VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

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IMPACT OF INNOVATIONS AND FIXED INVESTMENTS ON ECONOMIC GROWTH OF THE COUNTRY: LITHUANIA IN THE CONTEXT OF EUROPEAN UNION

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ECONOMICS (04S)

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INOVACIJŲ IR MATERIALIŲJŲ INVESTICIJŲ POVEIKIS ŠALIES EKONOMINIAM AUGIMUI: LIETUVA EUROPOS SĄJUNGOS ŠALIŲ KONTEKSTE

DAKTARO DISERTACIJA

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Abstract

This dissertation analyses innovations and fixed investments as well as their impact on economic growth by sector in all European Union member states in the period of 2000–2010. The main researched subjects are: innovativeness of European Union member countries, fixed investments and variations in their structure.

The aim of the work is to evaluate the contemporary approaches towards innovations, fixed investment as heterogeneous driving force of economic growth and impact of those forces on economic and sector growth of Lithuania in the context of the EU. Existence of consistent patterns is to be clarified.

The work consists of introduction, four chapters, general conclusions, list of references and references to the author‘s publications on the dissertation topic as well as annexes. The total scope of the dissertation – 125 pages excluding addenda, 20 figures, 22 tables and 4 addenda.

The introduction sets out the problem analysed and its topicality, the goal and tasks of research. It also presents the defended statements and scientific novelty of the work.

The first chapter analyses innovations, their different conceptions, the origin of innovation science, classification and types of innovation, innovation measurement systems, factors suppressing and stimulating innovation, legal environment of innovations.

The second chapter analyses fixed investments, different approaches towards fixed investment impact on economic growth and legal environment of fixed investments.

The third chapter presents Lithuanian enterprise innovativeness survey and economic interpretation of survey results.

The fourth chapter presents the model of research, analyses innovativeness, fixed investments and economic growth in the context of the European Union, researches interrelationship between innovativeness and fixed investments and their impact on economic growth by structure.

The results of the work help to presume the character of impact of innovations and fixed investments, its constituents on particular economic sectors in order to formulate innovation and fixed investment stimulation policies for specific economic sectors (state programs, objective projects; objective support for business and other).

The author of the dissertation has published 12 publications in Lithuania and abroad. Nine of them – in reviewed scientific editions and three – in other editions.

Reziumė

Disertacijoje nagrinėjamas šalių inovatyvumas ir materialiosios investicijos. Pagrindiniai tyrimų objektai – Europos Sąjungos narių šalių inovatyvumas, materialiosios investicijos atskiruose sektoriuose ir jų tarpusavio sąryšis; ES narių šalių inovatyvumo, ir materialiųjų investicijų poveikis ekonominiam augimui atskiruose ūkio sektoriuose. Pagrindinis disertacijos tikslas – įvertinti šiuolaikinius požiūrius į inovacijas ir materialiąsias investicijas, kaip į heterogeninę ekonomikos augimo varomąją jėgą ir jos poveikį ekonomikos ir atskirų jos sektorių augimui Lietuvoje, įvertinti dėsningumus Europos Sąjungos šalių kontekste.

Disertaciją sudaro įvadas, keturi skyriai, bendrosios išvados, naudotos literatūros ir autoriaus publikacijų disertacijos tema sąrašai bei keturi priedai. Bendra disertacijos apimtis – 125 puslapiai (neskaičiuojant priedų), 20 iliustracijų, 22 lentelės ir 4 priedai.

Įvade pateikiamas disertacijoje gvildenamos problemos aktualumas, tyrimo tikslas, uždaviniai, pristatomi ginamieji teiginiai bei mokslinis darbo naujumas.

Pirmasis skyrius skirtas inovacijų apžvalgai. Jame pateikiamos skirtingos inovacijų sampratos, apžvelgiamos inovacijų sąvokos ir inovacijų mokslo raida, inovacijų klasifikavimas ir tipai. Skyriuje taip pat pristatomos inovacijų matavimo sistemos, inovacijas stabdantys ir skatinantys veiksniai bei inovacijų teisinė aplinka.

Antrajame skyriuje apžvelgiamos materialiosios investicijos, skirtingi požiūriai į materialiųjų investicijų poveikį ekonominiam augimui, teisinė materialiųjų investicijų aplinka.

Trečiajame skyriuje pristatoma atlikta Lietuvos įmonių inovacinės veiklos apklausa ir jos rezultatai.

Ketvirtajame skyriuje pateikiamas tyrimo modelis, analizuojamas inovacijų ir materialiųjų investicijų tarpusavio poveikis bei šių veiksnių poveikis Europos Sąjungos šalių narių ekonominiam augimui, analizuojant skirtingas struktūros dedamąsias.

Darbo rezultatai suteikia pagalbą vertinant tiesioginių investicijų įtaką inovatyvumui, inovatyvumo įtaką ekonominiam augimui ir tiesioginių investicijų įtaką ekonominiam augimui. Šie vertinimai naudingi formuojant inovacijų ir materialiųjų investicijų skatinimo politiką atskiroms ūkio šakoms (valstybės programos, tiksliniai projektai, tikslinė parama verslui ir kt.).

Disertacijos tema paskelbta 12 publikacijų Lietuvoje ir užsienyje. Devynios iš jų – recenzuojamuose mokslo žurnaluose, trys – kituose leidiniuose.

Notations

Abbreviations

CII	Composite innovation index;
CIS	Community innovation survey;
EC	European Community;
EIS	European innovation scoreboard;
EPO	European Patent Office;
EU	European Union;
EU27	27 European Union member states;
GDP	Gross domestic product;
OECD	Organization for Economic Cooperation and Development;
R&D	Research and development;
RIS	Regional innovation scoreboard;
S&E	Science and engineering;
S&T	Science and technology;
SII	Summary innovation index;
SMEs	Small and medium-sized enterprises;
UN	United Nations.

Contents

Introduction

Topicality of the Problem

Post-industrial economies, also called innovative economies, are considered as the most economically powerful economies of the world. However the influence of new emerging countries has become more and more noticeable in the world economy. Certainly, the speed of integration into the global economy, based on innovations and knowledge space depends on the national innovation system of individual countries. Obviously the innovative activities are not on the same level of development in all countries. Also it is not supported by the same means. Every national innovation system has its own typical characteristics. In scientific literature different innovation definitions as well as conceptions are presented and different innovation impact towards economic growth are being considered.

In scientific literature fixed investments (expenditures on acquisition of buildings, engineering structures, equipment, machines, vehicles; construction and renewing of available long-time fixed assets) are treated as factors that also significantly affect economic development. In modern scientific literature discussions present different opinions on the impact of fixed investments on economic growth.

Therefore, the main goal of this dissertation is on the interrelationship between innovations and fixed investments and their impact on the development of economic sectors.

The Object of Research

Innovativeness of European Union member countries, fixed investments in different sectors and their impact on economic growth in particular economic sectors.

The Goal of the Thesis

The goal of the work is to evaluate the contemporary approaches towards innovations, fixed investment as heterogeneous driving force of economic growth and impact of those forces on economic and sector growth of Lithuania in the context of European Union member countries. Existence of consistent patterns is to be clarified.

The Tasks of the Thesis

To achieve the specified goal, the following tasks should be performed:

1. To perform critical analysis of scientific literature, official documents and other relevant information sources in order to reveal complexity of innovation notion and to detect differences of treatment of innovation, prevailing in different sources, i.e. to highlight that innovation treatment of officially recognized institutions might differ from perceptions of business companies operating in real markets.
2. To evaluate critically contemporary approaches towards role of fixed investment as driving force of economic growth. To reveal differences of significance treatment of fixed investments as countries develop. To test if role of fixed investment remain the same in earlier and late levels of countries' development estimated in terms of innovativeness.
3. After tuning theoretical treatment of innovations and treatment prevailing in practice of Lithuanian enterprises, to perform quantitative analysis of interrelation between innovations and fixed investments. Taking into account that fixed investment is not homogenous, i.e. embraces investment into very different fields, such as equipment, construction etc., the analysis of relationship between fixed investment comprising parts and innovativeness has to be

performed. The results would allow finding out if structure of fixed investment is important for increase of innovativeness of the country; the context of the EU is to be taken.

4. As innovativeness is a generalized indicator provided for a country, estimation of interrelationship between innovativeness indicator and economic growth of Lithuania in the context of the EU is to be provided. To go beyond analysis of rather general indicators interrelationship is to be scrutinized at the level of the main branches of economy; i.e. interrelationships between innovativeness indicator and the following branches - construction, industry, including energy sector, trade, transport and communication services, business activities, financial services - are to be estimated.

5. Analogic approach is to be adapted to fixed investment and economic growth elaboration: estimation of interrelationship between fixed investment indicator and economic growth of Lithuania in the context of the EU is to be provided. Sequently, fixed investment impact on main branches of economy is to be defined.

6. After raised scientific questions would be answered, main insights, characterizing role of fixed investment, its structure in innovativeness development, innovativeness impact on growth economy and its main branches and impact of fixed investments on economy and its branches growth, will be provided. The context of the EU countries provides with additional insights for identification of consistent patterns.

Research Methodology

Methodology of research includes the systematization, comparison and summarization of the scientific propositions and empirical studies' results. The empirical research includes descriptive statistics, one-sample Kolmogorov–Smirnov test, correlation analysis, t-test, analysis of variance and other research methods. The analysis is performed using Microsoft Office Excel Professional 2010 and IBM SPSS (Statistical Package for the Social Sciences) version 19 software.

Importance of Scientific Novelty

While preparing the dissertation the following new results were obtained for the economical science:

1. A new approach towards investigation of impact of innovations and fixed investment on growth of economy and its sectors has been developed.

Novelty is embedded in putting emphasis on technological aspect of innovativeness, which is being enhanced by respective structure of fixed investment. Heterogeneousness of fixed investment is being emphasized.

2. A model for research of growth of economy and its main sectors depending on innovativeness and heterogeneous fixed investment is being theoretically grounded and presented.

3. The context of the EU countries provided with certain insights letting identify consistent patterns of economic growth conditioned by innovations and particular constituents of fixed investment.

Practical Significance of Achieved Results

The results of the work will help to presume the character of impact of innovations and fixed investments, its constituents on particular economic sectors in order to formulate innovation and fixed investment stimulation policies for specific economic sectors (state programs, objective projects; objective support for business and other) in EU countries.

Using the resulting interrelations and taking into account the level of development of country, and considering consistent patterns characteristic for different levels of development, factors that make the more considerable impact on the economic growth of country can be indicated. Findings should be seen as novel contributing to contemporary approaches of economic growth in the context (based on the evidences) of European Union member countries during the period of 2000–2010. Based on the results of the work, the factors for policy making should be considered.

The Defended Statements

1. Innovativeness of a country is impacted by fixed investment. Constituents of fixed investment determine different effects on innovativeness. Structure of fixed investment appears to be crucial factor affecting innovativeness growth.

2. The context of the EU countries provided with the following insights enabling to identify consistent patterns of economic growth:

2.1. Fixed investments are one of the main conditions for innovativeness for countries that are less innovative. The following constituents of heterogonous fixed investment play a crucial role: construction work: other construction, construction work: housing (paradoxically nor constituent of equipment as stream of investigations claims).

2.2. Innovativeness is actually one of the main conditions for economic growth, but for countries that are less innovative. The following sectors of economy are affected the most: trade, transport and communication services, business activities and financial services.
2.3. Fixed investments are actually one of the main factors stimulating economic growth of EU countries, not depending on their level of innovativeness. The following sectors of economy are affected the most: construction, trade, transport and communication services.

Approval of the Results

The author of the dissertation has published 12 publications in Lithuania and abroad. Nine of them – in reviewed scientific editions and three – in other editions.

Dissertation Structure

The dissertation consists of the general characteristic of the dissertation, 4 chapters, conclusions, list of references, list of publications and addenda. The total scope of the dissertation – 125 pages excluding addenda, 20 figures, 22 tables and 4 annexes.

1

Innovations as a Driving Force of Economic Growth

1.1. Review of Different Innovation Conceptions

Innovation is one of the main and the most important factors of competitive advantage for companies. The central role of innovation in the global economy is also undoubted. The significance of innovation was also highlighted in the field of individual firm's activities, but now the innovation is seen as key regional economic growth indicators. Most literature focuses on the role of innovation in two important respects:

- as a way for organizations to survive and to gain a competitive advantage in a given market;
- as one of the most important national and global general economic growth promoting factors.

Enterprises implement innovations for many reasons. Their objectives may consist of products, markets, efficiency, quality or the ability to learn and to implement changes. Firms' motives for implementing innovations and importance of it may be examined by identifying the forces that drive innovation activities, such as competition and opportunities for entering new markets (OECD 2005).

The main reason of implementing innovations is to improve firms' performance. For example, by increasing demand or reducing costs.

Those times when tangible assets and technology companies were the main factors in the value chain, has already passed, and the ability to constantly innovate, creating new and improving existing products, services or enterprise processes, is becoming a major competitive weapon in the fight for greater market share (Ališauskas *et al* 2005). Paul Trott in his book points out those firms wishing to remain strong in competitive market must adapt in creating and developing the innovation (Trott 1998).

Knowledge based economy leads to rapid changes, so each business unit, in order to better adapt in the competitive environment of European Union and Globe, it is important to update constantly their activities. As one of the most effective ways to upgrade is the search and development of innovation. The role and necessity of Innovation are influenced by shortening of product life cycle, which encourages companies not only to supply existing products on the market, but also look for ways to improve these products.

In the press more and more articles appear about the effects of innovation on a global scale. It is often stated that for global product, services, technology markets correct and active innovation policy is a factor of the successful development of the region. Zina Gineitienė and Juozapas Girdenis in their article (Gineitienė, Girdenis 2004) also argue that innovation is a key factor for economic development. R. Sollow – Nobel Prize winner – long year studies have shown that exactly technological progress, rather than capital is a key factor in economic development processes (Maler 1992).

Probably it is acceptable that role of innovation is extremely important for individuals same as for the whole world economy.

Analyzing innovation it is crucial not only to identify their effects, but also to understand the so often used and at first glance so simple meaning of the word "innovation". This term within a relatively short time has become so important in our society. Thus its meaning is quit complicated and confusing.

1.1.1. Origin of Innovation Science

The origin of the word innovation seeks to XIII century. In XV century in Middle France word "inovacyon" was used as a renewal or a new form of contained object. Meanwhile, in English language, two terms are divided: innovation (innovation) and novation (novation). However, only after the Second World War, this term became used in various countries in the field of scientific and technological innovation (Ališauskas *et al* 2005). The interests toward innovation as a science, has appeared only in 5th decade of twentieth century. One of the main factors that prompted the interest toward innovation was the significant decline

of realization of scientific discoveries. An American scientist F. Linn argued that the average period of takeover of innovation in 1885–1919 was 37 years, 1920–1994 was 24 years, 1945–1964 it took 14 years, and promising discoveries, such as electronics, lasers, nuclear energy, 3–5 years.

The main countries which supported the innovative development were United States, Japan and Germany. These countries have accepted programs encouraging the development of innovation. According to the level of development and implementation of innovation, countries may be divided into three groups.

The countries of the first group are U.S., Germany, Switzerland, Holland and Japan. These states have very effective and quickly responding to the competitive global Marketplace innovation policy. In these countries, governments have a big role, because they carry out long-term and targeted programs encouraging the innovation. It should be noted that these countries have a positive technology trade with other countries balance.

The second group includes countries such as France, Belgium, Canada and Denmark. These countries carry a less intense, compared with the first group of countries, innovative activity and their industrial growth rates are somewhat lower.

The third group includes all other countries, which has quit low effectiveness of the implementation of innovation. These countries in general have the negative balance of technology trade.

Analyzing the history of innovation, the N. Kondratjev and J. Schumpeter's long wave theory has to be named. Nikolai Kondratiev in his work explored the innovation wave dependence on economic cycles (Kondratieff 1984). His studies led to considerable debate about the long-term fluctuations, also called “long-wave theory”. These findings were based on the theory of the various indicators such as interest rates, wages, commodity prices, international trade, bank deposits, etc. N. Kondratjev stressed the importance of economic cycles of from 50 to 60 years stimulate the rising of technology.

N. Kondratjev “long-wave theory” was used by another prominent scientist Joseph Schumpeter. This scientist was analyzing the phenomena of economic crisis and was searching the ways to solve it. He argued that economic fluctuations can be avoided if the innovation process is continuous. Long-wave theory is often associated with J. Schumpeter. Under long-wave theory, the world's economies have already reached the fifth wave of innovation, which is coming to the end by 2020 (Schumpeter 1961).

1.1.2. Different Conceptions

It is mean less to discuss about innovation, it‘s impact on corporate activities, public policy, economics and growth, without first examining the meaning of this word. Although a lot of people often link innovation with novation, but it is not entirely accurate, because, firstly, not all novations can be described as innovative, and, secondly, the concept of innovation is very broad and includes many factors that are often not know. Therefore, this chapter provides a study of contrasting word “innovation”.

In the scientific literature the definition of innovation is given very widely. It might be started with the concept of new ideas, carrying a lot of money for business, and ending with the creation of higher value to the consumer. It is important, that every definition of innovation reveal an important of it. The academic literature contains a number of definitions of innovation, each revealing important aspects of it. Several authors emphasize newness, including anything perceived to be new by the people doing it (Rogers and Kim, 1985) or innovation as something different for each organization into which it is introduced (Downs and Mohr, 1976), or as the generation, acceptance, and implementation of new ideas, processes, products or services (Thompson, 1965) in an applied setting (Mohr, 1969). Some see it as early adoption of a new idea (Rogers and Kim, 1985), others as synonymous with creativity (Jacques and Ryan, 1978), still others as the same thing as improvements (Ellwein, 1985), and a final group as substantive but not revolutionary changes (Merritt, 1985; Deutsch, 1985; Glor 1997).

As it is already mentioned, innovation is often regarded as a key and one of the most important factors for the organization gaining a competitive advantage. International journal of innovation management stated that the definitions of innovation are quite similar in the areas in which they are analyzed. According to the authors, the definition of innovation is conditioned by the activity covered by the definition. Damanpour and Evan, said: “Innovation is a very broad term that can be variously defined depending on the kind of scientific work it is presented” (Damanpour, Ewan 1984).

Thus, in the literature the range of definitions of innovation are sufficiently broad. Different authors provide detailed or sometimes very short or even more abstract definitions. It is possible to divide the definition of innovation in certain groups. Such attitudes towards the definition of innovation may be presented:

- process approach;
- socioeconomic approach;
- managerial / organizational approach;
- technological / marketening approach;
- systematic approach.

Many writers are looking to innovation as to a process which leads to creating

a novelty. In Procedural approach innovations are defined as specific actions needed for achieving the final result. Often, innovation, as some processes, consists of the stages, each of which is an important and necessary.

Before the analyzing the innovation as a process, it is necessary to find out what the process is. Process (from Latin processus – moving forward) – means developing naturally or artificially created certain sequence of actions, often using appropriate resources and causing a certain result.

Blohowiak sees innovativeness as the process of a) encouraging creativity, and of b) putting the resulting new ideas to work, of developing the opportunity (Blohowiak 1992).

Other author Vadim Kotelnikov, declares that "Innovation – is a process offering new ideas for consumers. It is the application of knowledge in trade and service sector" (Kotelnikov 2001).

Bruce D. Merrifield gives such attitude towards innovation: "The three stages in the process of innovation: invention, translation and commercialization". He also objects innovation as "not one time event, but risky, complex, interactive and consecutive program of creation of new ideas, production and marketing" (Merrifield 1986).

"Innovation is a process of idea generating, enterpreneuring or Championing; Project Leading; Gatekeeping; Sponsoring or Coaching" is said by Edward B. Roberts and Alan R. Fusfeld (Roberts, Fusfeld 1980).

According to Donald G. Marquis "Model of the Process of Innovation: 1. recognition (technical feasibility and potential market demand), 2. idea formulation (fusion into design concept hand evaluation); 3. problem solving (search, experimentation, and calculation; readily available information); 4. solution (solution through invention; solution through adoption); 5. development (work out the bugs and scale up); 6. Utilization and Diffusion (implementation and use)" (Marquis 1988).

"Innovation is the combination of two processes: creativity and implementation" Richard K. Lyons, Jennifer A. Chatman, Caneel K. Joyce declare (Lyons *et al* 2007).

In new marketing magazine the scheme of innovation process was presented (Fig. 1.1). According it innovation is certain process which needs certain input and gives certain output. Process consists of such parts as creating new concepts, redesigning the production processes, developing products, redesigning the marketing processes, which cooperate between each other and may be affected by managing knowledge and technology (Terré i Ohme 2002).

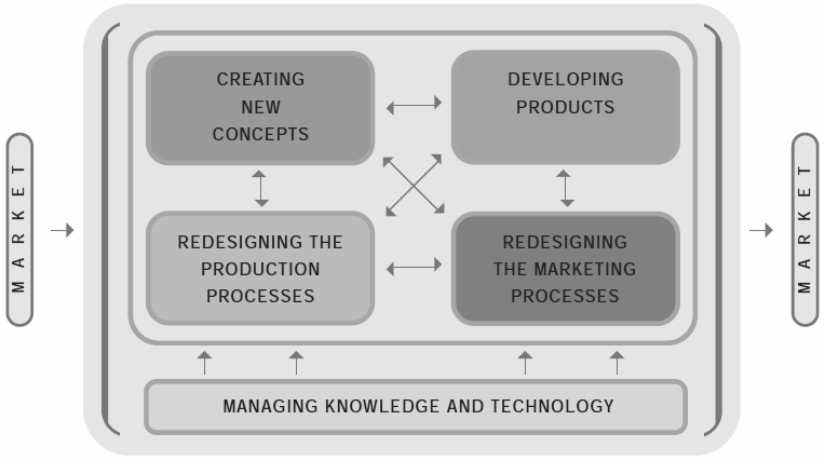

Fig. 1.1. The Scheme of Innovation Process

Many authors consider that the innovation must lead to economic benefits, create a real economic value. Therefore, when talking about the concept of innovation, mostly economic and even social effects are highlighted. In this case, created value of innovation is the most important aspect of it. One of the first creators of the theory of Innovation J. Schumpeter named innovation as the main cause of cyclical economic fluctuations (Melnikas *et al* 2000).

He argued that the economic rise is when businessmen in their activities use new technological inventions and new methods of management. J. Schumpeter considered innovations more as economic as a technological phenomenon. "Whatever the technological breakthroughs are, it will not be an innovation, if do not lead to an economic growth of profit growth". In order to get profit for the company, innovation should create and maintain a unique advantage compared with domestic and international competitors. Profit in this case means the profit created by innovation by itself, excluding the profit from other factors.

"Innovation – is a creating of new value and benefit, which help to the growth of business" is stated by Russia economist Vadim Kotelnikov (Kotelnikov 2001).

