater basins are managed as common property. That is, many users have access to the resource in question. If we want to halt the degradation of our natural environment and prevent a repetition of the many collapses of natural-resource stocks experienced in the past, we should learn from the successes that failures of common-property regimes. Ostrom's work teaches us novel lessons about the deep mechanisms that sustain co-operation in human societies.

It has frequently been suggested that common ownership entails excessive resource utilization, and that it is advisable to reduce utilization either by imposing government regulations, such as taxes or quotas, or by privatizing the resource. The theoretical argument is simple: each user weighs private benefits against private costs, thereby neglecting the negative impact on others.

However, based on numerous empirical studies of natural-resource management, Elinor Ostrom has concluded that common property is often surprisingly well managed. Thus, the standard theoretical argument against common property is overly simplistic. It neglects the fact that users themselves can both

create and enforce rules that mitigate overexploitation. The standard argument also neglects the practical difficulties associated with privatization and government regulation.

Failed collectivization and privatization

As an example of Ostrom's concerns, consider the management of grasslands in the interior of Asia. Scientists have studied satellite images of Mongolia and neighboring areas in China and Russia, where livestock has been feeding on large grassland areas for centuries. Historically, the region was dominated by nomads, who moved their herds on a seasonal basis. In Mongolia, these traditions were largely intact in the mid-1990s, while neighbouring areas in China and Russia – with closely similar initial conditions – had been exposed to radically different governance regimes. There, central government imposed state-owned agricultural collectives, where most users settled permanently. As a result, the land was heavily degraded in both China and Russia. In the early 1980s, in an attempt to reverse the degradation, China dissolved the People's Communes and privatized much of the grassland of Inner Mongolia. Individual households gained ownership of specific plots of land. Again, as in the case of the collectives, this policy encouraged permanent settlement rather than pastoral wandering, with further land degradation as a result. As satellite images clearly reveal, both socialism and privatization are associated with worse long-term outcomes than those observed in traditional group-based governance.

Failed modernization

There are many other examples which indicate that user-management of local resources has been more successful than management by outsiders. A striking case is that of irrigation systems in Nepal, where locally managed irrigation systems have successfully allocated water between users for a long time. However, the dams – built from stone, mud and trees – have often been primitive and small. In several places, the Nepalese government, with assistance from foreign donors, has therefore built modern dams of concrete and steel. Despite flawless engineering, many of these projects have ended in failure. The reason is that the presence of durable dams has severed the ties between head-end and tail-end users. Since the dams are durable, there is little need for cooperation among users in maintaining the dams. Therefore, head-end users can extract a disproportionate share of the water without fearing the loss of tail-end maintenance labour. Ultimately, the total crop yield is frequently higher around the primitive dams than around the modern dams. Both of the above-mentioned failures refer to economically poor regions of the world. However, the lessons are much more far-reaching. Ostrom's first study concerned the management of groundwater in parts of California and also highlighted the role of users in creating workable institutions.

Active participation is the key

While Ostrom has carried out some field work herself, her main accomplishment has been to collect relevant information from a diverse set of sources about the governance – successful and failed – of a large number of resource pools throughout the world and to draw insightful conclusions based on systematic comparisons. The lesson is not that user-management is always preferable to all other solutions. There are many cases in which privatization or public regulation yield better outcomes than user management. For example, in the 1930s, failure to privatize oil pools in Texas and Oklahoma caused massive waste. Rather, the main lesson is that common property is often managed on the basis of rules and procedures that have evolved over long periods of time. As a result they are more adequate and subtle than outsiders – both politicians and social scientists – have tended to realize. Beyond showing that self-governance can be feasible and successful, Ostrom also elucidates the key features of successful governance. One instance is that active participation of users in creating and enforcing rules appears to be essential. Rules that are imposed from the outside or unilaterally dictated by powerful insiders have less legitimacy and are more likely to be violated. Likewise, monitoring and enforcement work better when conducted by insiders than by outsiders. These principles are in stark contrast to the common view that monitoring and sanctioning are the responsibility of the state and should be conducted by public employees. An intriguing outcome of these field studies concerns the willingness of individual users to engage in monitoring and sanctioning, despite only modest rewards for doing so. In order to ascertain more about individuals' motivations for taking part in the enforcement of rules, Ostrom has conducted innovative laboratory experiments on cooperation in groups. A major finding is that many people are willing to incur private costs in order to sanction free-riders.