"Innovation is a process which proceeds from the conceptualization of a new idea to a solution of the problem and then to the actual utilization of a new item of economic or social value" is written by S. Meyers and D.G. Marquis (Myers, Marquis 1968).

The famous scientist of innovation Joyce Wycoff gives such a definition of innovation: "Innovation is using new knowledge and understanding to experiment with new possibilities in order to implement new concepts that create new value" (Frey 2004).

"Innovation is a method to transform the ideas of people, creating value" is declared by Paul Schumann et al (Schumann *et al* 1994).

In the Green Book of EU it is noted that: "Innovation – it is successful producing of any novelty, absorption and exploitation in economic or social field" (European Commission 2001).

Paul Romer thinks that innovation is the biggest instrument, power capable to improve life level and to create the bigger value for consumers (Romer 1994).

The specialist of Japan management system K. Urabe suggests such a definition of innovation: "innovation consists of generating of new ideas and implementation of it in the field of new products, process or services, which determine the increasing of national economic and occupation and increasing of profit for company implementing innovations"(Urabe 2004).

There are also authors who prelate innovation with enterprise and perceive them as a management tool or corporate organizational changes. Frequently, innovations considered as a source of competitive advantage. Such authors may be considered as supporters of managerial / organizational approach toward innovation.

P.F.Drucker sees innovation as a specific tool of entrepreneurs, the means by which they exploit change as an opportunity different business or a different service (Drucker 2006).

Another scientist – Damanpour – gives us such definition: "Innovation – this is creation and application of internal machinery, system, policy, program, process, product or service in company" (Damanpour 1988). Damanpour also gives such definition of innovation: "Innovation – is generation and implementation of certain part of the firm new conceptions and ideas" (Damanpour 1991).

"Innovation – is some kind of level of company's transformation" (Mohr *et al* 2009).

"Innovation – it is creation and application of a new, previously tested and significantly improved objects in organization, which directly is a benefit for organization and indirectly for its consumers". (Business Council of Australia 2006).

"Innovation is something new, what is implemented in separate companies". (Downs, Mohr 1979).

"Innovation – it is a background of flexible and preparing to survive in future organization" (Lapres 2008).

In many cases, however, the innovation is viewed as some ideas for new products and services. Such approaches are often related to marketing, since new ideas and products are presented to the market. Innovation is often accompanied by a technological point of view and describes certain technological improvements

and enhancements. A lot of scientists share Technological / Marketing approach towards innovation.

It is now widely used such a descriptive term: "Innovation – it is successful commercial implementation of new technologies, ideas and methods, in the field of presenting new or improved products and processes to the market" (European Commission, OECD 2009).

Professor Gerald Zaltman et al. describe innovation as "certain idea, practice or material product of person's work, which is newly implemented" (Zaltman *et al* 1984).

"Innovation – is an implementation of new ideas" was said by other two authors Rogers and Kim (Rogers, Kim 1985).

"Innovation – it is introduction of new product or new service to the market, which was not seen by consumers before... It is discovery of a new market. It is creation of new supply of the products" tells economist, the pioneer of innovation science Schumpter (Schumpeter 1947).

"Innovation – it is improvement of service product, which is new". Declares Urabe, Child, Kagono (Urabe *et al* 1988).

In scientific literature a lot of scientists see innovation as a certain system, which involves a lot of factors. Others scientists separate these factors and concretize them separately. The supporters of systematical attitude name in the description of innovation more than one characteristic common to innovation. This attitude in some kind connects all other attitudes which were named before.

Professor P. Kulviec gives us such generalized definition of innovation: "Innovation generally means complex creation, development, universal spread and effective implementation of novations in various fields of human activities". He suggests to separate and use terms of innovation and novation. Innovation is suggested to understand as a process, meanwhile, novation as a result of mentioned process (Staškevičius 2004).

According to Boer and During, innovation – it is creation of combination of new product, marketing, technology in the company (Boer, During 2001).

"Innovation in economics is related with first commercial implementation of product, process or system" thinks Christopher Freeman (Freeman, Soete 1997).

"The process of innovation must be viewed as a series of changes in a complex system not only of hardware, but also of the market environment, production facilities and knowledge and the social contexts of the innovation organization". Steven J. Kline and Gnathion Rosenberg (Rosenberg *et al* 1986).

U.S. scientist W. R. Maclaurinsuggestes such definition of innovation: "when invention is commercialized in such way that product is started to produce or is improved, it become an innovation" (Jakubavičius *et al* 2003).

As it can be noticed, there are such authors, who share few attitudes towards innovation. This fact only illustrates us that there is no one definition, which can directly and concretely reveal what the world innovation means.

Meanwhile Department of Statistics of the Republic of Lithuania in one of its presented catalogue defined innovation as: "Innovation – commercial implementation of new technologies, ideas and methods, presenting to the market new or improved products or services, implanting new (developed) production (service supplement) technological processes" (Department of Statistics of the Republic of Lithuania 2010).

It is stresses that innovation may be evaluated only when, then new or improved product will be presented to the market or when it will be started to use in manufacturing process. It is also highlighted that new or improved products may be considered to be innovation in the company level also (not only in the market level).

Tinnesand researched the definitions of innovation. In 1973 m., appealing to 188 publications, his research showed that 36 percent of respondents thought that innovation mean the implementation of new idea, 16 percent respondents – named it as new idea, 14 percent – idea, diverge from the other ideas, the same number thought that innovation mean the implementation of invention, 11 percent – the implementation of behavior disturbing idea, 9 percent – as an invention (Ališauskas *et al* 2005).

In nowadays society, word innovation is being heard too often. Politicians, businessman, scientists and other characters of society use this word constantly. As it can be noticed from the previous definitions, a big part of economists and scientists prelate innovation with new products, services, new ideas – factors, which helps to adapt to the conditions of environment, to get advantage in competition, getting bigger profit and creating bigger economic value. Thus, novelty, despite of a facts, is it new product, service, method of organization managing or element of marketing, is a fundamental condition of innovation. The question arises: what does the word "new" means. Some things which are new for certain group of people are well known for other.

J. Schumpeter gives us five forms of innovation (Malerba, Orsenigo 1995), which describe what is new:

- new products and services, which were not known for consumers earlier, or producing of existing, but having higher quality, production;
- new process of production, which is new in some kind of sector and not necessary promoted by new scientific results. It is selfsame new commercial procedure;
- new opportunities of distribution – the opening of new markets, in which certain industry was not taking part yet, despite of the fact where that market existed before;

- new sources of stocks, which existed before, but nobody had drew attention toward it;
- new organizations, which are suitable for performing certain tasks.

Conversely A. Jakubavičius, R. Strazdas, K. Gečas declare that innovation is not complete original, which creation was based on new knowledge, it consist of 99 % well known facts and only 1 % it is issues based on novelties. According to the authors, innovation cannot appear from nowhere, new ideas need well tested information, allowing going forward (Jakubavičius *et al* 2003).

Another question for who it is knew? According to K. Ališauskas, H. Karpavičius and J. Šeputienė, the meaning of innovation, considering the subject for who it is new, may be (Ališauskas *et al* 2005):

- new for certain market;
- new for separate company;
- new in national level;
- new in global level.

Another important factor, related with innovation, is the factor of success. Success, successful implementation of innovation was stressed by big part of mentioned authors. Operating in competitive market, when the only alternative way to survive is to be a pioneer – permanent search of innovation, implementation of it. Success in this situation becomes a very important factor.

The next question is what is the meaning of the success? How it can be evaluated? During the process of evaluation of success, A. Jakubavičius, R. Strazdas, and K. Gečas suggests drawing our attention to such factors as decreasing costs, increasing income, higher turnover. J. Schumpeter sees innovation as economic phenomenon and says that no technological invention can be named as innovation till it does not fate increasing of the income, which is gotten because of the implementation of innovation (Jakubavicius *et al* 2003). The role of success is also stressed in Green book of European Commission, where such a definition of innovation is embodied: "Innovation – it is successful production of any novelty, absorption and exploitation of it in economic to social environment".

A lot of other scientist for example Luecke and Katz, Amabile, Robert Lawrence Kuhn and others stresses success as one of the basic factors of innovation (Harvard Business School 2003).

Success and element of novelty are the main factors that separate innovation and invention. Thus, there are number of authors who prelate innovation not only with novelty and success, but also with creativity. Creativities are also very important factor of innovation.

Latest scientific literature stresses the impacts of innovation on competitiveness. New technologies, innovative companies can help to increase the possibilities of international competitiveness.

Each definition competitiveness and creativity may have an impact on attitude towards innovations. Of course the relation of innovation factors in each case depends on the kind of the certain innovation. According to analysis of the definitions of innovations it is clear that there is no universal description of the word “innovation” as well as there is no uninfected classification of innovations. After the analysis of the definition of innovation, the author of this work defines innovation as new products, services, management and marketing processes or substantial improvements, which enable to be more successful in the market, to create bigger additional value to the company as well as to the economics of the certain country.

1.1.3. Classification and Types of Innovation

There are now universal standards of identical system of classification of innovation. It should be stressed that classification of innovation depends on the attitude of author towards innovation. In this chapter of work the main classifications of innovation will be presented.

During the process of classification of innovation, the main issue is to find the starting point. For example A. Jakubavičius, R. Jucevičius and other authors, classify innovations into eight point (Jakubavičius *et al* 2008).

The innovation of the content:

- technological – it is innovation, which helps to create and implement new technologies;
- complex – it is innovations, which relate between each other all innovations of the content;
- social – it is innovations, by which it is seeked to create and to implement new managerial, organizational and economic structures;
- by using product innovations it is pursued to create, produce and use new products.

Effect innovation:

- complex innovation – it is synthesis of economic, ecologic and social innovations;
- by economic innovations it is pursued to have major productivity, income, and lower costs;
- by the ecologic innovation it is pursued to find the ways for the resolution of ecological problems;
- by the social innovation it is pursued to reduce unemployment, to expand social services.

Innovation in accordance with final result:

- the final result of experimental innovation is backed up by the experimental examples of the product, created after scientific researches;
- the final result of fundamental innovation is scientific theory;
- the final result of diffused innovation is the application of existing products for the mass production in separate companies, regions;
- the final result of conditional innovation is the partial renewal of existing products;
- the final result of basic innovation is the mass production of the experimental product for the first time in separate company.

Innovations in accordance of the level of novelty:

- modificating innovations – it is the improvement and development of existing products;
- radical innovation – it is creation of new methods, which supply new or existing demand.

Innovation in accordance with character:

- qualitative innovation seeks to increase the quality of producing, managing and etc.
- quantitative innovation seeks to increase the productivity and the amount of it.

Innovation in accordance with the level of implementation:

- society‘s/State‘s – innovation which is implemented with a help of society or state;
- ecosystem’s – innovation, implementation of which affects all ecosystem;
- economy‘s branch – innovation, which is implemented in certain branch of economy;
- human‘s – innovation, the implementation of which is important for separate human being;
- global – innovation, which are implemented in the global level.

Innovation in accordance with the character of organization:

- internal – such innovation are being implemented in certain company;
- between organization – the different functions of innovation are implemented in few organizations.

Innovations in accordance with the amount of implementation:

- onetime innovation – innovation which is implemented only one time;
- multifold innovation – implemented for many times.

Richard Adams in his publication (Adams 2003) classifies innovation in other way and excludes other types of innovation (Table 1.1).

Table 1.1. The classification of innovation by Richard Adams

Types of innovation	Administrative, social, technological, procedural, market, subsidiary, program, psychological, product innovations.
In accordance with novelty of innovation	Radical, architectural, autonomic, inventive merit, embodiment merit
In accordance with importance/significance	Centralized, consentaneous, complex, partial, important, observability, pervasiveness, risky, social, doubtful.
In accordance with effectiveness of innovation	Applicable, systematic, operating, market's

The Department of statistics of the Republic of Lithuania excludes such basic groups of innovations:

- the innovation of technological process, which includes new and improved methods of producing, implementing new manners of the organizing of producing or new equipment in separate company as well as in all market. These innovations include and the field of services;
- the innovations of the product – it is products and services (at the level of company or market), which differs a lot from the previous and are directly available for the consumer. It can be technologically new products as well as improved products;
- organizational innovations – it is new or improved methods of the organizational structure or managing, by witch it is pursued to improve the quality of the products and to increase the productivity;
- the innovations of the marketing – it is the new or improved methods of designs or sales, which helps to increase the attractiveness of the product or to assimilate the new markets.

S. P. Osborne (1998) gives us such classification of innovation. Four groups of innovations are excluded (Table 1.2).

Table 1.2. The classification of innovation by S.P.Osborne

New group of consumers	**Development innovation**	**Absolute innovation**
Existing consumers	**Process innovation**	**Evolution innovation**
	Existing product or service	*New product or service*

Development innovation – company starts to present its product or services for a new market.

Process innovation – company improves existing products or services and presents it to existing consumers.

Absolute innovation – company present new product or services for a new group of consumers.

Evolution innovation – company presents new products or services for its consumers.

Paul Trott in his book excludes these groups of innovation (Trott 1998):

- Product innovation – it is creation of new product or improvement of the existing products;
- Process innovation – the creation of new producing processes;
- Organizational innovation – new attempts of organization, new internal communication systems, including new systems of accounting;
- Managerial innovation – the innovations of quality management, the processes of business re-engineering;
- Product innovation – just-in-time concept, the programs of planning of new product, new programs of revision;
- Commercial marketing innovation – the arrangement of new financial decisions, the search for new canals for sales;
- Service innovation – for example, the companies of financial consulting on phone.

According the methodic of the Oslo manual (OECD 2005) four groups of innovation is excluded: product, process, marketing and organizational innovations.

A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.

A process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.

A marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

An organizational innovation is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations.

1.1.4. Innovative Company and its Main Features

Innovative company – it is a company that form and implement innovation (Government of the Republic of Lithuania 2003). Innovative companies permanently create new or significantly improved product, implement new or improve existing technological processes (Zvicevičiūtė 2007). Innovative company has an intention and all opportunities to exploit new ideas, methods and technologies quicker as their competitive. All companies must create new products and services in order to survive in the market, which is constantly changing.

Innovative companies have some certain features, which do not depend on the size of the company, on the branch of economy or the character of business. Companies, which manage to administer changes and to create and implement innovation, possess these features:

The culture of the company is strong and expressed with clear definition of mission, stimulates for the permanent development and changes, teaches to accept changes, new ideas and methods, created in external environment. Such culture of the company shows that for this company the most important thing is the interests of consumers. Also the importance of cooperation in the internal level is clear. Wages are related with the results of the company and personal achievements, what leads to enthusiasm of the personnel.

Manager is good in transmitting of information, rules by its own example, is visible and available for everybody. He has very clear goals and concerted vision. He is able to agree on short time goals as well as to long time goals. He is enthusiastic towards the novelties. Such manager is oriented towards operation and is determined to be successful in managing of changes. He always takes part in selecting main employees and gives all attempts to achieving quality and the satisfaction of consumers.

Employees are competent in their work and are self confident. Thus, they know their advantages and disadvantages and realizing the need to change and to accept new ideas, have a common vision and are good in working in the group. Also they recognize that it is necessary to have alone working specialists. They know well their work and ale looking toward training as to the permanent process.

Internal communication. Good communication is secured in all levels. All news is spread quickly and exactly. The opportunities for informal change of ideas are granted.

Structure. Structure reflects the needs and specific of the business, creates opportunities to develop for new ideas and is very flexible for the changes.

Relationship with clients is the main propulsion. Such relationships help to carry on long-term and very productive contacts, what assist to guess the demand before creation of new production.

Good system of sponsoring secures investments, which are sufficient for remaining competitive. The short term change is granted for the investors.

Relations with suppliers are carries on behalf of principle of bilateral benefit, involving programs of cooperation with the main suppliers.

Competition is appreciable. The company understands clearly the situation in market and realizes the main tendencies of competition. Also competition stimulates to reconsider permanently the activities of the company. Competition stimulates to seek for the position of the leader in the market and teaches to be ready for various surprises.

Technologies, which are unique, are considered to be vitally important for the business. The priority is given to protected technologies. The permanent relationships with universities are cultivated.

Products. In the creation of new products it is pursued to make the existing products old-fashioned. Namely the differentiation of the products is the basis for the leading in the market.

Processes. The operation and effectiveness of it is evaluated permanently. The close contact is carried on with suppliers of the equipment. Procedures are constantly reconsidered in order to be suitable for the expansion of business.

Innovative companies have to orient in changes and must possess permanent information channels. In such companies the command work must be dominant and even decentralization have to exists. The factor of the risk must be accepted as naturally realized thing and the creativity and initiativity must be stimulated. In such companies the hierocracy and formality is not regarded (Šukienė, Damkus 2007).

1.2. Innovation Measurement Systems

For a long time R&D and patents were the main indicators for innovation measurement, but these have major limitations for understanding the complexity of innovation processes. A number of studies (Archibugi and Pianta, 1996; Smith, 2005) have assessed the strengths and weaknesses of different technology indicators, pointing out that R&D and patents are of limited relevance in the innovative activities of some manufacturing and most service sectors, resulting in a serious underestimation of the extent of innovative efforts in these industries. In empirical analyses, these data have the advantage of being available over long time series for firms, industries and countries.

On the other hand, innovation survey data according to the summary results of European Commission (Eurostat) make it possible to capture a much broader range of innovative efforts carried out in firms, including internal and external R&D expenditure; the acquisition of outside knowledge; internal design and engineering efforts associated to new products and processes; the acquisition of innovation related machinery and equipment and efforts associated to the

marketing of new products.

Moreover, innovation surveys provide rich evidence on the sources of knowledge, on the type of innovation introduced, on the economic impact of new products on sales, on the overall strategies pursued by firms in their technological activities, and on the obstacles found in these efforts, among others. In empirical analyses, these data are available for firms, industries and countries.

1.2.1. Innovation Measurement at the National Level

European Union member states, including Lithuania, are using unified innovation measurement system that comes from the European Commission. The Innovation Union Scoreboard (former European Innovation Scoreboard) is being published annually since 2001 to track and benchmark innovation performance of 27 member states. It uses recent statistics from Eurostat and other internationally recognized sources available at the time of analysis. International sources are being used wherever possible in order to improve comparability between countries (PRO INNO Europe 2009).

Also it is important to note that the data relates to actual performance in a few years lag. As a consequence the 2010 Innovation Union Scoreboard may not fully capture the most recent changes in innovation performance, or the impact of policies introduced in recent years which may take some time to impact on innovation performance. Nor does it fully capture the possible impact of the economic and financial crisis on innovation performance.

The Innovation Union Scoreboard 2010 includes innovation indicators and trend analyses for the European Union member states, as well as for Croatia, Iceland, the Former Yugoslav Republic of Macedonia, Norway, Serbia, Switzerland and Turkey. It also includes comparisons based on a more reduced set of indicators between the EU27, the US, Japan and the BRIC (Brazil, Russia, India and China) countries.

Innovation Union Scoreboard uses the summary innovation index as a measure of innovation performance of the state. Summary innovation index is calculated as a composite of the 25 IUS indicators that are grouped into 3 blocks: enablers, firm activities and outputs (Table 1.3).

For each innovation dimension average performance is summarized by calculating a composite innovation index. For each of the 3 blocks of dimensions average performance is summarized by calculating a weighted composite index using the composite innovation indexes for those dimensions belonging to a specific block. Overall innovation performance is summarized in the summary innovation index. The methodology used for calculating these composite innovation indexes was implemented since European innovation scoreboard 2008 as it was the first year in which this methodology has been used.

Table 1.3. Innovation Union Scoreboard indicators

Main type / innovation dimension / indicator	Data source
ENABLERS	
Human resources	
1.1.1. New doctorate graduates (ISCED 6) per 1000 population aged 25–34	Eurostat
1.1.2. Percentage population aged 30–34 having completed tertiary education	Eurostat
1.1.3. Percentage youth aged 20–24 having attained at least upper secondary level education	Eurostat
Open, excellent and attractive research systems	
1.2.1. International scientific co-publications per million population	Science Metrix / Scopus
1.2.2. Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	Science Metrix / Scopus
1.2.3. Non-EU doctorate students as a % of all doctorate students	Eurostat
Finance and support	
1.3.1. Public R&D expenditures as % of GDP	Eurostat
1.3.2. Venture capital (early stage, expansion and replacement) as % of GDP	Eurostat
FIRM ACTIVITIES	
Firm investments	
2.1.1. Business R&D expenditures as % of GDP	Eurostat
2.1.2. Non-R&D innovation expenditures as % of turnover	Eurostat
Linkages & entrepreneurship	
2.2.1. SMEs innovating in-house as % of SMEs	Eurostat
2.2.2. Innovative SMEs collaborating with others as % of SMEs	Eurostat
2.2.3. Public-private co-publications per million population	CWTS / Thomson Reuters
Intellectual assets	
2.3.1. PCT patents applications per billion GDP (in PPS€)	Eurostat
2.3.2. PCT patent applications in societal challenges per billion GDP (in PPS€) (climate change mitigation; health)	OECD / Eurostat
2.3.3. Community trademarks per billion GDP (in PPS€)	OHIM / Eurostat
2.3.4. Community designs per billion GDP (in PPS€)	OHIM / Eurostat

End of Table 1.3.

OUTPUTS	
Innovators	
3.1.1. SMEs introducing product or process innovations as % of SMEs	Eurostat
3.1.2. SMEs introducing marketing or organizational innovations as % of SMEs	Eurostat
3.1.3. High-growth innovative firms	N/A
Economic effects	
3.2.1. Employment in knowledge-intensive activities (manufacturing and services) as % of total employment	Eurostat
3.2.2. Medium and high-tech product exports as % total product exports	UN / Eurostat
3.2.3. Knowledge-intensive services exports as % total service exports	UN / Eurostat
3.2.4. Sales of new to market and new to firm innovations as % of turnover	Eurostat
3.2.5. License and patent revenues from abroad as % of GDP	Eurostat

1.2.2. Innovation Measurement at the Regional Level

As the regional level is important for economic development and for the design and implementation of innovation policies, it is important to have indicators to compare and benchmark innovation performance at regional level. Such evidence is vital to inform policy priorities and to monitor trends. European Regional innovation scoreboard (RIS) is used to measure innovations in the regions of European Union and Norway.

European Regional innovation scoreboard 2009, with respect to the previous report published in 2006, which used a very limited set of regional indicators, RIS 2009 report offers richer information to regional innovation policymakers, mainly thanks to the availability for the first time, of more comprehensive and detailed, regional Community Innovation Survey (CIS) indicators. As a result, the 2009 Regional innovation scoreboard is able to replicate the methodology used at national level in the European innovation scoreboard, using 16 of the 29 indicators used in the EIS 2009 for 201 regions across the EU27 and Norway. Despite this progress, the data available at regional level remains considerably less than at national level, and in particular four member states: Germany, Sweden, Ireland and the Netherlands – were not able to provide regional CIS data. Due to these limitations, the 2009 RIS does not provide an absolute ranking of individual regions, but ranks groups of regions at broadly similar levels of performance.

Cluster analysis is used to identify regions that share similar innovation

systems. Two approaches are taken. The first method searches for similarities in absolute performance, or regions that display similar strengths and weaknesses in innovation. These analyses use the three composite indices for Enablers, Firm activities and Outputs separately and for the regional innovation index (RII). The second method searches for similarities in the pattern of strengths and weaknesses. For example, a region that performed twice as well as another region on every composite index would have an identical pattern of strengths and weaknesses. In order to remove the effect of absolute performance in the cluster analysis of similar patterns, the sum of performance across all composite indices is set to the same value for all regions. Both approaches have different uses for policy.

The main findings of the latest (2009) regional innovation scoreboard are (PRO INNO Europe 2009):

- There is considerable diversity in regional innovation performances. The results show that all countries have regions at different levels of performance. This emphasizes the need for policies to reflect regional contexts and for better data to assess regional innovation performances. The most heterogeneous countries are Spain, Italy and Czech Republic where innovation performance varies from low to medium-high.
- The most innovative regions are typically in the most innovative countries. Nearly all the "high innovators" regions are in the group of "innovation leaders" identified in the European innovation scoreboard. Similarly all of the "low innovators" regions are located in countries that have below average performance in the EIS. However, some regions outperform their country level.
- Regions have different strengths and weaknesses. Regions are performing at different levels across three dimensions of innovation performance included in the EIS: Innovation enablers, Firm activities and Innovation outputs. Although there are no straight forward relationships between level of performance and relative strengths, it can be noted that many of the "low innovators" have relative weaknesses in the dimension of Innovation enablers which includes Human resources.
- Regional performance appears relatively stable. The pattern of innovation is quite stable between year 2004 and 2006, with only a few changes in group membership.

As Lithuania in the innovation measurement of regional innovation scoreboard is approached as one region and is not particularly divided, regional innovation measurement will not be further analyzed in this work.

1.3. Review of Factors Suppressing or Stimulating Innovation

Often the questions arise: what are the reasons stimulating companies to create new products or services? It is clear that in order to survive, every company or organization should try to do its best in the field of satisfying the needs of consumers, which are changing very quickly. In scientific literature few reasons for innovation activity are presented.

The changes of demand. The attitude of consumer toward introduced products or services is not permanent. Changes of demand may be related with fashion as well as with changes of opinion towards certain product. Every company, which does not seek to lose its consumer, is induced to introduce to a market new production, which satisfy the requirements of consumer.

The supply of competitors. Every product always may be changed by the netter one. During the competition process in the market, companies are trying to overtake each other. Companies do not want to lose its consumers, so they are ought to create new product or service, which are essential for the further competition in market.

The reduction of the popularity of the product. It is common that the reduction of popularity of the product is related with decreasing of quality or with conditional change of criterion of intensively.

Social changes. Social changes are complex measurement, which is expressed as the change of the value system of the certain period of time or as a change of fashion. Fashion in this case must be understood as the change of material, forms or colors. Social changes inspire to create and to produce new services and products.

Technological advance. Competitors in the market may use in producing new technological solution, and may create new product or service and in this way to present better competitive supply. Few situations may be analyzed. The first situation is when the new technological solutions, which empower to create new products, may be presented to a market. Second situation, when the new product is being created in a company and later the search for opportunities to use that product is started.

The changes of potention of the company. It happens that after certain period of time, the opportunities of the company in the field of sales, producing and etc. changes. The previously popular products do not satisfy new opportunities of the company. The need for new product and service appears.

The changes of legal environment. During the process of creation and producing products or services, companies and organizations often are facing various legal restrictions. After the changes of certain legal acts, producing of certain product may be restricted or even forbidden. In order to survive in the

market, company, in this case, has to introduce the market with new product or services (Vijeikienė, Vijeikis 2000).

Often it is declared that the management of innovation activity is identified with non-innovation activity, which districts with frequent repetition and cliché. The understanding of disparities between such activities, lead to the capability to take managerial decisions.

Innovation activity may be defined as complex process, which includes the creation of novelties, the spreading and using of it. In scientific literature innovation activity is defined as complex dynamical system, which effectiveness mostly depends on the internal mechanism of innovation activity and its interaction with external environment (Jakubavičius *et al* 2003).

In certain concrete company or organization a lot of subjects interact between each other, starting with owners and ending with employees. Subjects perform certain functions and have certain influence towards the process of the implementation of innovation. Every manager has to form positive attitude of the personnel towards the implementation of innovation.

Interaction with the external environment is very important in order to achieve the success of implementation of innovation. Frequently in scientific literature external environment is named as system of innovation, which is defined as whole of elements and mechanisms of interaction, creating assumptions for the transformation of knowledge into new products and services (Melnikas *et al* 2000). Such system is based on three levels:

Innovation policy, which is implemented and formed by states and local institutions with a help of legal acts, strategies and programs. The main trends of such policy is the stimulation of innovation culture, the creation of innovation friendly environment and the orientation of the science towards the creation of innovations and implementation of it in business.

The infrastructure of innovation, that are scientific institutions, the centers of innovation and business, science and technologies parks, consulting companies and associative organizations of business. As an example it can be named universities, science institutes, banks and etc.

The main trend of this activity is to supply the services of innovation stimulation for the companies and organizations, which create and implement innovation. Frequently such innovation support services are separated into certain groups:

- information in the field of technological development;
- the search of partners;
- the search of new technologies;
- the financing of innovation projects;
- technological consultations;
- marketing services;

- help in carrying researches.

Companies are the main element of innovation system. The main characters of innovative company are presented:

- orientation toward changes;
- permanent canals of information;
- command work;
- decentralization;
- risk;
- the disregard of hierocracy and formality;
- the stimulation of initiative.

Often as innovative company is named such company, which has implemented new technology or applied new knowledge in producing of a new product. Thus, it is not correct. Innovative company is company which does not stop after the commitment of mentioned activities. Such company permanently seeks for opportunities to improve its producing. The formation of innovations and implementation of it must be permanent and dynamic process.

In the process of interaction between innovation activity and external environment, it is necessary to exclude such cycles of existence:

- creation;
- introduction;
- growth;
- maturity;
- end.

Every stage of cycles of existence may be characterized with such factors as the novelty of the product, extent of supply, economic effectiveness and etc. (Staniškis, Staniškienė 2006).

The implementation of innovations often is related with alterations and bigger that it is command risk. That's why a lot of internal and external factors suppressing the implementation of innovation appear.

After the analysis of various sources of scientific literature, such factors of suppression of implementation of innovation were excluded (Fig. 1.2).

The implementation of novelties is not dissociative from various changes, which may have economic or organizational character. Such changes can disturb for the company to make a decision to implement the innovation.

Fig. 1.2. The factors suppressing innovations (Ališauskas *et al* 2005)

Economic reasons. If innovation is radical in the sense of profit, it can convert existing production of the company to not competitive. Such perspective carries on for potential difficulties for the decision to implement the innovation:

Fear to lose the income. If innovation converts existing product or service to not competitive, companies will face fear to lose its earnings, guaranteed by old production. Thus, decision to implement the innovation may seem to be unattractive.

The lack of stimulus to invest in innovation. The fear to lose earnings, disturbs the process of implementation of innovation, especially in cases, when company takes almost monopolistic position in the market. The company in such situation often decides not to take that risk. Situation may be different, when company realizes that somebody else may invest in that innovation.

Fear "to sale on shoal". Innovation may be more valuable when more people use it. Companies may have fear that it will be the only one, who uses such innovations or that the net of implementing it will be too small, for the success of innovation.

High costs of recession. The implementation of novelty may mean the cancellation of old technologies that can cost a lot. Consumers may be not able to

understand such costs and evaluate negatively such decision of the company.

Organizational reasons. If innovation is radical in organizational sense, such difficulties for the implementation of innovation may appear:

The loosing of existing skills. The first problem of the radical innovation – it convert existing skills of the company to the redundant. The previously useful skills of employees after the implementation of innovation may become disused. Even it may disturb the process of upbringing of new skills, which are crucial for the further activities of the company.

Emotional attachment. The success of the company may be related with certain service or product. Decision making persons may be emotionally attached to the certain products or services and in that case the decision to change it may be unacceptable for them.

Dominating logic. The convictions of the managers in the field of development of business, may have huge influence for the capacity of the company to recognize the opportunities of innovation.

There are groups of factors, which stimulate the implementation of innovations in companies. During the analysis of scientific literature (Ališauskas *et al* 2005) external and internal factors, stimulating the implementation of innovations were excluded (Fig. 1.3).

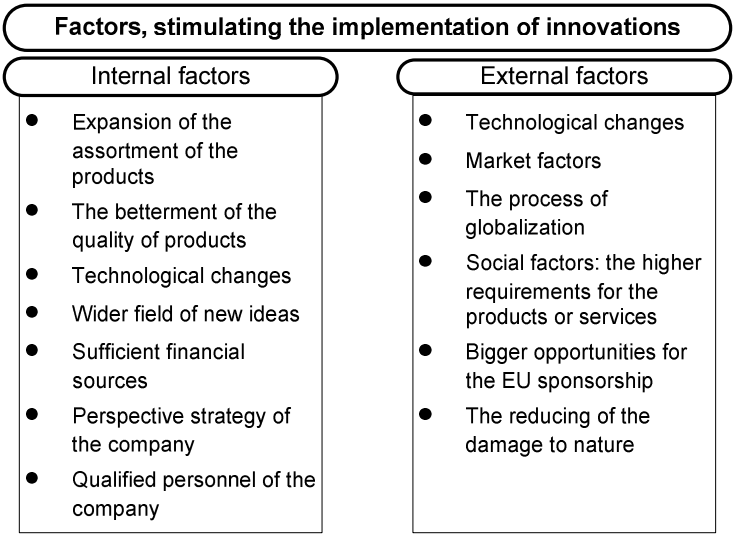

Fig. 1.3. The factors stimulating innovations

1.4. Legal Environment and Main Trends

The developing of innovations in Lithuania is closely connected with corresponding actions in EU. As all EU members, Lithuania is obliged to follow the requirements set out by the authorities of EU. In this chapter the main EU documents will be shortly introduced. Next step of the analysis of legal environment of innovation will be brief presentation of Lithuanian legal acts and other documents implementing EU strategies and legislation and creating the legal basis for the developing of innovations in Lithuania.

The fundamental document in the field of innovations is the strategy set out in Lisbon in March 2000 (European Commission 2000) by the Heads of States. This strategy was based on an idea to make Europe more dynamic and competitive. This strategy were intended to be the response of EU to the challenges of globalization, enhance the EU position in economic competition with USA and other centers of economic potential of the world and to provide extra impulse for further integration of Europe (Nakrošis, Barcevičius 2007). The initiative became known as the "Lisbon Strategy" and came to cover a very wide range of policies. The implementation of Lisbon strategy may be divided into three cycles. The first cycle of the implementation of Lisbon strategy covers the period of 2000–2005. Lisbon strategy was a complicated collection of reforms, which are closely connected between each other. Thus, a great number of goals and positive actions were not supported with clear distinction of Community and national level responsibilities. The great job was done in 2003, when the governments of the member countries determined a list of structural indicators of Lisbon strategy (79 indicators of Lisbon strategy can be assessed on Eurostat). The first cycle of Lisbon strategy was widely criticized, because of its enormous intentions without certain action plans. The next cycle of Lisbon strategy is the period of 2005–2007. The crucial point of such separations of the implementation process was the mid-term evaluation of the achievements of goals set out in the strategy. In spring 2005 it was clear that EU goal to become the most competitive and dynamic knowledge-based economy in the world will not be achieved till 2010 (Commission of the European Communities 2005). During the meeting of Heads of States in 2005 March the agreement to start the implementation of Lisbon strategy newly was reached. The importance of on actions that promote growth and jobs in a manner that is fully consistent with the objective of sustainable development was stressed. By the relaunching of the Lisbon strategy all the governing structure was overviewed and certain guidelines for the growth and jobs were created. All EU member states got the duty to prepare (European Council 2005) the National Reform Programs for the tree year term. In these document states had to integrate national goals with EU guidelines. In order to guarantee the control of implementation of the Lisbon strategy, each year, Member States

produce reports on the implementation of their NRPs. The Commission in its own turn issues an Annual Progress Report assessing the implementation of National Reform Programs and reviewing the Community Program. The last cycle of Lisbon strategy is the period of 2008–2010. During this cycle in fact no more amendments were made. The main goal during this period was for each member state to implement the last reform in the fields which were remarked during the manual evaluation of the progress. All main reforms set in national reform programs were intended to be finished by 2010.

In general the Lisbon strategy distinguished five main points for the reforms in EU countries:

- Investing in people – to adjust to globalization, the EU's fast changing economy requires a flexible and highly skilled workforce. Lifelong learning projects help people to adapt to a changing job market.
- More research, development and innovation – strengthening links between research institutes, universities and businesses. At the same time, spending on research and development in the EU should increase to match international competitors.
- A more dynamic business environment – less red tape and easier access to credit, especially for small and medium-sized businesses.
- A greener economy – leading the fight against climate change, the EU aims to reduce the environmental impact of economic growth by saving energy and promoting new, environment friendly technologies.

As it can be seen innovations is one of the main issues of the Lisbon strategy. In March 2003 (Commission of the European Communities 2003) the Communication "Innovation policy: updating the Union's approach in the context of the Lisbon strategy" was prepared. According to this document innovation has to become the driving force of the structural economic growth. In this communication a certain list of actions is given. Also the responsibility for the implementation is clearly divided between EU bodies and national institutions.

The certain prolongation of the ideas drafted in Lisbon strategy finds its reflection in ultimate strategy, which will cover the next decade and is named EU 2020 strategy. The main goal is to make EU to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion. The Union has set five ambitious objectives on employment, innovation, education, social inclusion and climate/energy to be reached by 2020:

- To raise the employment rate of the population aged 20–64 from the current 69% to at least 75%.
- To achieve the target of investing 3% of GDP in R&D in particular by improving the conditions for R&D investment by the private sector, and develop a new indicator to track innovation.

- To reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30% if the conditions are right, increase the share of renewable energy in final energy consumption to 20%, and achieve a 20% increase in energy efficiency.
- To reduce the share of early school leavers to 10% from the current 15% and increase the share of the population aged 30–34 having completed tertiary from 31% to at least 40%.
- To reduce the number of Europeans living below national poverty lines by 25%, lifting 20 million people out of poverty (Commission of the European Communities 2003).

The strategy elements were formally adopted on 17 June 2010 (General Secretariat of the Council 2010). Innovations in EU 2020 strategy are one of the elements of smart growth. The Innovation Union is one of the seven flagship initiatives of the Europe 2020 strategy for a smart, sustainable and inclusive economy. The main document revealing the meaning and the aims of Innovation Union is Communication from the European Commission of 6 October 2010 "Europe 2020 Flagship Initiative. Innovation Union" (Commission of the European Communities 2010). This communication partly extended the previous communications on Innovation.

All mentioned actions of EU certainly had a reflection in national innovation policies of Lithuania. Lisbon strategy presented for Lithuania a challenge to create the long term development strategy, which was necessary to achieve the demanded situation in the state.

The brief analysis of European legislation on Innovations diverts our attention towards national legal acts and strategies implementing the mentioned supranational acts. The implementation of the Lisbon strategy in Lithuania may be divided into two periods of time. Till the 2005, the Ministry of Foreign Affairs was responsible for the implementation of National Lisbon program. It must be remarked that till the 2005 the implementation of Lisbon Strategy was held through Lithuania's economy development long term strategy till 2015 (Ministry if Economy of the Republic of Lithuania 2002). This document do not directly was the one which implemented the Lisbon strategy, thus it suggested for the Government to create the certain system of strategic analysis and monitoring, involving governmental institutions and research institutions, in order to prosecute the constant fixation of the results of the implementation of the Strategy as well as for indicating the main changes in the market. Also it was suggested to reconsider adopted national strategies and programs, create new programs and concepts in order to realize the conclusions of Lisbon strategy. In the mentioned national long term strategy the backwardness of the state in the field of technical and technological potentiality, in comparison with the average of other EU member

states. The low level of innovation development and the lack of cooperation between the Research institutions and business units also were indicated.

The next period of implementation of Lisbon strategy is connected with the adopting of National reform program in 2005. After 2005 (Government of the Republic of Lithuania 2005) responsibility for the implementation of the Lisbon strategy was delegated for the Ministry of Economy. During the period of 2005–2010 the Committee of the implementation of National Lisbon Strategy implementation program was operating. The Lisbon strategy, which was the fundamental programming document in the field of innovation development, was implemented in Lithuania by National Program of the implementation of Lisbon strategy (Government of the Republic of Lithuania 2005), which was adopted by the Government of the Republic of Lithuania in 2005. In this document the main goal of Lithuania's economic was set out – to reduce the country's economic development gap with the EU average. The Program noted, as well as a number of other strategic documents of Lithuania, the crucial need to promote innovations and knowledge in the field of creating competitive products and providing it to the market. At the same time acknowledged that low activity of the business units in research, development and innovation can haves serious consequences for long-term development of Lithuania's economy and economic growth. In Program such national priorities, which had had to be implemented in order to reach the growth of economy and the increasing of employment, were set out:

- In the field of macroeconomics – to maintain rapid economic growth, macroeconomic stability;
- In the field of microeconomics – stimulate the competiveness of Lithuanian business units;
- In the field of employment – stimulate the employment and investments to human capital.

According to these priorities the measures for achieving the relevant objectives and targets were set out. The National reform program raised up two key quantitative targets:

- To reach 68.8 percent employment rate by 2010;
- To award 2 percent of GDP on R&D expenditure.

The document included a number of different measures (total more when 268). In addition, it was expected to keep it up to date constantly. Thus, it was updated only in 2008, by adopting of National program for implementation of the Lisbon strategy for 2008–2010 (Government of the Republic of Lithuania 2008). This document for the first time gave a significant role for the innovation development processes. The 4th goal of the amended national reform program was "stimulating innovations and research and experimental development in the field of expansion of the partnership of private and public sectors and creating incentives for the private business to invest to innovations, research and

experimental development". The main measures related with innovations foreseen in this document were creating and implementing the Innovations in Business program for 2008–2013, providing financial support for the business units wishing to take a part in innovative business, establishing of centers of business interactions, create the voucher scheme for the companies of innovative activities, creating of effective system of promotion of all kinds of innovations, giving the financial support for inventors. In conclusion it must be stated that the National implementation program of Lisbon strategy had created a background for Lithuanian innovation policy and despite of quit low results in period of its validity, all ultimate documents corresponding innovations one or another were inspired by it.

As it was mentioned before The Ministry of Economy and the Ministry of Education and Science are the main institutions responsible for the formation and the implementation of innovation policy in Lithuania. The Ministry of Economy manages the policy for the development of the innovation environment. The Ministry of Education and Science manages the policy for the research and development. The main strategic planning document of innovation policy – Lithuanian Innovation Strategy for the year 2010–2020 (Government of the Republic of Lithuania 2010). The strategy sets vision, objectives, goals and results to be achieved in the field of Lithuanian Innovation up to 2020. The objective of this strategy is to build a creative society and create the conditions for the development of entrepreneurship and innovation. Objectives and goals of innovation development following to the strategy are:

- to accelerate Lithuania's integration into the global market ("Lithuania without borders");
- to educate a creative and innovative society;
- to develop broad-based innovation;
- to implement a systematic approach to innovation.

This document was adopted as a result of implementing the State Long-Term Development Strategy and the National Lisbon Strategy Implementation Program 2008–2010.

During the period of analysis few additional applicable programs and strategies in the field of innovations can be mentioned Program of Development of High Technologies (Government of the Republic of Lithuania 2006), Long-term Strategy for Research and Development and Program for Implementing the White Book on Lithuanian Science and Technology (Government of the Republic of Lithuania 2003) , Industrial biotechnology development program for Lithuania for 2011–2013 (Government of the Republic of Lithuania 2011).

The first one program shall continue the High Technology Development Program of 2003–2006. The objective of this Program is to help to develop already existing trends of high technology production which are promising in the

worldwide context and which have scientific potential enabling to produce the output that is competitive in the world market. The tasks of this Program shall be as follows:

- to develop research and experimental development works in biotecnoogy trend;
- to develop research and experimental development works in mechatronics trend;
- to develop research and experimental development works in laser technology trend;
- to develop research and experimental development works in information technology trend;
- to develop research and experimental development works in nanotechnology and electronics trend.

The tasks of this Program have been set having considered the following aspects:

- they conform to the EU priorities;
- they cover the entire most perspective part of the economy of the state and stimulate the establishment of science and technology parks, clusters, etc. based on knowledge;
- there are inter-related areas that create favorable conditions for the synthesis of knowledge and co-operation of production;

The investment into creation of new high technology would face high risk; however, the risk of investments into the chosen trends that have already entered the world market and already have scientific cultivation is much lower.

Long-term Strategy for Research and Development and Program for Implementing the White Book on Lithuanian Science and Technology was adopted in 2003 December. This document is intended for the implementation of White Book on Lithuanian Science and Technology (Ministry of Economy of the Republic of Lithuania), which was framed by the leading scientist in 2000. Despite of the fact that The White book does not have judicial power and must be treated as only recommendation, this strategic work found its reflection in governmental planning of the economy of the state. The importance of innovations was stressed in the in the White book of Lithuania already in year 2000. Authors of the book have reasoned the growth of economy of the state by active implementation of innovations. The white book also presented an analysis of the most popular measures, applied by the governments of the different states in order to stimulate the innovations. Considering the fact that the project of the White book was widely discussed with different political powers and also with nongovernmental organizations it is natural, that the main ideas of such huge and well-timed work gained a lot of attention. In order to encourage the implementation of best ideas the Long-term Strategy for Research and

Development and Program for Implementing the White Book on Lithuanian Science and Technology was adopted. This document was passed by the Government of the Republic of Lithuania and has an obligatory power. This document was harmonized with the goals set out in Lisbon strategy and is intended to cover the period till 2015. The main goal of the strategy is to fortify Lithuania's scientific technological potential, to seek for its effective use on behalf of acceleration of the state progress and the raising of competitiveness considering the limited recourses of Lithuania. Ministry of education and science and Ministry of economy are the institutions responsible for the implementation of this program.

Industrial biotechnology development program for Lithuania for 2011–2013 was adopted by the Government of the Republic of Lithuania in 2011. The aim of the program is to accelerate biotechnology industry development in Lithuania. The objectives of the program:

- Create materials and products from renewable raw materials using biotechnological methods;
- Create bio-plastics and materials to produce it from renewable raw materials using biotechnological methods;
- Create new biocatalysts and develop its Application technologies;
- Create pharmaceutical and veterinary products and veterinary products.