Markets versus hierarchies

Nowadays, a large fraction of economic activity takes place within firms. Oliver Williamson has facilitated our understanding of why this is so. More broadly, he has taught us to regard markets, firms, associations, agencies, and even households from the perspective of their contribution to the resolution of conflict. Why are there large firms? Couldn't we all be self-employed, trading our goods and services in the market? A general answer to this question was proposed more than seventy years ago by Ronald Coase, who received the 1991 Prize in Economic Sciences. According to Coase, firms tend to emerge whenever transaction costs, i.e., the costs of exchanging goods, services, and money, are lower inside a firm than in the corresponding market. But what exactly are those transaction costs that may tip the balance between markets and hierarchies? While Coase offered tentative suggestions, the question remained elusive. An appropriate answer should explain why some firms grow by integrating many stages of production, whereas other firms in the same industry focus on only one or a few production stages, thereby leaving other stages to suppliers or customers. As an example, take the energy sector, where some companies operate both coal mines and coal-burning power plants, whereas other similar mines and plants are operated as separate firms.

Efficient conflict resolution

In the early 1970s, Oliver Williamson argued that hierarchical organizations sometimes dominate markets because they provide a cheaper way to resolve conflicts. If two employees quarrel about the allocation of tasks or the distribution of revenues, a chief executive is entitled to decide. In a market, on the other hand, negotiations have to continue until both parties agree. Haggling costs can be substantial, and there is no guarantee that the final agreement will be either immediate or efficient. This argument may seem to suggest that all transactions should take place in a single giant firm. But this is clearly not an accurate description of the world as we know it. The last decade has witnessed just the opposite. Considerable outsourcing has taken place, sometimes by merely selling part of a company, while activities continue in all units much as before. That is, outsourcing creates a market transaction replacing an internal transaction. In order for this kind of outsourcing to make any sense, there must be drawbacks associated with hierarchical organization too. A common view

had been that hierarchical organization is costly because it entails administrative costs. Williamson realized that this view was unsatisfactory, because it is eminently possible to move the boundaries of firms without changing administrative routines. Instead, Williamson argued that the primary reason why hierarchies are problematic is that executive authority can be abused – for example by extracting surplus from subordinates in unproductive ways.

Mutual dependence behind hierarchical organizations

How can these rather broad assertions be transformed into a theory of governance that yields nontrivial and falsifiable implications? Williamson's key insight is that the value of conflict resolution depends on two main factors. First, there is no point in being able to resolve conflicts that never arise. If it is easy and cheap to regulate future transactions through a contract, there is little need for a firm. Thus, there will not arise firms unless there are limitations to contracting. Second, there is no reason to be able to resolve conflicts if disagreement is costless. If both the seller and the buyer can easily find other suitable trading partners, the firm is again superfluous. In other words, Williamson expects hierarchical organizations to emerge when transactions are complex or non-standard, and when parties are mutually dependent. Perhaps the most typical case of mutual dependence is that parties have assets, either physical assets or knowledge, which are only valuable inside a relationship. Let us see whether this theory can explain the boundaries of firms in the energy market described above. The value of a coal mine in case the owner cannot agree on the terms of trade with a nearby power plant depends on the distance to the second-nearest buyer of coal, which is usually another power plant. Likewise, the value of a coal-burning power plant in case it cannot trade with the nearby coal mine depends on the distance to the second nearest mine. The larger the distances, the greater is the mutual dependence, and – according to the theory – the more likely the mine and the plant are vertically integrated. This is precisely what is observed. When there are other nearby mines and power plants, firms are typically incorporated separately and trade under relatively short and simple contracts. As the distance to alternative trading partners increases, contract duration and complexity also increase. According to one of the studies, a coal-burning power plant that is located next to a coal mine is about six times more

likely to be fully integrated than is any other coal-burning power plant.