Industrial biotechnology development is relevant for Lithuania, because industrial biotechnology is new and quickly growing field of production. Innovations in this field no doubly may create a faster economy development and determine the lodgment of Lithuanian business units in the global market of biotechnology.

All national legal acts mentioned above have already created innovation policy and, despite of the economy crises, established certain legal environment for the innovations. Next part of this chapter encloses the system of innovation stimulation, which is practiced in Lithuania.

All measures concerning stimulation of innovations is presented in Fig. 1.4.

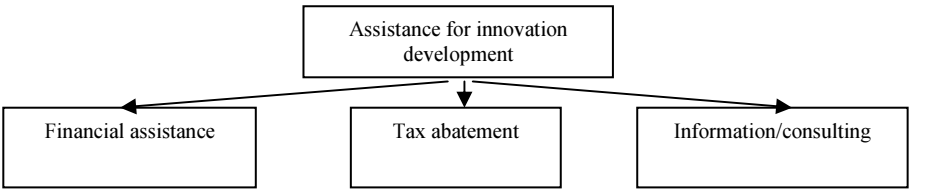

Fig. 1.4. Measures concerning stimulation of innovations

Financial assistance in the field of stimulating innovations discloses in two forms: national financial assistance and EU support.

The main national measure of financial assistance for innovation is the system of Innovation vouchers. This form of support was started in 2010 and was designed to encourage business to benefit from the most state-of-the-art research institutions cooperate with business for commercialization of research results. This form of support specifically designed for micro entities and small and medium sized enterprises seeking to innovate was welcomed by business community representatives, also public research institutions and universities. There are two types of innovation voucher – LTL 10 000 (2 900 euro – with no requirement for own contribution) and LTL 20 000 (5 800 euro – SME is required to contribute ¼ of this amount from its own resources). Innovation vouchers finance R&D services. The eligible suppliers of Research and development services under this scheme are state universities and state research institutes. The administrative institution of the innovation voucher scheme is Science, Innovation and Technology Agency. The detail methodology on getting innovation voucher is provided in the Schedule of the Innovation voucher, which was adopted by the Minister of Economy in 2008.

Another national support measure is financial assistance in the field of protection of intellectual property. The Ministry of Economy encourages Lithuanian inventors and businesses to protect their intellectual property rights by offering aid for patents. Funds are available for persons seeking international patents for their inventions, European Patents or patents under the Patent Cooperation Treaty. Support is available from the funds of the national budget, covering 95 percent of eligible patenting costs. In order to make support accessible to each inventor, the Ministry of Economy has introduced three ways to reimburse patent-related costs since 2009: prepayment of fees, payment of invoices and reimbursement of incurred expenses. The following patenting costs are covered: patent application fee, search fee, examination, designation fee, patent issuance fee, renewal fees for the first 5 years, translation costs and patent attorney services. The administrative institution of the national support is Science, Innovation and Technology Agency.

The Ministry of Economy also administrates various programs, which are granted with certain governmental subsidies. All programs and information considering the order for applications are constantly announced in mass media.

Assistance from European Union Structural Funds and Cohesion Fund is provided to Lithuania in the programming period of 2007–2013. On 18 December, 2006, Government of the Republic of Lithuania approved projects of four Operational Programs and made a decision on distribution of structural assistance to Lithuania allocations in percentages among intervention areas “On amendment of Governmental Resolution” of 14 March, 2006, No. 252 “On distribution of

responsibilities for administration of 2007–2013 European Union structural assistance, received under convergence objective of European Union cohesion policy, and on formation of Governmental European Union structural assistance committee for decisions on European Union structural assistance for the periods of 2004–2006 and 2007–2013" (Government of the Republic of Lithuania 2006). Representatives from national institutions and agencies as well as other partners participated in the preparation of Operational Programs. Drafts of Operational Programs were submitted to European Commission and corrected in accordance with comments and proposals received. European Commission has approved all operational programs of the Republic of Lithuania. The investment areas under competence of Ministry of Economy during programming period of 2007–2013 are focused on business, including research & development, business environment, tourism and energy sectors.

The enterprise, which develops innovations, according to Law on Corporate Income Tax, may use the tax privilege. This support measure may be implemented in few ways. In order to promote private investment in Research development and innovation, the Parliament of the Republic of Lithuania passed Law of Amendments and Supplement of Articles 2, 12, 13, 17, 18, 21, 23, 26, 28, 30, 31, 381, 47 and 50 and Appendices 1 and 3 and Supplement by Article 171 to Law on Corporate Income Tax of the Republic of Lithuania, which enables enterprises to deduct their costs for R&D from income three times. It is also allowed to write off fixed assets used for activity of R&D to costs in a shorter period. Law of Amendments and Supplement of Articles 2, 5, 12, 34, 382, 41 and 58 and Supplement by Article 401 and Chapter IX1 to Law on Corporate Income Tax the Republic of Lithuania provides that the enterprises, which invest in essential technological renewal, have the following reliefs of corporate income tax: such enterprises have a possibility to reduce their taxable profits up to 50 percent.

In order to make innovative activity accessible for wilder range of enterprises and other business units, certain assistance in the field of informing and consulting is also applied. The main governmental institution, responsible for implementation of innovation policy in Lithuania is Agency for Science, Innovation and Technology (MITA). This body provides free consultations for clients from business, science and public sectors, interested in possibilities to develop strong cooperation relations with international partners and get financial support for research and innovation projects. The main activity is the coordination of national and international of research, technological development and innovation and other financial schemes. MITA is an organization responsible for providing innovation vouchers and supervising the appliance of it. MITA also promotes business and science cooperation, commercialization of research and protection of intellectual property rights. This institution was established on 4th of May in 2010 with the aim to foster business and science cooperation and to create a friendly

environment for business needs and innovation. These goals are foreseen in national Innovation Strategy for the year 2010–2020, approved by Lithuanian Government. Two ministries: the Ministry of Economy and the Ministry of Education and Science are the main founders of MITA. The activities of MITA are jointly supported and funded by them. Before the reorganization, MITA was well known as an Agency for International Science and Technological Development Programs (2002–2010), coordinating FP7. The start was under the activities of Lithuanian national EUREKA information center (1999). Another organization working for the interests of business units, which apply innovations, is The Public Institution Lithuanian Innovation Centre (LIC). LIC is a non-profit organization, providing innovation support services to enterprises, research institutions, industry associations and business support organizations. It was established on February 1st 1996 as a non-profit organization and 1997 was reorganized to public organization. The first shareholders and founders of LIC were United Nations Development Program, Ministry of Education and Science and Lithuanian Stock Innovation Bank. Now shareholders of LIC are the Ministry of Economy, the Ministry of Education and Science and the Lithuanian Confederation of Industrialists. This organization helps to implement Lithuanian innovation policy. The main strategic goal of LIC is the increasing of Lithuanian international competitiveness by stimulating innovations in business.

The list of measures of innovation development in Lithuania can be supplemented by mentioning incentives of government for the cooperation between business and science. The need for better interaction between research, study and business establishments has been emphasized in Lithuania's long-term strategic documents. Aiming at better interaction of the research and studies system with economic sectors as well as perspective technology development and introduction to knowledge-intense business sectors, development of integrated research, study and business centers has been started in Lithuania. Five centers (focusing in different areas of industry) were established in 2008.

Analyzing the legal environment of innovation it is integral to name Science and Technologies parks. It is a physical or virtual space in which the company carrying out research or other innovative activities can be established. In such place certain specialized value added services such as business incubation, consultancy and technology transfer are provided. The main goal of such parks is to increase the competitiveness of region by promoting excellence and innovation culture between its members through knowledge and technology transfer. Today in Lithuania 9 Science and Technology parks are operating.

1.5. Conclusions for Chapter 1

Upon systemical analysis of scientific literature sources it was determined that the usage of a lot of multiple of terms and definitions supposed a formation of different standpoints in this topic. Over 100 different terms of innovation and different concepts were analyzed and three main innovation trends were distinguished: scientific concept (sources: scientific literature, articles); official trend (sources: law acts, institutions) and enterprise trend (source: a survey of innovativeness of Lithuanian enterprises).

From the innovation legislation point of view it must be stressed that the importance of innovation development in Lithuania firstly was stated in the White book on Lithuanian Science and Technology, published by a group of leading Lithuanian scientists in 2000. Lithuanian innovation policy was also affected with EU legislation, especially by the Lisbon strategy adopted in March 2000. Despite of ambiguous evaluation of this strategy, this document no doubly had significant meaning for all members of union in the field of innovation promotion. In the process of implementation of the Lisbon strategy Lithuania had created its innovation policy and adopted main documents concerning its attitude towards innovative activities of business. As a main finding of the brief analysis of EU and national legislation on innovations may be indicated the fact that Lithuania have already created the system of stimulating of innovations and the main universal trends of this process have been already transferred. Thus the implementation of adopted programs was not wholly successful. Financial crisis and the general financial situation in the state had restricted the full implementation of strategically goals. Thus, the same situation may be observed in all member states of EU. Still, despite of financial shortage, main issues of strategic documents implementing Lisbon strategy and additional national initiatives established innovation promotion system, which consists of special financial assistance measures, taxation abatement and special services of consulting and providing of information on innovations. All measures of stimulating innovations in Lithuania are based on international good practice and design attractive for investor environment for innovation development.

2

Fixed Investments as a Driving Force of Economic Growth

According to H. Dellas and V. Koubi economic development involves several phases – the early ones associated with the industrialization of labor, the later ones with the industrialization of capital and the shift in the technological frontier. In early stages of development, economies tend to have sizable labor resources that are employed in low-productivity agriculture and lack the general skills associated with an industrial society (work ethics, discipline, etc.). With mechanization, labor moves into the industrial sector, and this increases aggregate productivity and output. Learning by doing on the job, interpreted broadly to include the acquisition of general industrial skills and ethics, becomes then a source of sustained growth. The pattern of industrial employment (overall share in the labor force as well as its rate of change) determines the rate of learning and, hence, productivity growth. During this phase, factors that support the process of labor industrialization, such as capital investments, contribute positively to growth. Mechanization, however, which leads to widespread labor substitution by capital, can hinder this process and undermine growth.

During a later stage, an economy that has already mastered the required industrial skills, has a disciplined and educated work force, but is still below the technological frontier, can move toward it by acquiring the available appropriate technology. This technology tends to be embodied in capital goods, so thee share

of equipment investment in upper-middle-income countries is an indicator of the shift toward the technological frontier.

Finally, a later stage involves countries that have already reached the technological frontier. Such countries can advance to achieve high growth only through the invention and implementation of new technologies.

Thus, there can be made a conclusion that in the early stages, the structure of employment does the job. In the later stages, first capital accumulation and then technological innovation become the critical factors for growth (Dellas, Koubi 2001).

Fixed investments – expenditures on acquisition of buildings, engineering structures, equipment, machines, vehicles; construction and renewing of available long-time fixed assets (except current repairs) (Official Gazette 1999).

2.1. Approaches towards Fixed Investment Impact on Economic Growth

Summers (1991) found at least three grounds for suspecting that fixed (equipment) investment may have higher social returns than other forms of investment (De Long, Summers 1991).

First, historical accounts of economic growth invariably assign a central role to mechanization. Economic historians have seen the richest countries as those that were first in inventing and applying capital-intensive technologies, in which machines embody the most advanced technological knowledge. The history of economic growth is often written as if nations and industries either seized the opportunity to intensify their specialization in manufactures and grew rapidly, or failed to seize such opportunities and stagnated.

Second, discussions of economic growth in the development economics and the new growth theory traditions stress external economies or "linkages" as causes of growth. Spillovers may well be larger in some sectors than in others. Manufacturing accounts for 95 percent of private sector research and development in America, and within manufacturing the equipment sector accounts for more than half of research and development (Summers 1990). Hence, it is plausible that equipment investment will give rise to especially important external economies.

Third, it is often alleged that a number of countries have succeeded in growing rapidly by pursuing a government-led "developmental state" approach to development. The rationale for this policy is that countries which adopt the price and quantity structure of more affluent nations are more likely to grow than those that possess the structure of poorer countries. The government should jump-start the industrialization process by transforming economic structure faster than private entrepreneurs would. Rates of equipment investment tend to increase, and

their price tends to fall as productivity rises. If the developmental state approach is correct, countries investing more heavily in and enjoying lower equipment prices should enjoy more rapid growth.

The search for the keys for economic growth is an important one, which is why many authors try to answer the question: is fixed investment the key to economic growth? For example H. Dellas and V. Koubi rejected De Long and Summers claim that equipment investment have higher social returns (Dellas, Koubi 2001).

De Long and Summers (1991) provided additional evidence against the hypothesis that equipment investment and growth are both driven by some third variable – that the same favorable conditions which raise productivity growth might also encourage equipment investment without equipment investment playing an essential direct role – in two further steps.

First, they examined the association between equipment investment and the components of GDP growth driven by productivity growth and labor force growth; they found a much closer relationship between productivity growth and equipment investment than between productivity growth and labor force growth; this is hard to reconcile with a viewpoint that holds that increasing GDP drives equipment investment.

Rapid growth leads naturally to rapid investment through an accelerator mechanism. Rapid total GDP growth driven by increasing productivity is closely associated with high equipment investment. Rapid total GDP growth driven by an increasing labor force is not. It is hard to reconcile this differential association of equipment investment with intensive and extensive growth without invoking a causal role for equipment investment in producing productivity growth.

De Long and Summers (1991) showed that equipment investment is strongly positively associated with increases in GDP that come from increasing productivity, and negatively associated with increases in GDP that come from increasing the labor force holding productivity constant.

If the association between equipment investment and growth arose from some sort of accelerator mechanism, and equipment investment was a consequence and not a cause of growth, one would expect increases in productivity and in the labor force to lead to increased equipment investment.

Second, they consider the joint behavior of equipment prices and quantities; they regard this as the strongest of the pieces of evidence: fast growth goes with high quantities and low prices of equipment investment, and this is not easy to reconcile with the belief that the high quantity of equipment investment in rapidly growing countries is due to some other factor that has both caused fast growth and shifted the demand curve for equipment investment outward.

Capital deepening: apart from labor inputs (quality and quantity), as already mentioned is one of the main channel which can account for labor productivity

gains is the accumulation of physical capital. For instance, the high level of investment in the new Member States (public infrastructure, private investment) following the restructuring and privatization of state owned companies as well as the stimulus provided by large FDI inflows has contributed to the relatively high productivity growth rates in these countries. This fast capital deepening corresponds to the transition phase of these economies, which is somewhat similar to the reconstruction period in Western Europe after the Second World War, characterized by a fast physical capital accumulation. As regards recent trends in productivity growth, and in particular the divergence in growth rates between the EU and the US since the mid 1990s, the following issues related to capital accumulation appear to have played an important role.

Technological progress embodied by productivity growth. Productivity growth is conventionally calculated as the Solow's residual, which corresponds to the component of productivity growth which cannot be explained by changes in the quality and quantity of labor and capital. Three stylized facts can be mentioned.

First, the slowdown of productivity growth in most EU economies since 1973 to half the levels observed in the 1950–1973 period is still largely unexplained. Second, higher productivity growth in Europe against the US in the period 1973–1995 probably reflects convergence towards the leading economy. Third, productivity growth in the US has been strong compared to the EU since the mid 1990s. Strong IT investment is only part of the story since US productivity growth persisted during the most recent downturn when IT investment and demand fell dramatically. The combination of IT investment and organizational changes (new processes, corporate culture, better knowledge and information dissemination, etc.) could explain the good productivity performance in the US (Carone *et al* 2006).

Other factors (e.g. changes in the sectorial composition of the economy). The shift of EU economies towards larger service sectors mechanically induces a decline in the overall labor productivity growth rate, as on average services display lower productivity gains compared with the manufacturing sector (mainly due to lower capital-intensity). However, the growing share of information technology producing sectors (both in manufacturing and services) may better explain the productivity results in some EU countries.

The classical macroeconomic theory says that economic growth depends on fixed investment, or to gross fixed capital formation (Government of the Republic of Lithuania 2006).

One risk in using pooled time series and cross-section data is that the cross-sectional differences among countries reflect permanent characteristics of the countries that encourage or discourage both fixed investment and economic growth. Examples of such characteristics might be the efficiency of government,

the degree of corruption, the level of violence, or the attitude of governments and populations toward individual achievement or enterprise. Any such relationship can give a false impression that high fixed capital formation resulted in high growth, or vice versa.

2.2. Legal Environment and Main Trends

Investment has a magnificent meaning for the economy, growth and welfare of society of every country. Not the less importance of investments can be indicated analyzing the financial status of enterprises. It is one of the most significant factors, which influences the continuity of the activity, development and competitive ability. In this chapter the main legislation regulating fixed investment in Lithuania will be presented.

Investments in Lithuania are regulated by national legislation as well as numerous international agreements on promotion and protection of investments. Liberalization of the investment conditions has been one of the main goals in the economic programs of Lithuania. In order to encourage investment, Lithuanian government have minimized restrictions on foreign investment, making them practically non-existent. Foreign investors are treated similarly with local undertakings. Enterprises owned by non-national shareholders can seek the same grants, subsidies and guarantees as enterprises owned by citizens of Lithuania. The state has encouraged foreign investment by signing bilateral agreements on the promotion and protection of investment and on the avoidance of double taxation with a large number of states. Such documents are signed with most of the EU member states, the USA, and many Central and Eastern European countries.

Investments made in various business and social spheres are different in content, purpose and scope. That is why in scientific literature investments are classified. Depending on the object of investment, all investments are divided into capital investments and finance investment (Tomaševič, Mackevičius 2010). The same classification is presented in Law on Investment (Official gazette 1999). In this legal act capital investment is identified as investments in the creation, acquisition or increase of value of tangible and intangible fixed assets. Thus, in scientific literature such classification is usually supplemented by dividing capital investments into fixed investments and intangible investments. According to V.Tomaševič and J.Mackevičius Fixed investments are investments in tangible assets (land, buildings, equipment, machinery, vehicles, appliances, construction in progress, etc.), thus intangible investment – an investment in intangible assets (development work, goodwill, patents, licenses, software, etc.). Other authors describe material investment as investment focused on fixed assets and working capital formation or an increase in the expectation of a certain period to make a

profit (Tomaševič, Mackevičius 2010). In general capital investments are major source of industrial capacity formation, so it is very important in shaping the capital structure; also it is a measure for recovery of the tangible and intangible assets. The term capital investment in financial accounting regulations is named as tangible and intangible assets. These assets according its functional purpose in accounting can be divided into different groups as buildings, reconstructions, machinery and equipment, facilities, vehicles and so on (Zinkevičienė, Bružauskas 2010).

Analyzing the legal environment of fixed investment in Lithuania, it is important to emphasize that stimulating of capital investment is an effective instrument for solving the economy problems of the state. That's way facing the crisis evaluation of fixed investment framework in Lithuania must focus not only on identification of main legal regulation concerning general issues, but also on economy policy in regard of capital investment. Next part of this chapter will reveal the fundamental legislation in the field of fixed investments. Later the main measures of stimulating of capital investment will be disclosed.

All national legislation of Lithuania Republic is harmonized with those of the European Union. The main principle of Lithuanian legislation in the field of investment is equal protection and equal treatment, meaning, meaning that both Lithuanian and foreign investors are subject to equal business conditions and their rights and lawful interests are equally protected by law. Taking into consideration strategically documents, the Investment promotion program 2008–2013 must be emphasized. The purpose of the Program is to set out the goals, objectives and measures of the general investment promotion policy for the period 2008–2013 and to designate institutions responsible for the implementation of the measures of the Program. The measures of the Program are mostly connected with increasing of attractiveness of Lithuania in the foreign investments market. The main law concerning investments in Lithuania is The Law on Investments, which was adopted in 1999. The Law sets forth the terms and conditions of investment in the Republic of Lithuania, the rights of the investors and investment protection measures for all types of investments. The Law on Investments emphasizes protection of investments, rights and lawful interests of investors. State institutions or officers have no right to prohibit or restrict the possession, use and disposal of the investment by investor. Investors can claim compensation of any damage suffered due to unlawful practices of the State or municipal institutions.

Expropriation of an investment may take place only for the public necessity and only in cases and under the procedures established in the laws, and provided the investor is adequately compensated pursuant to the rules established by the Government. Generally, the investor must be compensated at the market value of the assets deprived. The compensation must be paid within three months after the day of expropriation in the currency requested by a foreign investor, including the

interest from the moment of publication of the notice of expropriation until the payment of compensation.

Disputes concerning the rights and lawful interests of an investor are settled according to the agreement between the parties, by the courts of Lithuania, international arbitration or by other institutions. In case of investment disputes foreign investors may also apply to the International Centre for Settlement of Investment Disputes. The disputes are resolved under the provisions of applicable Lithuanian or foreign law and the relevant international treaties.

Such mentioned provisions of the Law on investment must be evaluated as globally oriented and stimulating, thus modern day requirements for investment attractive countries are noticeable higher and such provisions have to be supplemented by certain state policy.

Despite of declaration of equality of foreign and domestic investors in Law on Investments, it is noticeable that in regard of real estate their rights differ a little bit. Enterprises with foreign capital may own, lease or use real estate in Lithuania. There are no limitations on the ownership or usage of buildings, but some particular requirements may apply if those are buildings with cultural or historical value, thus the same restrictions are applied for domestic companies also. Enterprises can lease state-owned land plots for a maximum period of 99 years. Privately owned land may be leased for a maximum period of 100 years. Foreign citizens and entities engaged in registered commercial activity in Lithuania and complying with certain established criteria are allowed to purchase non-agricultural land plots. Based on the amendments to the Constitution adopted in January 2003 (Official gazette 2003), it is also possible to acquire agricultural land, but subject to a number of restrictions. According to the ė article of law on the Amendment to the Constitutional Law on the Subjects, Procedure, Terms and Conditions and Restrictions of the Acquisition into Ownership of Land plots, Provided for in paragraph 2 of Article 47 of the Constitution of the Republic of Lithuania land may be acquired only by foreign investors, which are legal persons meeting the criteria of European and trans-Atlantic integration. Foreign legal/natural persons may not acquire agricultural and forestry land until May 2011. Such restriction is not applied in respect of foreign individuals who permanently reside and have been engaged in agricultural activities in Lithuania for at least three years and foreign legal persons and other organizations that have established in representative offices or branches in Lithuania. Foreign investors may use and hold land on another legal basis (e.g. leasing) without restrictions.

Another group of legal acts concerning investment in the Republic of Lithuania is regulations in the field of Concession. Currently, concessions are regulated by the Law on Concessions (Oficial gazette 1996), which is harmonized with the EU directives 89/665/EEC (European Council 1989), 92/50/EEC (European Council 1992), 93/37/EEC (European Council 1993) and 2001/78/EU

(European Commission 2001). The law defines a concession as the granting of special permission to the concessionaire to perform economic activities related to design, construction, development, renovation, change, repairs, management, use and (or) supervision of infrastructure objects, rendering of public services, management and (or) use of state or municipal property (including natural resources) in accordance with the concession agreement, whereby the concessionaire accepts all or main liability for risks, rights and obligations arising out of such activities. The law includes the list of spheres of activities which may be subject of concession agreement. The main spheres of such activities are: energy, oil and natural gas extraction, transmission, distribution, supply, railway lines and systems, water economy, utilization, recycling and management of waste, roads, bridges, tunnels, parking and other infrastructure of road transport; ,health care system, educational system and etc. All areas are identified in Law on Concessions. Concessions may be granted to Lithuanian or foreign entities. Usually a public tender must be held for granting of a concession, however, in case of necessity a concession may be granted without it. It must be noticed that lately, the concessions have been rapidly gaining popularity, particularly among the municipalities.

Mentioned basic laws in the field of investment (Law on Investment and Law on Concession) create a background for every foreign and national entity which minded to invest in Lithuania. Government of the Republic of Lithuania, as true to form, is interested in stimulating of investments. In this part of this chapter the main trends of promoting of investments in Lithuania will be presented.

The 13 article of Law on Investment declares the measures of promotion of investment. It is stated that investment shall be promoted by the following methods:

- the investors shall be granted tax incentives determined by appropriate tax laws;
- personnel retraining costs shall be covered in part or fully in the manner specified by the Government of the Republic of Lithuania or an institution authorized by it;
- Lithuanian and foreign creditors who have granted loans for the execution of investment projects shall be given state and municipal guarantees according to the procedure established by the laws of the Republic of Lithuania;
- the repayment to the banks of loans intended to be used by economic entities for financing the execution of investment projects may be secured by the guarantees offered by the guarantee institutions set up by the Government or the guarantees offered by insurance undertakings or by insurance of the loans;

- investment contracts worth at least LTL 200 million and meeting the criteria set by the Government of the Republic of Lithuania, concluded with strategic investors by the Government or an institution authorized by it by 1 September 2001 shall be implemented in accordance with special terms and conditions of investment and business set in the said contracts;
- contracts for the investment of not less than LTL 20 million and, in the districts where the unemployment level is above the national average officially announced by the Department of Statistics under the Government of the Republic of Lithuania, not less than LTL 5 million, shall be concluded with investors according to the procedure established by the Civil Code of the Republic of Lithuania by the Government of the Republic of Lithuania or an institution authorized by it, with special terms and conditions of investment and business set in the contracts;
- contracts for investment in municipal infrastructure, production or service area, which meet the criteria set by the municipal council, shall be concluded by the municipality. Special terms and conditions of investment, business or choice of a land plot shall be established in such contracts according to the competence of municipality;
- in the cases specified by laws of the Republic of Lithuania state-owned land shall be leased to the investor without holding an auction;
- the infrastructure shall be created (up to the boundaries of the land plot allotted to the investor) with the state/municipality resources following the procedure established by the Government of the Republic of Lithuania or an institution authorized by it.

As it was mentioned before, facing crisis, governments of the stated true to form seek for the measures to stimulate the capital investments. Mostly state investment promotion policy is being implemented by tax incentives. In literature tax incentives are named as most efficient measure, because of the fact that in order to gain the economy growth it is purposeful to reduce the income tax rate for the capital investments (Zinkevičienė, Bružauskas 2010). According to the Law on corporative income tax fixed assets (it may be also determined as fixed investment) shall mean assets used by an entity to earn income (derive economic benefit) or provide been Employees and/or their Family Members (specified in paragraph 2 of Article 26 of the Law) for a period exceeding one year and the acquisition price whereof is not less than the price set by the entity according to the class of fixed assets listed in Appendix 1 to the Law. The acquisition price of such assets may be included in the entity's costs spread over the depreciation or amortization period. It means that all capital investments (together fixed and intangible) may be recounted during the depreciation or amortization period and in

this way the taxable income will be reduced. Generally, buildings may be depreciated over periods from 8 to 20 years (new buildings – 8 years), machinery and plant – over 5 years. Several types of intangibles (software, rights obtained etc.) may be amortized over periods from 3 to 4 years. Goodwill may be amortized over 15 years if certain conditions are met.

This general rule is supplemented by two additional provisions: article 171 (Costs of Scientific Research and Experimental Development) and article 461 (Reduction of Taxable Profits Due to an Investment Project).

Tax relief for Research and Development is the novelty in Lithuania Taxation policy. Provisions regulating this measure for investments stimulation entered into force only in 2008 (Official gazette 2001). According to the regulation, in calculating corporate income tax, the costs of scientific research and experimental development, except for depreciation or amortization costs of fixed assets, shall be deducted three times from income for the tax period during which they are incurred where the scientific research and/or experimental development works carried out are related to the usual or intended activities of the entity which generate or will generate income or economic benefit. It is also allowed to write off fixed assets used for activity of R&D to costs in a shorter period. Mentioned regulation should be supplemented by another provision – tax relief for investment projects. Entities carrying out investment projects are entitled to reduce their taxable profit up to 50% by the actually incurred acquisition costs of fixed assets meeting certain requirements. Depreciation (amortization) expenses of such fixed assets shall be deducted in a common manner. Taxable profit can be reduced by the above mentioned costs only if they are incurred in 2009 – 2013. The costs exceeding the abovementioned 50% limit can be carried forward for 4 years. The concept of investment Project is presented in Law on Corporative income tax. It is stated that investment project means the entity's investment in the fixed assets specified in Law intended for the production of new, additional products or the provision of services or the increase in the production (service provision) capacity or the introduction of a new process of production (provision of services) or a substantial change in the existing process (part thereof) also the introduction of technologies protected by international invention patents. It must be remarked that the concept of investment project does not overcome all investments in tangible and intangible assets, because it may be applied only for the investments towards assets which fits the indicated criteria (Zinkeviciene, Bruzauskas 2010). The entity's investment intended only for replacement of the held fixed assets with fixed assets of an equivalent class shall not be treated as an investment project (or a part thereof). According to the first paragraph of article 461 the taxable profits shall be reduced if the assets are necessary for the entity to carry out the investment project and the assets are attributable to the following classes of fixed assets listed in Appendix 1 to the Law on Corporate income tax: "plants and

machinery", "installations (structures, wells, etc.)", "computer and communications equipment (computers, computer networks and hardware)", "software", "acquired rights", and the assets have not been used and were produced not earlier than two years ago (as calculated from the date when such fixed assets were put into use).

The taxable profits may be reduced by not more than 50%. Where the amount of costs exceeds 50% of the amount of taxable profits calculated for a tax period, the costs exceeding this amount may be carried forward to reduce the amounts of taxable profits calculated for the four subsequent tax periods, respectively reducing the amount of the costs carried forward. However, taxable profits calculated for each tax period may not be reduced by more than 50%. It is important to emphasize that the taxable profits may be reduced in accordance with the described procedure only by the costs incurred during the tax periods of 2009–2013. The period of validity of such tax relief is closely connected with complicated situation in the market because of crisis. Fixed assets for the acquisition of which the taxable profits have been reduced must be used in the activities of the entity for at least three years. Where such fixed assets are used in the activities of the entity for a shorter period, except when the entity ceases to exist and in cases when the assets are lost due to force majeure or criminal activity by third parties, the corporate income tax that has not been calculated due to the reduction of taxable profits must be paid to the State budget, recalculating and taxing the taxable profits of the previous tax periods. An entity intending to reduce its taxable profits due to an investment project, upon having started to carry out the investment project, must inform thereof the local tax administrator in accordance with the procedure and within the time limits established by the central tax administrator.

Analyzing the legal framework of fixed investments in Lithuania it is crucial to mention the free economic zones, which operate in the territory of the state. Lithuanian tax legislation specifies a special tax treatment for enterprises established in Free Economic Zones. Free Economic Zone ("FEZ") is a territory designated for the purpose of economic-commercial and financial activities within which economic entities are provided with preferential economic and legal conditions of operation. Each FEZ is established by a separate law. Currently, there are two FEZ – one in Kaunas and the other in Klaipeda. The zone enterprises can be involved in trade, production and export, banking or other activities. However, retail trade is permitted only to the extent it serves to satisfy the internal needs of the FEZ. The main incentives for zone enterprises are as follows:

- for the companies that have invested more than LTL 3.64 million (EUR 1 million): exemption from corporate income tax for 6 years following the date of investment and a 50% discount reduction for the following 10 years;

- no real estate taxes;
- 0% VAT is imposed on goods imported to or placed in a FEZ.

There are also simplified customs and administration procedures applicable for the zone enterprises. Lithuanian and foreign enterprises, corporations and associations are eligible to participate in FEZs. FEZs offer considerable benefits for the companies registered and operating within their boundaries. It should be admitted that in the light of the EU law the above listed incentives (applicable to FEZ companies) are recognized as the State aid which is strictly regulated in the EU legislation and monitored by the European Commission. The main legal act applicable in the field of regulating the FEZ operations is Law on the Fundamentals of Free Economic Zones (Official gazette 1996), which was passed in 1995 (the firs FEZ in Kaunas was established in 1996. According to the mentioned law, free economic zone (FEZ) means a territory designated for the purpose of economic commercial and financial activities within which economic entities are provided with special economic and legal conditions of operation as established by this Law. The territory must have no permanent residents. There are several activities which are strictly forbidden in FEZ. For example it is unhallowed to organize economic commercial activities connected with ensuring state security and defense, as well as with the production, storage or sale of arms, ammunition or explosives, or having a harmful effect on the environment; production, processing, storage and neutralization of hazardous and radioactive materials; production, sale and storage of narcotics, narcotic, virulent and poisonous substances; manufacture of vodka, liqueur and other liquors; manufacture of tobacco products and etc. The Law on the Fundamentals of Free Economic Zones regulates the main issues, which are applied to all FEZ. The organizational issues of certain FEZ are being regulated by separate laws. FEZs are one of the factors stimulating foreign direct investment and domestic investment in Lithuania (Ministry of Economy of the Republic of Lithuania). Klaipeda Free Economic Zone (205 ha) was founded on 12 September 1996 after the adoption of the Law on Klaipeda Free Economic Zone of the Republic of Lithuania (Official gazette 1996). It was the first free economic zone to launch its activities in Lithuania, which now enjoys successful development. Kaunas Free Economic Zone (534 hectares) was founded on 22 October 1996 after the adoption of the Law on Kaunas Free Economic Zone of the Republic of Lithuania (Official gazette 1996). Both FEZ today are operating successfully and presents to their clients wide range of opportunities, incentives and comfort.

2.3. Conclusions for Chapter 2

The classical macroeconomic theory says that economic growth depends on fixed investment, or to gross fixed capital formation.

It must be mentioned that Lithuania legal system in the field of regulation of investments is fully harmonized with EU law. The main documents in this field are The Law on Investments, The Law on Concession, The Law on Corporate Tax and etc. Lithuanian state policy in the field of investments promotion distinguishes by the wide rate of measures. Fixed investments in Lithuania are stimulated by the state granted tax reliefs, government‘s supported credits, government supported investment contracts, concession contracts and other instruments.

All the measures used in order to gain the increase of investments are globally recognized as advanced and effective. Considering this fact the general environment of the investment in Lithuania should be evaluated as quit attractive.

Thus, mentioned measures must be supplemented by additional guarantees of stability in the state economy and policy areas. Depending on crisis, these factors today determine the certain stagnation in the field of investment.

3

Evaluation of Innovativeness of Lithuanian Enterprises

3.1. Lithuanian Enterprise Innovativeness Survey

This chapter aims to reveal how innovations are perceived in Lithuanian companies, and, how their efficiency has been evaluated. Research tackles innovation activity metrics used by Lithuanian enterprises. Probability sampling by simple random technique has been applied. Obtained results lead us to make generalizations about innovation management specifics, what in its turn, enable relevant policy implications formulation

The research tries to reveal how innovations are being managed practically inside Lithuanian companies, and if reasons of comparatively low susceptibility to innovation stimuli could be found. To achieve that objective the following research questions are being formulated. At first, keeping in mind variety of innovations' perceptions, the question about innovation interpretations in practice has been raised. The second research question is how innovative activity in terms of costs and benefit is being assessed. Opinions about managerial targets would complement to the picture, and, we assume, would reveal endogenous retardations of wider innovation implementation in Lithuanian companies. Questioning as

research method have been used; probability sampling by simple random technique (Saunders *et al* 2003) applied.

The survey of Lithuanian enterprises innovativeness was performed at three years in turn, at the period of 2007–2009. The questionnaires were sent and received in written form, by e-mail and via the special polling website. In total 2957 questionnaires from different enterprises of the country were received and processed. 279 of them were rejected due to wrong filling or unreadable filled data (the part of rejected questionnaires takes about 9.4 percent of all questionnaires received) and 2678 were appropriate for further investigation. Numbers of processed questionnaires yearly are presented Table 3.1.

Table 3.1. Number of processed questionnaires yearly

Number of questionnaires	2007	2008	2009	Total
Number of questionnaires received	1 192	973	792	2 957
Number of questionnaires rejected	134	87	58	279
Number of questionnaires accepted	1 058	886	734	2 678

Structure of the questioned companies according their size (Fig. 3.1) do not exactly correspond actual structure of Lithuanian companies (Fig. 3.2). Despite in Lithuanian enterprises comprised of 1–19 employees prevail, simple random questioning let to obtain opinion of greater number of respondents belonging to bigger organizations, which, assumingly, more significantly contribute to innovative activity development. Hence, a presumption is made that further generalizations on inquiry provide approximate reflection of current situation on innovations perception in innovative activity developing enterprises.

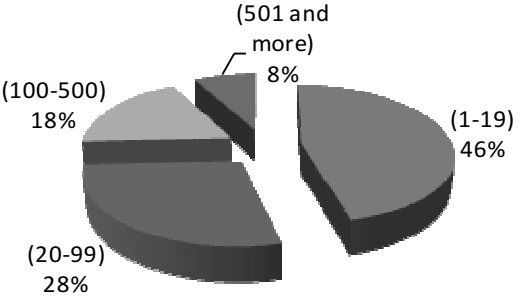

Fig. 3.1. Distribution of respondents according number of employees

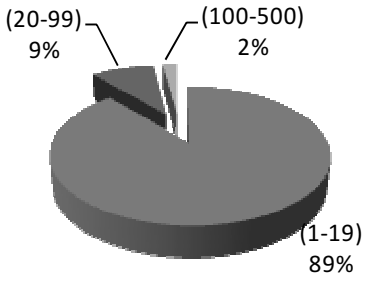

Fig. 3.2. Distribution of Lithuanian enterprises according number of employees (Department of Statistics of Lithuania, 2006)

The first question provided to companies in context of innovations, which participated in the survey had been formulated as follows: "What innovation is for your company". In the menu of optional answers main types of innovations were included. A possibility to indicate different than listed aspect of innovated activity was foreseen. Generalization of answers is reflected in Fig. 3.3.

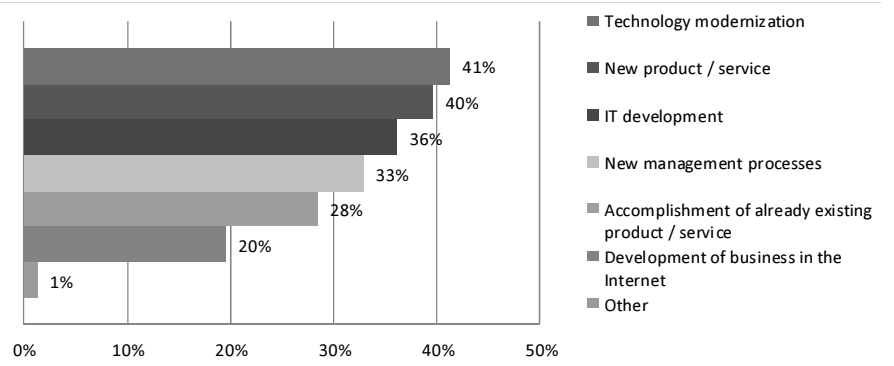

Fig. 3.3. Distribution of respondents according responses to a question: "What innovation is for your company?"

Responses of Lithuanian business companies reveal that classical understanding of innovative activity as, firstly, related to technological accomplishments, and, assumingly related to investments, prevail. Even 41.26% of enterprises technology modernization perceive as being of major facet of innovative activity. The second, according frequency of appearing (39.63%) is new product or service. It means, that production and product innovations are rather unanimously emphasized. Information technology development for any purposes (Korsakienė *et al* 2006) is being seen as generic feature of innovative activity (36.13%). Sufficient attention by companies was paid to new management

processes (32.87%) and development of business in Internet (19.58%). Recall, that menu of optional answers does not embrace all possible facets of innovative activity. Nevertheless, especially small fraction of companies (1.4%) distinguished aspects not provided by formulated options. Assumption arise that marketing activities usually are not attributed to innovative activity, unless they are related to development of information activities and Internet.

Seeking to reveal scale of innovative activity the question about innovation financing is provided. In order to eliminate differences in innovative activity perceptions, the question has been targeted specifically to technological and product innovations: "What percent of annual turnover does your company invest into technology modernization and development of new products/ services?". Responses let us reveal that almost one third of companies into technology and product development invest 2–5% of annual turnover, and another one third invests respectively up to 30% of their annual turnover (Fig. 3.4). Notably, that estimated 12% of companies devote more than 30% of annual turnover to production and products' innovations. Researches in the area verify that companies' capital origin affect innovation policy. In presented research nor capital origin (local or partly foreign, or foreign) neither industry have not being taken into account. Revelation of general tendencies is being talked. Hence, which exactly companies comprise that innovative, in terms of investment, sector is not being indicated. To continue picturing the Lithuanian companies approach, we state that according obtained empirical evidences, about 20% of surveyed companies does not or almost does not attribute financial means to development of innovative activity of the considered kind.

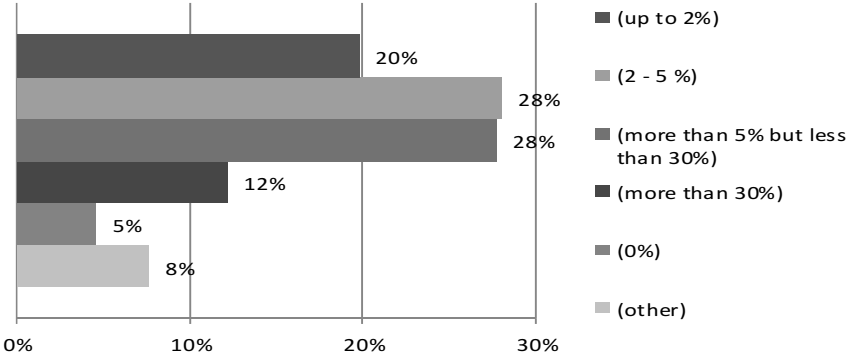

Fig. 3.4. Distribution of respondents according responses to a question: "What percent of annual turnover does your company invest into technology modernization and development of new products/ services?"

As it was mentioned above, questioning let us reveal that Lithuanian companies put emphasis on production and product innovations and majority of surveyed ones attribute rather significant financial means to their development. The second relevant in the context of this investigation question has been put: if major part enterprises innovative activity associate with implementation of new technology and development of new products, and, as it appeared, devote considerable amount of financial recourses, how then companies measure resulting effects? In order to reveal innovation activity management style, series of questions have been formulated. At first, a question about innovation activity measurement has been put. Enterprises have been asked if they measure theirs innovative activity at all (Fig. 3.5). Generalization of obtained responses gave an impression that even 52% of enterprises do not use specific metrics for innovative activity measurement; 18% of respondents restrict measurement by indicator of costs for technological improvement. Almost one third companies, it appeared, use metrics devised ad hoc for innovative activity measurement. The next question targeted specifically those companies, which use metrics (estimated half of respondents; i.e. companies measuring technological improvement costs and ones using other ad hoc metrics). Recall that, only 20% of companies do not devote funds to development of innovative activity at all. It means that estimated 80% of surveyed companies devote financial means to innovation development but only approximately 50% measure innovative activity.

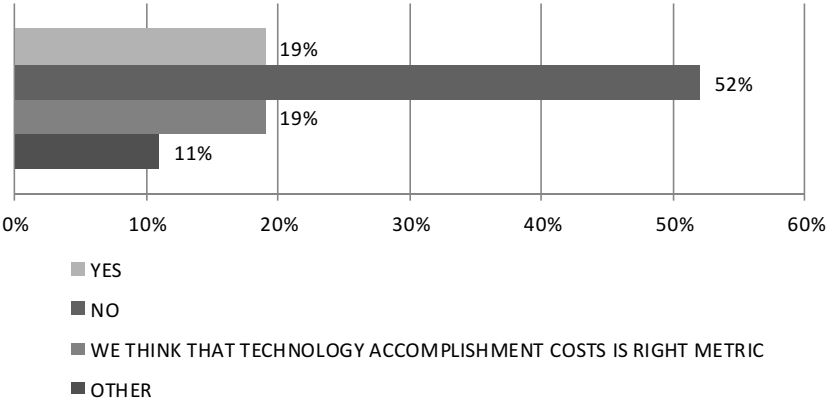

Fig. 3.5. Distribution of respondents according responses to a question: "If your company uses metrics (certain indicators) for innovative activity measurement?"

In order to identify how innovation measurement is being performed, a question about innovation metrics has been raised. Responses to a question about concrete indicators (Fig. 3.6) in use have led to the following generalizations.

More than 70% of respondents indicated that total funds invested into growth projects are considered as the most important indicator. More than 40% of surveyed companies put emphasis on such indicators as number of projects that meet planned targets, average development time and projected versus actual performance.

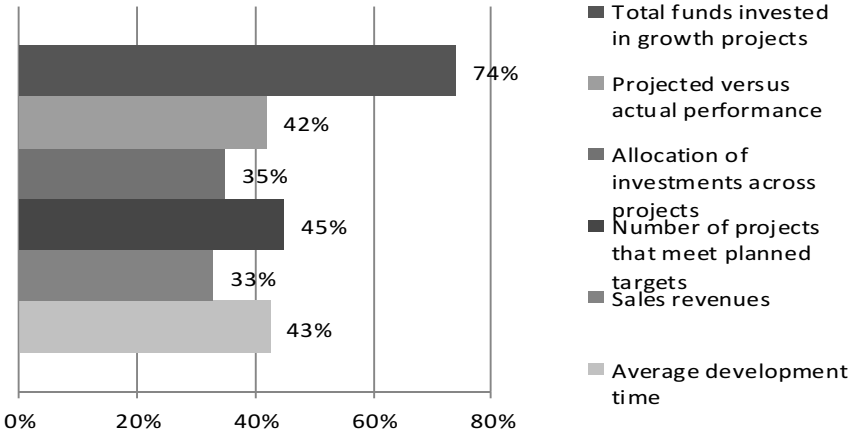

Fig. 3.6. Distribution of respondents according responses to a question: "Which indicators (metrics) your company uses for innovative activity measurement?"