Policy implications

Williamson's theory of the firm has been tested extensively in many other industries too, and the empirical support is strong. Activities are more likely to be organized inside firms when transactions are complex and assets are relationship-specific. Moreover, Williamson's general framework has proven productive in analyzing all sorts of incomplete contracts, ranging from implicit contracts between household members to financial contracts between entrepreneurs and investors. According to Williamson's theory, large private corporations exist primarily because they are efficient. They are established because they make owners, workers, suppliers, and customers better off than they would be under alternative institutional arrangements. When corporations fail to deliver efficiency gains, their existence will be called in question. Large corporations may of course abuse their power. They may for instance participate in undesirable political lobbying and exhibit anticompetitive behaviour. However, according to Williamson's analysis, it is advisable to regulate such behaviour directly rather than through policies that limit the size of corporations.

Source: http://nobelprize.org/nobel_prizes/economics/laureates/2009/press.html

FURTHER READING

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. New York: Cambridge University Press, p. 298.

Williamson, O. E. (1998). The Economic Institutions of Capitalism. New York: Free Press, p. 468.

Ostrom, E. et al. (1999). Revisiting the Commons: Local Lessons, Global Challenges. In: Science, 284: 278–282.

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"METHODOLOGICAL ISSUES IN FORESIGHT STUDIES" YEDITEPE INTERNATIONAL RESEARCH CONFERENCE ON FORESIGHT, YIRCOF'09. SEPTEMBER 4 - 6, 2009, ISTANBUL

38 individuals from 18 countries, both from academic (economics, management, political science, architecture and engineering) and business worlds came together to discuss and communicate on challenging problems related to methodological issues in foresight studies. Participants from Norway, Poland, Sweden, Thailand, Japan, South Korea, Denmark, the UK, Spain, the U.S. and other countries shared their scientific research experience. The most insightful presentations include: "Sectoral Foresight in Poland - Thematic and Methodological Analysis" by Ł. NAZARKO (Poland); "S&T Foresight Baker's Dozen – A Pocket Primer of Comparative & Combined Foresight Methods" by Jack E. SMITH (Canada); "Foresight Study in Korea" by Jong Guk SONG (South Korea); "Trial of a New Science and Technology Foresight Survey" by Yuko

ITO (Japan); "Systemic Foresight Methodology" by Özcan SARITAŞ (the UK). V. RUDZKIENĖ (Lithuania) presented a study "Analytical Approach using Clusters' Hierarchy for e-Government Modelling".

Presentations were given at three thematic sessions.

National Foresight. Foresight at the national level used to address (i) choices within the domain of science and technology, and (ii) the structures by which science and innovation achieve impacts upon the economy and society. This track was based on the experience gained from the national Foresight exercises and new research methodologies.

Regional Foresight. Both supra-national Foresight, covering more than one country, and sub-national Foresight, covering a smaller region of a country or neighbour regions of multiple countries, were

considered in this track. Supra-national Foresight has been useful to promote joint analysis of common problems, detect opportunities for

cooperation, identify complementary attributes, and define infrastructures needed, which are not feasible at the national level. Sub-national Foresight is the application of foresight methods (involving some combination of five essential elements — anticipation, participation, networking, vision, action) to inform and orient policy decisions that are taken at the sub-national level.

Sectoral and Corporate Foresight. The challenges faced by firms reflect the structural changes taking place in the economy and society. A new global setting of the world economy is defining the framework for the operation of the industrial sector both inside the national boundaries and internationally. In this context, the corporate sector and industries use Foresight to detect and prepare responses to such changes.

Conference Outputs. Selected papers will be published in special issues of *International Journal of Innovation and Technology Management (IJITM)* and *Futures*.

The Foresight Initiatives Network of the conference participants was created and mutual cooperation on research and publications was agreed upon. An Erasmus Agreement between Mykolas Romeris University, Faculty of Economics and Finance Management and Yeditepe University, Department of Business Administration was signed. The proposal for COST Actions *The Impact of Megatrends on Future Societies and Life Quality in Different European Regions Using Foresight Methodology* was accepted.

According to global economy forecasts, Turkey is a country with a business environment friendlier than in the majority of CEE and advanced countries. It indicates the future growth of economy. All participants agreed about an extraordinary input from the organising team, the Executive Committee and its Chair Dr. M. Atilla Öner. The next YIRCoF '11 Conference *"Theory Building in Foresight and Futures Studies"* will take place on August 24 - 26, 2011 in Istanbul.

Dr. ass. prof. Eugenija Martinaitytė

ATMENA ŽURNALO „INTELEKTINĖ EKONOMIKA" AUTORIAMS

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