Obtain results seems to be sufficiently compatible with emphasis, which, as it was indicated above, companies put on technological and product innovative activity facets of innovative activity. The sequent question was addressed to CEOs and aimed to reveal their judgments and suggestions (Fig. 3.7). Answers to the question: "What indicators (metrics) would you suggest for innovative activity measurement?" clarified that CEOs opinions about innovation metrics do not coincide with those used in practice, i.e. average development time, new product sales and return on innovation (ROI) it appeared to be suggested metrics.

Hence, generalization of obtain results has led to a conclusion that innovative activity is being managed rather intuitively, targets are not clearly set, metrics for innovative performance assessment are not being purposefully devised. Two different tracks in innovation management can be distinguished. On the one hand, survey let us reveal that innovative activity is being assets through investments; i.e. total funds invested into growth projects are considered as the most important indicator. It verifies that material investments are being emphasized and, therefore, funds invested serve as one of innovation metrics. On the other hand, costs of other innovative activity facets development and return on innovation (ROI) are not being monitored, despite ROI are being included into CEOs' suggestions.

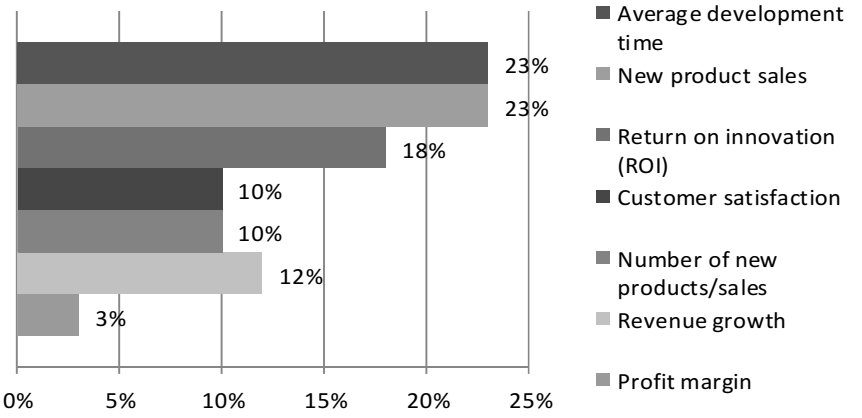

Fig. 3.7. Distribution of respondents according responses to a question: "What indicators (metrics) would you suggest for innovative activity measurement?"

Specific innovation activity metrics embrace number of projects that meet planned targets (it remains unclear what kind of projects) and average development time of a new product.

Notably, CEOs' opinions rather differ from prevailing practice in the field of innovation measurement, and, sequent, further management. Even taking into account, that some metrics are being used in practice, and considered as important by managers (e.g. sales revenues or, rather, new product sales), impression is, that managers are more oriented towards product innovations. Such indicators as new product sales (against sales revenues), number of new products, ROI, and, especially, customer satisfaction, mentioned by estimated more than 10% of managers reflect, it seems, product innovativeness. Notable, that customer satisfaction as innovation metrics is being used by product innovative companies. Another widely discussed question is how to use that indicator in order to make it driving force fostering new products' (Bettencourt, Ulwick 2008). It seems Lithuanian companies do not go so far.

The sample questionnaire and all the data from the questionnaires of the survey of Lithuanian enterprises innovativeness that were used in this dissertation is provided in Annex A.

3.2. Conclusions for Chapter 3

The survey presented in this chapter let us formulate the following considerations about innovation management practice in Lithuanian companies. Impres-

sion is that companies do not identify clearly directions of innovative activity development. Hence, innovation measurement system seems to be poorly developed, what does not allow set targets and monitor deviations, respectively. Results of survey signal that perception of innovation activity in Lithuanian companies significantly differs. Nevertheless, in practice companies rather heavily rely on investment into technology measurement, while product innovations (despite being distinguished as important one) almost are not being measured.

To generalize, the whole set of innovation metrics seems to lack systematic approach and, therefore, hardly allow indicating and managing innovation development efficiently. Accomplishment of innovation activity management inside companies, would allow to increase their susceptibility to exogenous innovation stimuli, e.g. innovation orientated state policy or explicit and implicit signals provided by market various players.

Another pattern that arises from the data of the survey of Lithuanian enterprises innovativeness is that most Lithuanian enterprises perceives innovations in general as implementation or development of new technologies in order to originate new products or services. This pattern lets us identify the properties of innovations from the point of view of enterprises and gives a framework for further analysis by indicating the aspects to scrutinize.

4

Evaluation of the Impact of Innovations and Fixed Investments on Economic Growth

4.1. Formation of the Research Model

Main points of this dissertation work are the interrelationship between innovations and fixed investments and also their impact on the growth of separate economic sectors.

The following research model was made sustaining the results of theoretical analysis of innovation and fixed investment. The model in Fig. 4.1 illustrates the way on which the research of the interrelationship between innovations and fixed investments and also their impact on the growth of separate economic sectors will be measured and evaluated.

Firstly it should be mentioned that this model does not stand for trying to identify and describe all factors that impacts growth of separate economic sectors. Secondly, the author does not assert that the links in this model are single-sided as it is represented. In some cases factors that impact objects may be impacted by those objects themselves. For example, innovations may be the factor that impact industry as an economic sector, but the rapid growth of this sector may

successfully impact a push in further development of innovations. Also the fact that economic growth may be impacted by other factors that are undefined in this model more than innovations and fixed investments, is uncontested.

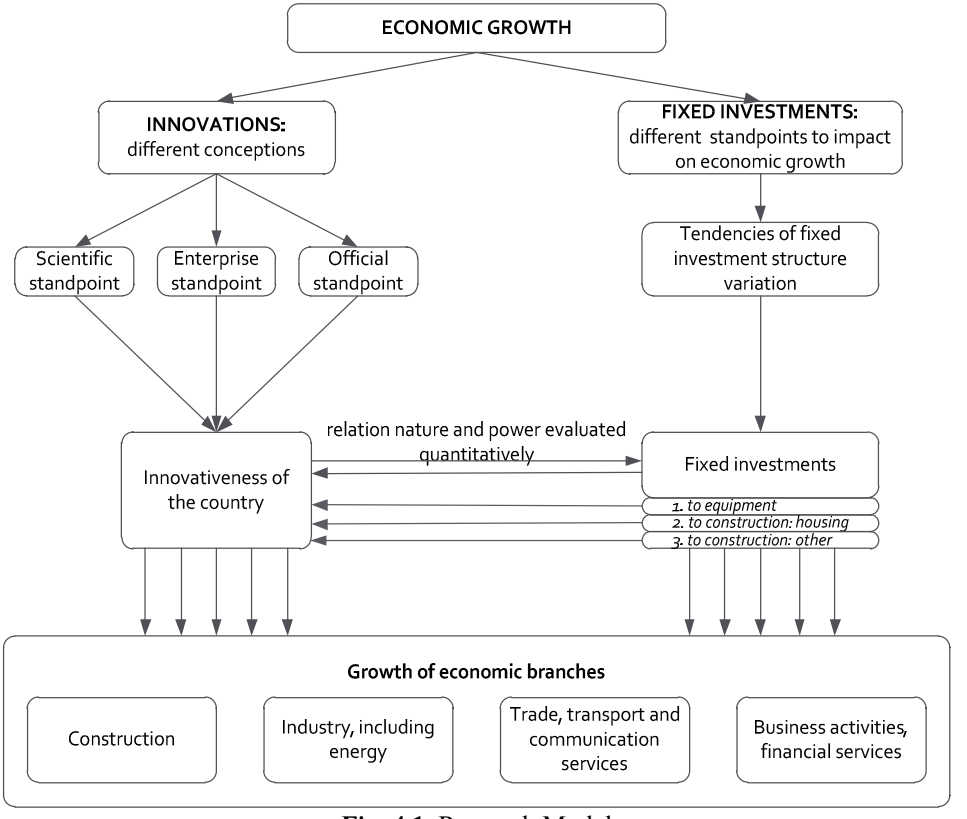

Fig. 4.1. Research Model

This model of research is a summary of theoretical and empirical scientific literature analysis and also the results of Lithuanian enterprise innovativeness survey.

Selection of research period

For the biggest precision of research results in the scientific literature (Saunders *et al* 2003) it is suggested to choose the longest period of research as possible. This also minimizes the impact of business cycles and various external shocks on the economic indicators and also on the research results. The other reason – the impact of one factor may be noticeable in the indicators not outright,

but in a period of time.

In this work the period of 11 years was chosen for the research, from year 2000 to 2010. The beginning of the period was determined by the year when innovation indicators of most countries were started to measure and announce. At the moment of writing this work the latest available data was for the year 2010, so this year was determined as the end of the research period. Predictive data of indicators were not taken into account.

Estimating that the results of innovation results in a lag of few years, in this analysis this variable, while comparing to others, is delayed in a two years period.

Selection of country sample

In order to gain the most reliable data results, it is recommended to analyses the biggest sample of different countries' data as possible. Problems occur when the lack of innovation data for different countries exists or when different countries try to use different techniques for innovation measurement and this data cannot be collated appropriately.

The data of all 27 European Union member countries are analyzed in this work. This sample was chosen because of the availability of unified and systemical data of indicators for all these countries and also because these countries perform measurements of indicators in the same way, according to the methodology of the European Union, so it can be properly collated.

Selection of research indicators

The choice of indicators that should be taken into account in the research came as a result of theoretical and empirical scientific literature analysis. Concrete research indicators, that were selected for this work, according to the model of the research, are presented below.

Indicators for innovation:

- summary innovation index (unit: SII).
- Indicators for fixed investment:
- gross fixed capital formation (unit: millions of euro);
- gross fixed capital formation (unit: euro per inhabitant).

Indicators for economic growth:

- gross domestic product at market prices (unit: millions of euro);
- gross domestic product at market prices (unit: euro per inhabitant);
- gross value added (unit: millions of euro);
- gross value added (unit: percent of all branches).

Selection of research methods

Statistical and econometrical model and methods mostly research connections between certain indicators. In every sphere of cognition the one confront many

separate proceedings. It is possible to ascertain the change order and regularity by evaluating the connections between them.

Before selecting the right research method data analysis should be performed to determine if sets of existing data correspond to the normal distribution. For such data analysis the one-sample Kolmogorov–Smirnov test that compares the observed cumulative distribution function for a variable with a specified theoretical distribution (e.g. normal) (IBM 2010) was performed. This data analysis was done with IBM SPSS (Statistical Package for the Social Sciences) version 19 software using one-sample Kolmogorov–Smirnov test procedure with significance level of 0.05.

As the results of the test show that the existing data sets correspond to the normal distribution, further the Pearson correlative analysis for the statistical connection analysis between variables should be used. Pearson correlation may be accounted according this formula (Januskevicius 2000):

$$r = \frac{\sum \left(x_i - \bar{x}\right)\left(y_i - \bar{y}\right)}{\sqrt{\sum \left(x_i - \bar{x}\right)^2 \sum \left(y_i - \bar{y}\right)^2}}, \tag{1}$$

where

$$\bar{x} = \frac{1}{n}\sum x_i \text{ and } \bar{y} = \frac{1}{n}\sum y_i . \tag{2}$$

Further analysis will contain the results of correlation, accounted with a help of functions CORREL or PEARSON of Microsoft Office Excel software (Microsoft 2010). This analysis show the intensity of reliance of variables and empowers to check is the correlation is meaningful statistically.

Correlation may achieve the meanings from −1 till +1. If the coefficient of correlation (r) is near +1, the connection between variables (X and Y) is direct and very strong (X increases and Y increases). If the coefficient (r) is near −1, which means that the connection between variables is reverse and strong (X increases, Y decreases). If the correlation of two variables is 0, that means that variables are statistically independent from each other.

If the coefficient of two variables is not 0, it is possible to conclude that statistical relation between these two exists (that means that X not necessary effects Y, thus X and Y are statistically related. Interpretation of correlation coefficient values (r) in various sources of scientific literature are presented differently (Kasiulevičius, Denapienė 2008; Januskevicius 2000; DeGroot 1986).

In this work correlation coefficient will be interpreted correspondingly as presented in Table 4.1.

Table 4.1. Interpretation of correlation coefficient

Value	Interpretation
0.00	No relationship
0.01 – 0.19	Very weak relationship
0.20 – 0.39	Weak relationship
0.40 – 0.69	Moderate relationship
0.70 – 0.89	Strong relationship
0.90 – 1.00	Very strong relationship

Correlation which does not reflect causality directly in statistic is named "spurious correlation". The connection between variables must also be confirmed by theoretical analysis or in other ways the reasonable presumptions must be created. In the process of correlative analysis the listed subsidiary description will be used: average, variance, standard deviation.

Average embodies the sum of the numeral data of all observed numbers set, divided from the number of elements of the numbers set. Average may be accounted according to formula No. 2 (Januškevičius, 2000). Further analysis will contain the results of correlation, accounted with a help of the function AVERAGE of Microsoft Office Excel software (Microsoft 2010).

Variance – the measure of the scatter over the average. This is a statistical characteristic, which reflects the most probable deviation of the ordinary measured value from arithmetical average. Variance helps in accounting of the quality and reliability of the results of measurement. Variance also reflects the characteristics of researched objected and may be (as an average) considered as the result of analysis.

Variance may be calculated according this formula:

$$D_x = \frac{1}{n}\sum_{i=1}^{n}(X_i - \overline{X})^2 \text{ and agreeably } D_y = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \overline{Y})^2, \qquad (3)$$

where n – the amount of elements of the number set.

Further analysis will contain the results of variance, accounted with a help of the function VAR of Microsoft Office Excel software (Microsoft 2010).

Standard deviation shows how in average analyzed number set values are

retired from the average. Standard deviation (*S*) may be calculated according this formula:

$$S_x = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(X_i - \overline{X})^2} \text{ and agreeably } S_y = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(Y_i - \overline{Y})^2}, \qquad (4)$$

where *n* is the amount of element of the number set.

Further analysis will contain the results of standard deviation, accounted with a help of the function STDEV of Microsoft Office Excel software (Microsoft 2010).

The importance of the correlation coefficient *r* will be evaluated by the help of Student criteria *t*. According to this criterion accounted value of the observational criteria is noted as t_{ob}. This value is compared with the critical value of the Student probability distribution (noted as t_{cr}), what is placed in the table of Student probability distribution according to the level of importance α and the level of the liberty *k*. Further analysis will contain the results accounted with a help of the function TINV of Microsoft Office Excel software (Microsoft 2010). The level of importance α will be chosen 0.05 and the level of liberty *k* will be chosen $n-2$.

The value of the observed criteria will be counted according to this formula:

$$t_{ob} = r\sqrt{\frac{k}{1-r^2}}. \qquad (5)$$

Calculated value will be compared with critical value t_{cr}. If $t_{ob} > t_{cr}$, it may be concluded, that the correlation coefficient is important and stochastic relation exists. If $t_{ob} < t_{cr}$, the conclusion on stochastic relation cannot be done (Čekanavičius, Murauskas 2000).

4.2. Innovativeness in the Context of the European Union

As post-industrial, frequently also named innovative, economies lately were named only the most economically powerful countries of the world. However it must be marked that recently the influence of new countries becomes more and more noticeable in the world economy. Certainly, the speed of integration into

global and based on innovations and knowledge space depends on the national innovation system of separate country.

Obviously in all countries the innovative activity is not developed in the same level. Also it is not supported by the same means. Every national innovation system has its own typical characteristics. In order to compare the national innovation system of different countries commonly the principle of comparative analysis is applied. The aim of this principle is to describe the advantages and disadvantages of certain national system and to try to ascertain systematical inadequacy.

Innovation performance is measured in all European Union member states by the decision of European Parliament and European Council in order to formulate fully comparable statistical innovation performance data for all member states of European Union (European Commission 2004).

According to the recommendations of Organization for Economic Cooperation and Development and European Union Statistics Office the Department of Statistics to the Government of the Republic of Lithuania started implementing this measurement system in 1998.

Innovativeness of European Union countries is being measured and evaluated using Summary innovation index (SII). SII is a composite variable of different indicators.

Until 2010 SII was a composite of 29 indicators going from a lowest possible performance of 0 to a maximum possible performance of 1 (PRO INNO Europe 2009). In 2010 SII structure has changed. The former list of 29 indicators has been replaced with a new list of 25 indicators, which better capture the performance of national research and innovation systems considered as a whole. 19 of the previous 29 indicators have been carried over from 2009 edition, of which 12 indicators have not been changed, 2 indicators have been merged, and 5 indicators have been partly changed by using broader or narrower definitions or different denominators.

Taking into account the merging of 2 indicators, 18 indicators of the 2010 are equivalent to those of the 2009 and in addition 7 new indicators have been introduced (PRO INNO Europe 2010). Fig. 4.2 reflects the results for the 2010 SII for European countries.

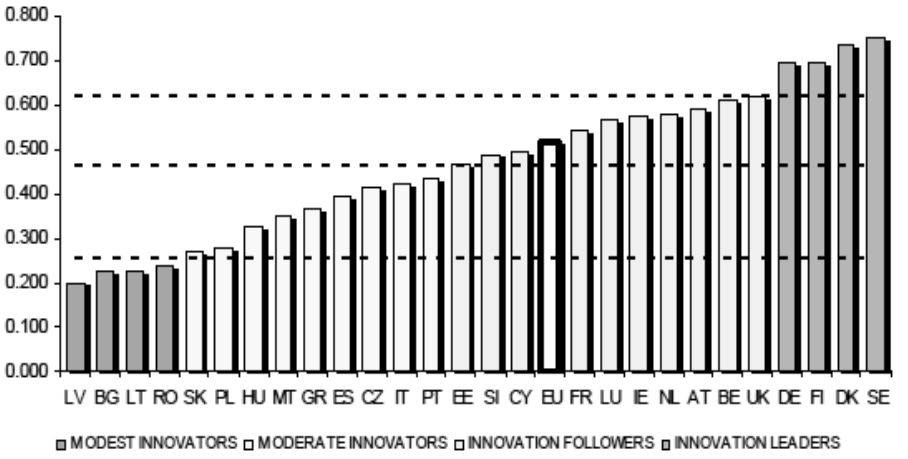

Fig. 4.2. SII for European countries

Based on a statistical cluster analysis of the SII scores over a five year period, the countries can be divided into the following groups (PRO INNO Europe 2010):

Denmark, Finland, Germany and Sweden all show a performance well above that of the EU27 and all other countries. These countries are the innovation leaders.

Austria, Belgium, Cyprus, Estonia, France, Ireland, Luxembourg, Netherlands, Slovenia and the UK all are the innovation followers, with innovation performance below those of the innovation leaders but close to or above that of the EU27.

The performance of Czech Republic, Greece, Hungary, Italy, Malta, Poland, Portugal, Slovakia and Spain are the moderate innovators with innovation performance below the EU27.

The performance of Bulgaria, Latvia, Lithuania and Romania is well below that of the EU27. These countries are modest innovators. Although their innovation performance is well below the EU27 average, this performance is increasing towards the EU27 average over time (Fig. 4.3).

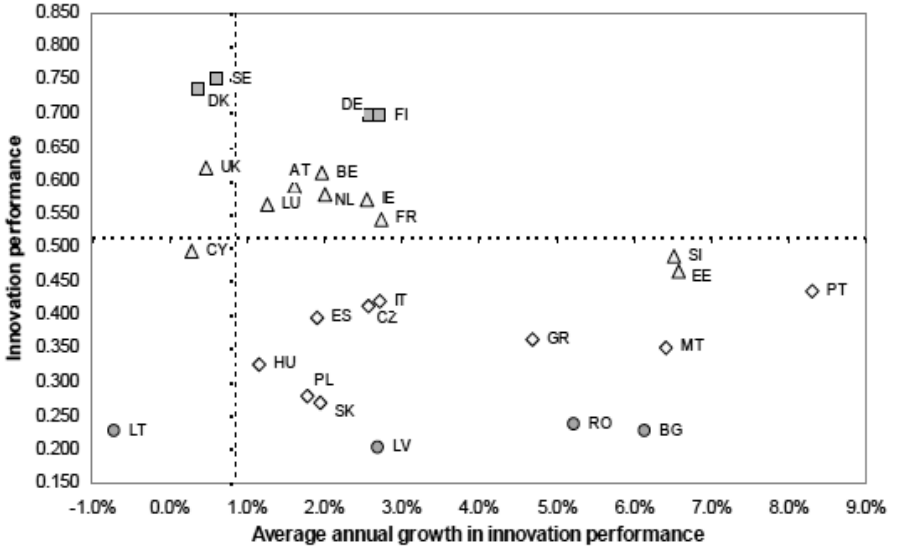

Fig. 4.3. Average annual growth in innovation performance of European countries

Lithuania is among the group of modest innovators, with an innovation performance well below the EU27 average and a rate of improvement above that of the EU27. Relative strengths are in human resources and finance and support. Relative weaknesses are in open, excellent and attractive research systems, intellectual assets, innovators and outputs.

High growth is observed for public-private co-publications, PCT patent applications and community trademarks. A strong decline is observed for non-EU doctorate students and community designs. Growth performance in human resources and Intellectual assets is above average. In the other dimensions it is below average. SII indicators of Lithuania are presented in Fig. 4.4.

Over the past 5 years, human resources, finance and support and throughputs have been the main drivers of the improvement in innovation performance, in particular as a result from strong growth in S&E and SSH doctorate graduates (14.8%), private credit (21.5%), EPO patents (15.5) and community trademarks (26.8%). Performance in innovators has worsened, in particular due to a decrease in SMEs introducing product or process innovations (−6.1%).

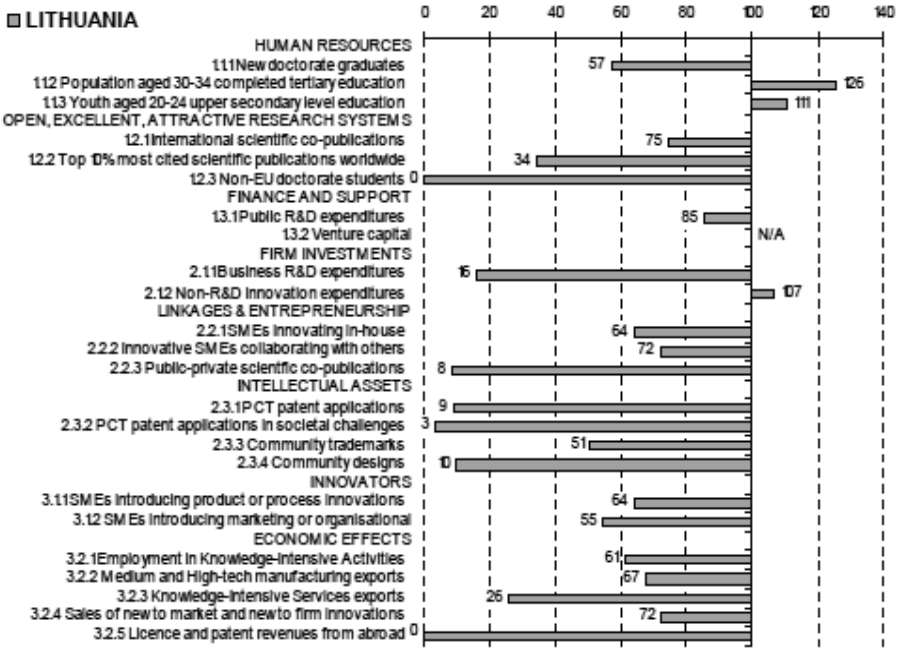

Fig. 4.4. SII indicators of Lithuania

The financial crisis has triggered a global economic downturn. This has resulted in at first falling economic growth rates followed by a real economic decline in many countries. Accordingly it had an impact to innovation performance of EU countries.

All 27 European Union member countries can be put into 4 groups by SII position history:

- Sweden is the only country that was in the first position by SII in the whole period of SII measuring;
- only 4 countries have been in top 2–5 positions by SII in the whole period of SII measuring: Denmark, Germany, Finland and United Kingdom;
- only 6 countries had positions between 6 and 11 by SII in the whole period of SII measuring: Belgium, Austria, Netherlands, Ireland, Luxemburg, France;
- all other (16) EU27 countries divided positions from 12 and below and have never had higher positions. Fig. 4.5 presents changes in positions of European Union member states, rated by SII in the period of 2002 – 2010.

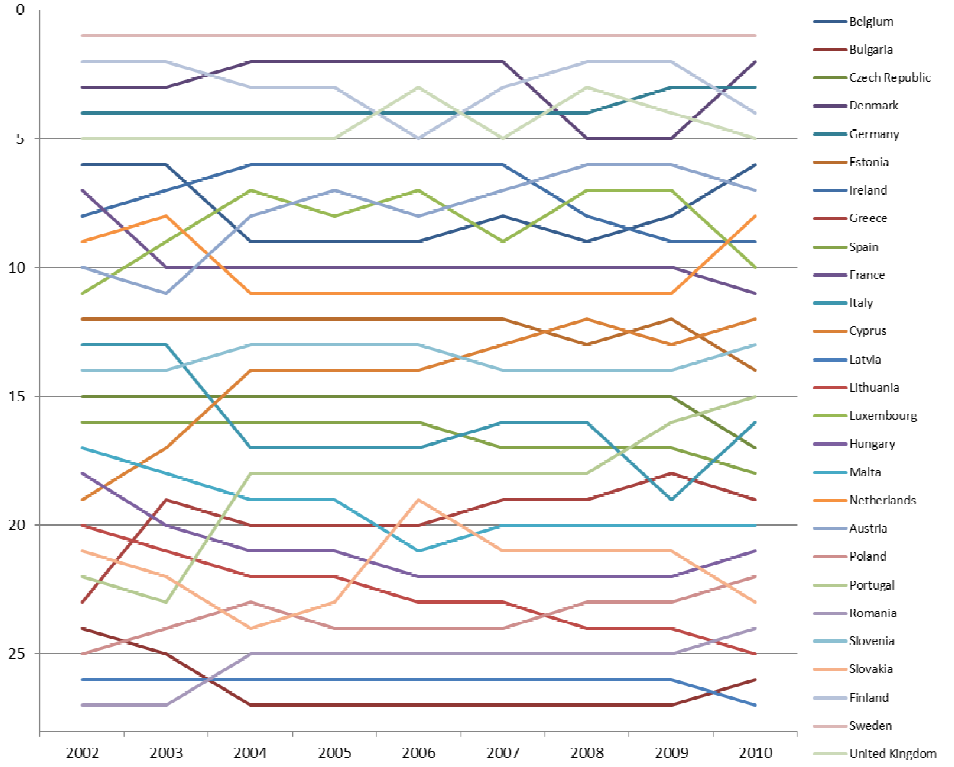

Fig. 4.5. EU27 member's positions by SII, 2002–2010

According to the history of innovation development in European Union countries, further in this work EU member countries will be grouped into main groups:

- top 5 EU member countries by SII – these will be treated as the most innovative countries;
- top 6–11 EU member countries by SII – these will be treated as moderate innovative countries;
- other EU member countries – these will be treated as less innovative countries.

4.3. Fixed Investments in the Context of the European Union

Fixed investments (or gross fixed capital formation) refers to spending on acquisitions of buildings, engineering structures, equipment, machines, transport means; construction and renewal of existing long-term fixed assets (excluding common repairs) (Offizical gazette 1999). The classical macroeconomic theory says that economic growth depends on fixed investment, or to gross fixed capital formation.

EUROSTAT official data (gross fixed capital formation, unit: euro per inhabitant) from the period of 2000 – 2010 will be taken into account while exploring fixed investments of European Union member states.

In 2010 the average of fixed investments in European Union member states amounted in 4500 euro per inhabitant. The highest extent of fixed investments for one inhabitant was in Luxembourg – 13500 euro, the lowest was in Bulgaria, Lithuania and Romania – 1300 euro per inhabitant. Fig. 4.6 shows fixed investments (euro per inhabitant) in European Union member states in 2010.

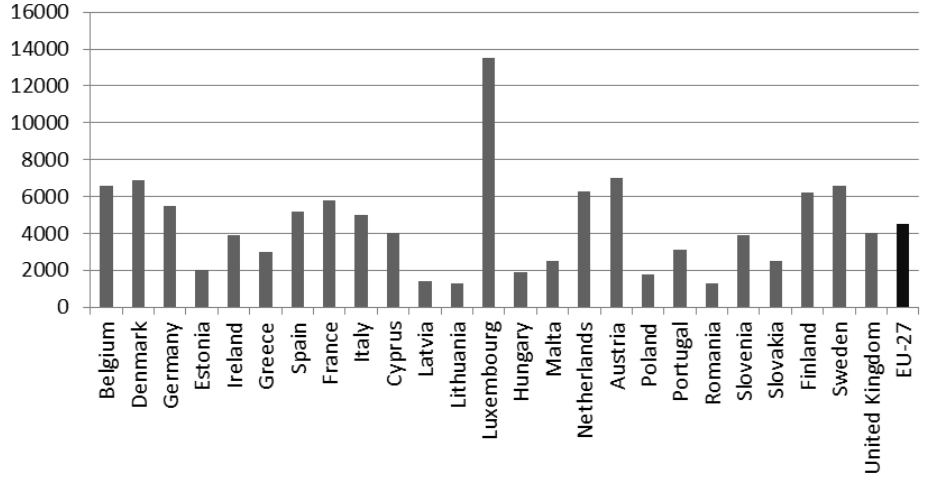

Fig. 4.6. Fixed investments (euro per inhabitant) in European Union member states in 2010

Fixed investments (gross fixed capital formation) are divided into 6 asset types:

- products of agriculture, forestry, fisheries and aquaculture;
- metal products and machinery;
- transport equipment;

- construction work: housing;
- construction work: other constructions;
- other products.

According to the EUROSTAT data, in 2010 fixed investments of EU27 countries amounted 2 276 573 million euro in total. By the structure most of it went to construction: 31 percent for construction work: other constructions, other 25 percent – to construction work: housing. Also 26 percent of total fixed investments comes to metal products and machinery.

In comparison, fixed investments of Lithuania in 2010 amounted 4 401.8 million euro in total and it distributed similarly: most of fixed investments went to construction: 51 percent for construction work: other constructions, other 12 percent – to construction work: housing. Also 22 percent of total fixed investments comes to metal products and machinery.

4.4. Economic Growth in the Context of the European Union

4.4.1. Gross Domestic Product

Economic performance is generally being measured through gross domestic product (GDP) – a variable that refers to the market value of all final goods and services produced within a country in a given period. GDP has also become the de facto universal metric for a country's standard of living (Goossens *et al* 2007). This variable is universally applied according to common standards, and has some undeniable benefits mainly due to its simplicity.

While exploring gross domestic product of European Union member states EUROSTAT official data (gross domestic product at market prices, unit: euro per inhabitant) from the period of 2000 – 2010 will be taken into account.

In 2010 the average of GDP in European Union member states amounted in 24 500 euro per inhabitant. The highest extent of GDP for one inhabitant was in Luxembourg – 82 100 euro, the lowest was in Bulgaria – 4 600 and in Romania – 5 700 euro per inhabitant. Fig. 4.7 shows GDP (euro per inhabitant) in European Union member countries in 2010.

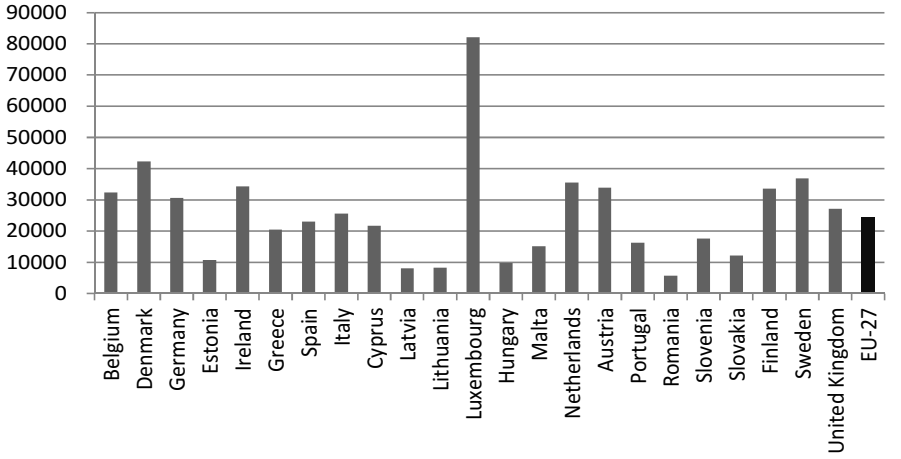

Fig. 4.7. GDP (euro per inhabitant) in European Union member states in 2010

Since 2000 average GDP in euro per inhabitant in European Union member states was increasing until 2009, when it decreased by 6 percent. In 2010 this value increased by 4 percent in comparison with 2009. The main factor of such decrease and slow straighten was the financial crisis which has triggered a global economic downturn and had an impact on countries' GDP. The history of average GDP (in euro per inhabitant) in European Union member states in 2000–2010 is presented in Fig. 4.8.

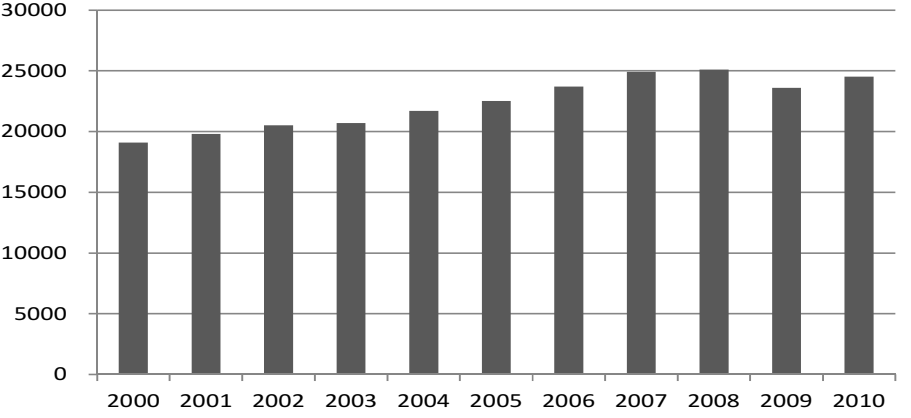

Fig. 4.8. Average GDP (euro per inhabitant) in European Union member states in 2000–2010

GDP, measured by euro per inhabitant in Lithuania in 2010 was 8 300 euro

per inhabitant or about 3 times lower than the average of European Union member countries. Similarly as in other European Union member countries, GDP was increasing since 2000 until 2009, when due to financial crisis it fell by almost 18 percent. In 2010 GDP increased by 5 percent.

4.4.2. Gross Value Added

Gross value added (GVA) is a measure in economics of the value of goods and services produced in an area, industry or sector of an economy. In national accounts GVA is output minus intermediate consumption (Eurostat); it is a balancing item of the national accounts' production account.

GVA is linked as a measurement to gross domestic product (GDP), as both are measures of output. The relationship is defined as: GVA + taxes on products − subsidies on products = GDP.

EUROSTAT official data (gross value added, unit: millions of euro) from the period of 2000–2010 will be taken into account while exploring gross value added of European Union member states.

In 2010 gross value added in European Union member states amounted in 10 990 122.9 million euro in total. The highest extent of gross value added was in Germany – 2 239 860.0 euro, the lowest was in Malta – 5 446.0 million and Estonia – 12 691.8 million euro. Table 4.2 shows gross value added (millions of euro) in European Union member states in 2010.

Table 4.2. Gross value added (millions of euro) in European Union member states in 2010

No.	Country	GVA
1	Germany	2 239 860.0
2	France	1 751 582.7
3	United Kingdom	1 511 239.9
4	Italy	1 386 942.2
5	Spain	972 403.0
6	Netherlands	529 139.0
7	Belgium	314 503.0
8	Poland	312 119.3
9	Sweden	301 562.2
10	Austria	257 803.3
11	Greece	203 198.9
12	Denmark	201 643.3
13	Finland	156 944.0
14	Portugal	151 344.1
15	Ireland	139 293.1
16	Czech Republic	130 460.3
17	Romania	108 238.9
18	Hungary	82 976.6
19	Slovakia	60 208.5
20	Luxembourg	37 852.1
21	Slovenia	31 476.3
22	Bulgaria	31 008.1
23	Lithuania	24 588.1
24	Latvia	16 098.2
25	Cyprus	15 750.0
26	Estonia	12 691.8
27	Malta	5 446.0

The structure of gross value added of European Union member states is not similar to each other. The structure of gross value added in all European Union member countries by 2010 is illustrated in Fig. 4.9.

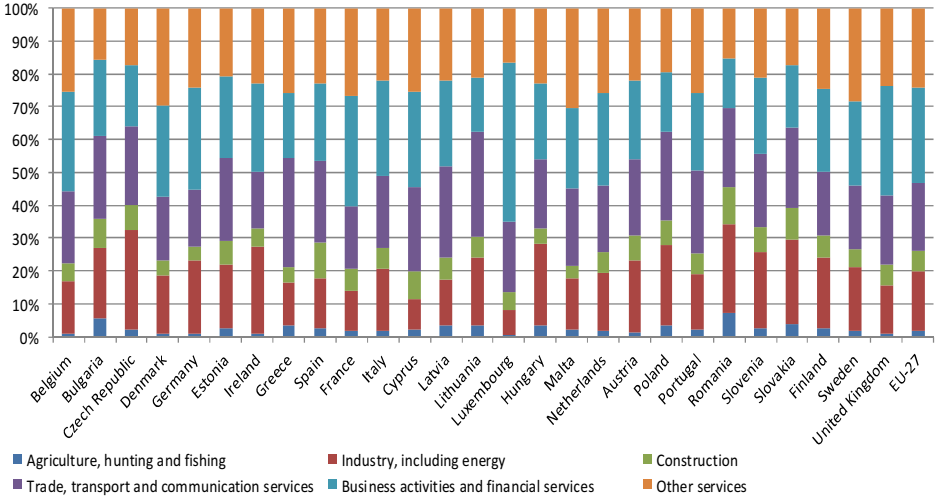

Fig. 4.9. Structure of economy (gross value added) in EU-27 countries in 2009

Different branches have different variation tendencies in countries' economics. For instance, in 2010 the branch agriculture, hunting and fishing takes a part from (minimum in EU-27) 0.3 percent of all branches in Luxembourg to (maximum in EU-27) 6.7 percent of all branches in Romania, so the difference is more than 22 times. The branch industry, including energy takes a part from 8.1 percent (in Luxembourg) up to 30.3 percent (in Czech Republic). Construction takes from 3.6 percent (in Malta) to 10.1 percent (in Spain). Trade, transport and communication services – from 17.2 percent (in Germany) to 33.5 percent (in Lithuania). Business activities and financial services – from 15.7 percent in Romania up to 48.4 percent in Luxembourg. Other services takes a part from 14.1 percent of all branches in Romania up to 30 percent in Malta. The difference in structure of gross value added in different EU-27 countries is obvious.

4.5. Interrelationship between Innovativeness and Fixed Investments

According to the literature, innovations are one of the main and the most important factors providing the competitive advantage for the companies. The role

of innovations in nowadays world economy cannot be doubted. Recently the role of innovations was named as important only for separate companies, thus now innovations are regarded as one of the most substantial factors of growth of the economy of regions.

The first hypothesis in this work is aimed to an assumption that fixed investments (or more precisely, the results that come from fixed investments) creates a basis or an infrastructure for innovation.

Hypothesis 1: *Fixed investments are directly related to innovativeness of the country (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlation analysis between fixed investments and summary innovation index in European Union member countries and also the t-test analysis are presented in Table 4.3.

Table 4.3. Results of correlation analysis between fixed investments and summary innovation index in EU-27

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.3037	2.3646	0.9016	Failed
Denmark	2	0.5562	2.3646	1.8931	Failed
Germany	3	0.5899	2.3646	2.0666	Failed
Finland	4	0.4857	2.3646	1.5716	Failed
United Kingdom	5	0.4977	2.3646	1.6228	Failed
Belgium	6	0.8762	2.3646	5.1422	Passed
Austria	7	0.7891	2.3646	3.6337	Passed
Netherlands	8	0.7368	2.3646	3.0824	Passed
Ireland	9	0.8554	2.3646	4.6716	Passed
Luxembourg	10	0.7691	2.3646	3.4038	Passed
France	11	0.7874	2.3646	3.6127	Passed
Cyprus	12	0.8996	2.3646	5.8259	Passed
Slovenia	13	0.9053	2.3646	6.0291	Passed
Estonia	14	0.8619	2.3646	4.8084	Passed
Portugal	15	0.5320	2.3646	1.7771	Failed
Italy	16	0.8566	2.3646	4.6960	Passed
Czech Republic	17	0.8383	2.3646	4.3493	Passed
Spain	18	0.9628	2.3646	10.0797	Passed
Greece	19	0.9472	2.3646	8.3530	Passed
Malta	20	0.8087	2.3646	3.8891	Passed
Hungary	21	0.9234	2.3646	6.8056	Passed
Poland	22	0.3040	2.3646	0.9026	Failed
Slovakia	23	0.6664	2.3646	2.5283	Passed
Romania	24	0.8000	2.3646	3.7713	Passed
Lithuania	25	−0.4944	2.3646	−1.6088	Failed
Bulgaria	26	0.5497	2.3646	1.8614	Failed
Latvia	27	0.3914	2.3646	1.2031	Failed

Results of correlative analysis show that the relationship between fixed investments and innovations is very strong in 4 countries, strong – in 12 and moderate – in 8 European Union countries. The t-test for show that 17 relationships are reliable and fixed investments are directly related to innovations in these countries: Belgium, Austria, Netherlands, Ireland, Luxembourg, France, Cyprus, Slovenia, Estonia, Italy, Czech Republic, Spain, Greece, Malta, Hungary, Slovakia, Romania.

From the results it is noticeable that in all of the most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010), strong relationships between fixed investments and innovations are not revealed or these relationships are unreliable according to the results of the t-test.

As in moderate innovative (No. 6–11 by SII in 2010), as in less innovative (No. 12–27 by SII in 2010) European Union member countries strong and reliable relationships between fixed investments and innovations exist.

According to the results of the analysis it may be declared that the relationship between fixed investments and innovations exists, but mostly in moderate and less developed countries. In most developed and most innovative countries such relationship in the environment of this analysis generally does not exist. So the first hypothesis "fixed investments are directly related to innovations" was proven partially – for less and moderate innovatively developed countries.

Economic interpretation of obtained results: it was revealed that fixed investment in less innovative and moderate innovative countries impact innovativeness more considerably if to compare to the same relationship in most innovative countries. From economic point of view it could be explained in the following way. When the country is underdeveloped in the context of innovativeness, fixed investment is the main condition to build necessary infrastructure for the functioning of innovations. Hence, fixed investment conditions growth of innovativeness at the particular stage of development (impact of fixed investment on innovativeness is significant). When a country develops and the infrastructure is already built, impact of fixed investment on innovations naturally diminishes. Role of fixed investment here changes: fixed investment are used mainly not for creating, but for maintenance of already built (in the context of the country) infrastructure. Maintenance in general can guarantee proper functioning, but not the growth of innovativeness. Presented economic interpretation is based on the universal economic law of diminishing returns on investments (Taylor 1998).

In statistical data the structure of fixed investments is defined as follows:

- products of agriculture, forestry, fisheries and aquaculture;
- metal products and machinery;
- transport equipment;
- construction work: housing;

- construction work: other constructions;
- other products.

The sector of products of agriculture, forestry, fisheries and aquaculture is specific by the different policy due this sector and the different level of financial support from the governments, so as this sector data may misrepresent the results of all other sectors, it will not be taken into account further in this work. The sectors of transport equipment and other products will also be underrated due to their specifics.

Further on these sectors of fixed investments will be analyzed and taken into consideration: metal products and machinery, construction work (housing) and construction work (other constructions).

The first sub-hypothesis aims to the presumption that the sector of metal products and machinery of fixed investments (or more precisely, the results that come from this sector of fixed investments) creates a background and directly impacts country's' innovativeness.

Hypothesis 1.1: *Fixed investments in the context of machinery are directly related to innovativeness of the country (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of the analysis show that the relationship between fixed investments (metal products and machinery) and innovations (summary innovation index) is very strong in 1 country, strong – in 11 and moderate – in 8 European Union countries. The t-test for these relationships show that 13 relationships are reliable, so fixed investments to metal products and machinery are directly related to innovations in 13 countries: Luxembourg, France, Cyprus, Slovenia, Estonia, Italy, Czech Republic, Spain, Greece, Malta, Hungary, Slovakia, Romania.

It is noticeable that in all of the most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010), strong relationships are not revealed between fixed investments in the context of metal products and machinery and innovations or these relationships are unreliable according to the results of the t-test. In moderate innovative (No. 6–11 by SII in 2010) countries these relationships exists but are not dominant: in two of six countries the relationship between fixed investments to metal products and machinery and innovations exists. In 11 of the rest 16 (No. 12–27 by SII in 2010) European Union countries strong and reliable relationships between fixed investments to metal products and machinery and innovations exist.

Table 4.4 presents the results of correlation analysis between fixed investments at the sector of metal products and machinery and summary innovation index in European Union member countries and also the t-test analysis.

Table 4.4. Results of correlation analysis between fixed investments (metal products and machinery) and summary innovation index in EU-27

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.3348	2.3646	1.0049	Failed
Denmark	2	0.4853	2.3646	1.5697	Failed
Germany	3	0.4825	2.3646	1.5580	Failed
Finland	4	0.4088	2.3646	1.2668	Failed
United Kingdom	5	−0.0221	2.3646	−0.0625	Failed
Belgium	6	n/a	2.3646	n/a	n/a
Austria	7	0.5944	2.3646	2.0904	Failed
Netherlands	8	0.5876	2.3646	2.0542	Failed
Ireland	9	0.2083	2.3646	0.6023	Failed
Luxembourg	10	0.7641	2.3646	3.3499	Passed
France	11	0.8805	2.3646	5.2539	Passed
Cyprus	12	0.8432	2.3646	4.4364	Passed
Slovenia	13	0.8971	2.3646	5.7420	Passed
Estonia	14	0.8825	2.3646	5.3081	Passed
Portugal	15	0.4585	2.3646	1.4591	Failed
Italy	16	0.8362	2.3646	4.3120	Passed
Czech Republic	17	0.6882	2.3646	2.6832	Passed
Spain	18	0.8367	2.3646	4.3208	Passed
Greece	19	0.8847	2.3646	5.3692	Passed
Malta	20	0.7295	2.3646	3.0168	Passed
Hungary	21	0.9311	2.3646	7.2194	Passed
Poland	22	0.2655	2.3646	0.7788	Failed
Slovakia	23	0.7489	2.3646	3.1965	Passed
Romania	24	0.8234	2.3646	4.1045	Passed
Lithuania	25	−0.3889	2.3646	−1.1940	Failed
Bulgaria	26	n/a	2.3646	n/a	n/a
Latvia	27	0.4378	2.3646	1.3772	Failed

According to the results of the analysis it may be declared that the relationship between fixed investments at the sector of metal products and machinery and innovations exists, but mostly in less developed and in some moderately developed countries. In most developed and innovative countries such relationship in the environment of this analysis generally does not exist. So the first sub-hypothesis "fixed investments in the context of machinery are directly related to innovativeness of the country" was proven partially – for less developed and innovative countries.

The second sub-hypothesis aims to the presumption that the sector of construction work (housing) of fixed investments (or more precisely, the results that come from this sector of fixed investments) creates a background and directly impacts country's' innovativeness.

Hypothesis 1.2: *Fixed investments in the context of construction work (housing) are directly related to innovativeness of the country (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of the analysis show that the relationship between fixed investments (construction work: housing) and innovations (SII) is very strong in 3 countries, strong – in 11 and moderate – in 8 European Union countries. The t-test show that 14 relationships are reliable and fixed investments to construction work (housing) are directly related to innovations in 14 countries: Netherlands, Ireland, Luxembourg, France, Cyprus, Slovenia, Estonia, Italy, Czech Republic, Spain, Greece, Malta, Hungary, Romania.

From the results it is noticeable that all of the most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010), do not reveal strong relationships between fixed investments into construction work: housing and innovations or these relationships are unreliable according to the results of the t-test. In most of moderate innovative (No. 6–11 by SII in 2010) and less innovative (No. 11–27 by SII in 2010) European Union countries strong and reliable relationships between fixed investments into construction work: housing and innovations exist.

According to the results of the analysis it may be declared that the relationship between fixed investments at the sector of construction work (housing) and innovations exists, but mostly in less or moderate developed countries. In most developed and innovative countries such relationship in the environment of this analysis generally does not exist. So the second sub-hypothesis "fixed investments in the context of construction work (other constructions) are directly related to innovativeness of the country" was proven partially – for less developed and innovative countries.

Table 4.5 presents the results of correlation analysis between fixed investments at the sector of construction work (housing) and summary innovation index in European Union member countries and also the t-test analysis.

Table 4.5. Results of correlation analysis between fixed investments (construction work: housing) and summary innovation index in EU-27

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.2069	2.3646	0.5982	Failed
Denmark	2	0.6271	2.3646	2.2769	Failed
Germany	3	0.1551	2.3646	0.4441	Failed
Finland	4	0.4634	2.3646	1.4790	Failed
United Kingdom	5	0.5600	2.3646	1.9119	Failed
Belgium	6	n/a	2.3646	n/a	n/a
Austria	7	0.5466	2.3646	1.8460	Failed

End of Table 4.5

Netherlands	8	0.8491	2.3646	4.5457	Passed
Ireland	9	0.8048	2.3646	3.8358	Passed
Luxembourg	10	0.6872	2.3646	2.6759	Passed
France	11	0.7509	2.3646	3.2158	Passed
Cyprus	12	0.9264	2.3646	6.9590	Passed
Slovenia	13	0.8658	2.3646	4.8943	Passed
Estonia	14	0.8008	2.3646	3.7813	Passed
Portugal	15	−0.7056	2.3646	−2.8161	Failed
Italy	16	0.9030	2.3646	5.9430	Passed
Czech Republic	17	0.7657	2.3646	3.3674	Passed
Spain	18	0.9794	2.3646	13.7130	Passed
Greece	19	0.8075	2.3646	3.8722	Passed
Malta	20	0.7929	2.3646	3.6808	Passed
Hungary	21	0.7822	2.3646	3.5513	Passed
Poland	22	0.4247	2.3646	1.3269	Failed
Slovakia	23	0.5525	2.3646	1.8750	Failed
Romania	24	0.7493	2.3646	3.2000	Passed
Lithuania	25	−0.5877	2.3646	−2.0544	Failed
Bulgaria	26	n/a	2.3646	n/a	n/a
Latvia	27	0.3875	2.3646	1.1889	Failed

The third sub-hypothesis aims to the presumption that the sector of construction work (other constructions) of fixed investments (or more precisely, the results that come from this sector of fixed investments) creates a background and directly impacts country's' innovativeness.

Hypothesis 1.3: *Fixed investments in the context of construction work (other constructions) are directly related to innovativeness of the country (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlative analysis show that the relationship between fixed investments (construction work: other constructions) and innovations is very strong in 3 countries, strong – in 10 and moderate – in 7 European Union countries. The t-test show that 13 relationships are reliable and fixed investments to construction work (other constructions) are directly related to innovations in these countries: Austria, Ireland, Luxembourg, France, Cyprus, Slovenia, Estonia, Portugal, Italy, Czech Republic, Spain, Hungary, Romania.

The results of correlation analysis between fixed investments at the sector of construction work (other constructions) and summary innovation index in European Union member countries and also the t-test analysis are presented in Table 4.6.

Table 4.6. Results of correlation analysis between fixed investments (construction work: other constructions) and summary innovation index in EU-27

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.2000	2.3646	0.5774	Failed
Denmark	2	0.4391	2.3646	1.3822	Failed
Germany	3	0.2591	2.3646	0.7587	Failed
Finland	4	0.4376	2.3646	1.3765	Failed
United Kingdom	5	0.5594	2.3646	1.9090	Failed
Belgium	6	n/a	2.3646	n/a	n/a
Austria	7	0.8691	2.3646	4.9699	Passed
Netherlands	8	0.4735	2.3646	1.5205	Failed
Ireland	9	0.8418	2.3646	4.4103	Passed
Luxembourg	10	0.7257	2.3646	2.9834	Passed
France	11	0.7662	2.3646	3.3725	Passed
Cyprus	12	0.8437	2.3646	4.4462	Passed
Slovenia	13	0.8999	2.3646	5.8377	Passed
Estonia	14	0.8591	2.3646	4.7470	Passed
Portugal	15	0.9368	2.3646	7.5763	Passed
Italy	16	0.7777	2.3646	3.4994	Passed
Czech Republic	17	0.8947	2.3646	5.6665	Passed
Spain	18	0.9529	2.3646	8.8888	Passed
Greece	19	0.0310	2.3646	0.0878	Failed
Malta	20	−0.6427	2.3646	−2.3728	Failed
Hungary	21	0.9136	2.3646	6.3546	Passed
Poland	22	0.2949	2.3646	0.8730	Failed
Slovakia	23	0.6026	2.3646	2.1358	Failed
Romania	24	0.7785	2.3646	3.5079	Passed
Lithuania	25	−0.4787	2.3646	−1.5423	Failed
Bulgaria	26	n/a	2.3646	n/a	n/a
Latvia	27	0.3904	2.3646	1.1995	Failed

From the results it is noticeable that all of the most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010), do not reveal strong relationships between fixed investments to construction work (other constructions) and innovations (SII) or these relationships are unreliable according to the results of the t-test. In most of moderate innovative (No. 6–11 by SII in 2010) and less innovative (No. 11–27 by SII in 2010) European Union countries strong and reliable relationships between fixed investments and innovations exist.

According to the results of the analysis it may be declared that the relationship between fixed investments at the sector of construction work (other constructions) and innovations exists, but mostly in less and moderate developed countries. In most developed and innovative countries such relationship in the environment of this analysis generally does not exist. So the first sub-hypothesis "fixed investments in the context of construction work (other constructions) are

directly related to innovativeness of the country" was proven partially – for less developed and innovative countries.

In summary of interrelationship between innovativeness and fixed investments by structure analysis, all three sub-hypothesis regarding interrelationship between innovativeness and fixed investments by structure (1.1: fixed investments in the context of machinery are directly related to innovativeness of the country; 1.2: fixed investments in the context of construction work (housing) are directly related to innovativeness of the country and 1.3: fixed investments in the context of construction work (other constructions) are directly related to innovativeness of the country) in general showed the same results: all of them were partially proven – for less and some moderate developed and innovative countries.

4.6. Interrelationship between Innovativeness and Economic Growth

According to the scientific literature, innovations are one of the main factors stimulating economic growth of the country. Although the role of innovations in nowadays world economy cannot be doubted, the second hypothesis in this work aims to verify this relationship in conditions of this research.

Hypothesis 2: *Innovativeness is directly related to economic growth of the country (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlative analysis show that the relationship between summary innovation index and gross domestic product is very strong in 8 countries, strong – in 9 and moderate – in 8 European Union countries. The t-test for these show that 19 relationships are reliable and economic growth is directly related to innovations in these countries: Germany, Belgium, Austria, Netherlands, Ireland, Luxembourg, France, Cyprus, Slovenia, Estonia, Portugal, Italy, Czech Republic, Spain, Greece, Malta, Hungary, Slovakia, Romania.

The results of correlation analysis between summary innovation index and gross domestic product (unit: euro per inhabitant) in European Union member countries and also the t-test analysis are presented in Table 4.7.

Table 4.7. Results of correlation analysis between summary innovation index and gross domestic product in EU-27

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.2048	2.3646	0.5918	Failed
Denmark	2	0.6299	2.3646	2.2941	Failed
Germany	3	0.8211	2.3646	4.0689	Passed
Finland	4	0.3230	2.3646	0.9654	Failed
United Kingdom	5	0.5612	2.3646	1.9179	Failed
Belgium	6	0.8501	2.3646	4.5649	Passed
Austria	7	0.9036	2.3646	5.9671	Passed
Netherlands	8	0.7911	2.3646	3.6586	Passed
Ireland	9	0.8598	2.3646	4.7624	Passed
Luxembourg	10	0.8181	2.3646	4.0231	Passed
France	11	0.6963	2.3646	2.7436	Passed
Cyprus	12	0.9212	2.3646	6.6980	Passed
Slovenia	13	0.9607	2.3646	9.7866	Passed
Estonia	14	0.8902	2.3646	5.5273	Passed
Portugal	15	0.9719	2.3646	11.6798	Passed
Italy	16	0.8724	2.3646	5.0492	Passed
Czech Republic	17	0.8642	2.3646	4.8582	Passed
Spain	18	0.9511	2.3646	8.7050	Passed
Greece	19	0.9628	2.3646	10.0785	Passed
Malta	20	0.9512	2.3646	8.7214	Passed
Hungary	21	0.9266	2.3646	6.9678	Passed
Poland	22	0.5194	2.3646	1.7192	Failed
Slovakia	23	0.6746	2.3646	2.5850	Passed
Romania	24	0.8359	2.3646	4.3070	Passed
Lithuania	25	−0.4840	2.3646	−1.5644	Failed
Bulgaria	26	0.4874	2.3646	1.5789	Failed
Latvia	27	0.4237	2.3646	1.3231	Failed

From the results it is noticeable that 4 of 5 most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010) do not reveal strong relationships between gross domestic product and innovations or these relationships are unreliable according to the results of the t-test (except of Germany, which is ranked No. 3 by SII in 2010 and where a strong and reliable relationship between analyzed variables exist). Relationships between gross domestic product and innovations also exists in all moderate innovative (No. 6–11 by SII in 2010) countries as well as in 11 of 16 less innovative (No. 11–27 by SII in 2010) European Union member countries.

According to the results of the analysis it may be declared that the relationship between innovativeness and economic growth exists, but mostly in less or moderate developed countries. In most developed and innovative countries such relationship in the environment of this analysis in general does not exist. So

the second hypothesis "innovativeness is directly related to economic growth of the country" was proven partially – for less developed and innovative countries.

Economic interpretation of obtained results: it was revealed that innovativeness in less and moderate innovative countries impact economic growth more considerably if to compare to the same relationship in more innovative countries. From economic point of view it could be explained in the following way. Innovations are usually being created in more developed countries. Less developed countries usually adopt and implement innovations rather than create them (this is the consistent pattern, but not without exceptions). While countries are in the process of implementation of innovations, they enjoy the effects of spillovers and due to them grow faster. When countries achieve the high level of development in terms of innovation, they encounter the need to create new innovations. That process is more complicated and costly. Hence, in countries that create innovations (mode developed countries) economic growth is affected by innovations less comparing with countries that adopt and implement created innovations.

In statistical data the structure of fixed investments is defined as follows:

- agriculture, hunting and fishing;
- industry, including energy;
- construction;
- trade, transport and communication services;
- business activities and financial services;
- other services.

Further in this analysis the following major branches will be taken into account: industry, including energy; construction; trade, transport and communication services and also business activities and financial services.

Structure of these branches is rather different in the European Union member countries. For example, the branch of agriculture, hunting and fishing is in average more than 1.7 times smaller in EU-27 countries that are in TOP-5 positions by SII in comparison to other EU member countries. The branch of industry, including energy is on a similar level in all EU-27 members. Construction branch is about 13 percent smaller in TOP-5 by SII countries than in other, the difference on trade, transport and communication services is less than 17 percent. Business activities and financial services in TOP-5 by SII countries is around 10 percent higher than in others, other services – around 14 percent. The summary of the structure of gross value added in EU-27 and TOP-5 by SII countries is provided in Table 4.8.

Table 4.8. Structure of economy (gross value added) in EU-27 and in TOP-5 by SII

Branch	EU-27			TOP-5 by SII		
	min	*max*	*average*	*min*	*max*	*average*
Agriculture, hunting and fishing	0.3	6.7	2.5	0.7	2.9	1.5
Industry, including energy	8.1	29.7	20.0	15.7	23.7	20.1
Construction	3.6	10.1	6.1	4.1	6.6	5.3
Trade, transport and communication services	17.2	33.5	23.5	17.2	20.7	19.6
Business activities and financial services	15.7	48.4	25.4	24.1	33.6	27.9
Other services	14.1	30.0	22.5	23.3	29.4	25.6

The following sub-hypothesis aims to the presumption that innovativeness of the country directly impacts the branch of industry, including energy of the gross value added of the country.

Hypothesis 2.1: *Innovativeness is directly related to economic growth of the country in the context of industry, including energy (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlative analysis show that the relationship between summary innovation index and gross value added of industry, including energy is very strong in 6 countries, strong – in 9 and moderate – in 7 European Union countries. The t-test that 16 relationships are reliable and economic growth in the context of industry, including energy is directly related to innovations in these countries: Germany, Belgium, Austria, Netherlands, Luxembourg, Cyprus, Slovenia, Estonia, Portugal, Italy, Czech Republic, Spain, Greece, Hungary, Slovakia, Romania.

From the results it is noticeable that 4 of 5 most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010) do not reveal strong relationships between gross value added of industry, including energy and innovations or these relationships are unreliable according to the results of the t-test (except of Germany, which is ranked No. 3 by SII in 2010 and where a strong and reliable relationship between analyzed variables exist). Relationships between gross domestic product sector (in the context of industry, including energy) and innovations also exists in 4 of 6 moderate innovative (No. 6–11 by SII in 2010) countries as well as in 11 of 16 less innovative (No. 11–27 by SII in 2010) European Union member countries.

The results of correlation analysis between summary innovation index and gross value added of industry, including energy in European Union member countries and also the t-test analysis are presented in Table 4.9.

Table 4.9. Results of correlation analysis between summary innovation index and gross value added of industry, including energy in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.2895	2.4469	0.8555	Failed
Denmark	2	0.5986	2.4469	2.1137	Failed
Germany	3	0.8784	2.4469	5.1998	Passed
Finland	4	0.3996	2.4469	1.2331	Failed
United Kingdom	5	−0.2248	2.4469	−0.6524	Failed
Belgium	6	0.8730	2.4469	5.0631	Passed
Austria	7	0.8525	2.4469	4.6134	Passed
Netherlands	8	0.8115	2.4469	3.9277	Passed
Ireland	9	0.2348	2.4469	0.6833	Failed
Luxembourg	10	0.8052	2.4469	3.8403	Passed
France	11	0.6437	2.4469	2.3794	Failed
Cyprus	12	0.9483	2.4469	8.4481	Passed
Slovenia	13	0.9697	2.4469	11.2205	Passed
Estonia	14	0.8999	2.4469	5.8349	Passed
Portugal	15	0.9371	2.4469	7.5957	Passed
Italy	16	0.8215	2.4469	4.0746	Passed
Czech Republic	17	0.8581	2.4469	4.7277	Passed
Spain	18	0.9372	2.4469	7.6011	Passed
Greece	19	0.9337	2.4469	7.3739	Passed
Malta	20	0.3037	2.4469	0.9014	Failed
Hungary	21	0.9351	2.4469	7.4618	Passed
Poland	22	0.5502	2.4469	1.8636	Failed
Slovakia	23	0.6876	2.4469	2.6783	Passed
Romania	24	0.8551	2.4469	4.6656	Passed
Lithuania	25	−0.4596	2.4469	−1.4638	Failed
Bulgaria	26	0.4794	2.4469	1.5451	Failed
Latvia	27	0.4023	2.4469	1.2429	Failed

According to the results of the analysis it may be declared that the relationship between innovativeness and economic growth in the context of industry, including energy exists, but mostly in less and moderate developed countries. In most developed and innovative countries such relationship in the environment of this analysis in general does not exist. So the sub-hypothesis "innovativeness is directly related to economic growth of the country in the context of industry, including energy" was proven partially – for less developed and innovative countries.

The next sub-hypothesis aims to the presumption that innovativeness of the country directly impacts the branch of construction of the gross value added of the country.

Hypothesis 2.2: *Innovativeness is directly related to economic growth of the country in the context of construction (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlative analysis show that the relationship between summary innovation index and gross value added of construction is very strong in 2 countries, strong – in 15 and moderate – in 7 European Union countries. The t-test for these 24 relationships show that 18 of them are reliable and economic growth in the context of construction is directly related to innovations in these countries: United Kingdom, Belgium, Austria, Netherlands, Ireland, Luxembourg, France, Cyprus, Slovenia, Estonia, Portugal, Italy, Czech Republic, Spain, Greece, Malta, Hungary, Romania.

From the results it is noticeable that 4 of 5 of the most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010) do not reveal strong relationships between gross value added of construction and innovations or these relationships are unreliable according to the results of the t-test. As in all moderate innovative (No. 6–11 by SII in 2010), as in most of less innovative (No. 11–27 by SII in 2010) European Union member countries moderate to very strong and reliable relationships between innovativeness and economic growth in the context of construction exist.

According to the results of the analysis it may be declared that the relationship between innovativeness and economic growth in the context of construction exists, but mostly in moderate and less developed countries. In most developed and innovative countries such relationship in the environment of this analysis in general does not exist. So the sub-hypothesis "innovativeness is directly related to economic growth of the country in the context of construction" was proven partially – for less developed and innovative countries.

The results of correlation analysis between summary innovation index and gross value added of construction in European Union member countries and also the t-test analysis are presented in Table 4.10.

Table 4.10. Results of correlation analysis between summary innovation index and gross value added of construction in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.2041	2.4469	0.5897	Failed
Denmark	2	0.6054	2.4469	2.1515	Failed
Germany	3	−0.3469	2.4469	−1.0462	Failed
Finland	4	0.4707	2.4469	1.5089	Failed
United Kingdom	5	0.6594	2.4469	2.4811	Passed
Belgium	6	0.8056	2.4469	3.8460	Passed
Austria	7	0.8681	2.4469	4.9465	Passed
Netherlands	8	0.7201	2.4469	2.9355	Passed
Ireland	9	0.8201	2.4469	4.0544	Passed
Luxembourg	10	0.8498	2.4469	4.5601	Passed
France	11	0.7632	2.4469	3.3412	Passed
Cyprus	12	0.9260	2.4469	6.9388	Passed
Slovenia	13	0.8963	2.4469	5.7157	Passed
Estonia	14	0.8771	2.4469	5.1644	Passed
Portugal	15	0.8257	2.4469	4.1397	Passed
Italy	16	0.8771	2.4469	5.1648	Passed
Czech Republic	17	0.8595	2.4469	4.7552	Passed
Spain	18	0.9678	2.4469	10.8766	Passed
Greece	19	0.8252	2.4469	4.1321	Passed
Malta	20	0.8755	2.4469	5.1241	Passed
Hungary	21	0.8884	2.4469	5.4722	Passed
Poland	22	0.2645	2.4469	0.7757	Failed
Slovakia	23	0.5419	2.4469	1.8236	Failed
Romania	24	0.7700	2.4469	3.4136	Passed
Lithuania	25	−0.4989	2.4469	−1.6281	Failed
Bulgaria	26	0.6441	2.4469	2.3817	Failed
Latvia	27	0.4429	2.4469	1.3973	Failed

The next sub-hypothesis aims to the presumption that innovativeness of the country directly impacts the branch of trade, transport and communication services of the gross value added of the country.

Hypothesis 2.3: *Innovativeness is directly related to economic growth of the country in the context of trade, transport and communication services (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlation analysis between summary innovation index and gross value added of trade, transport and communication services in European Union member countries and also the t-test analysis are presented in Table 4.11.

Table 4.11. Results of correlation analysis between summary innovation index and gross value added of trade, transport and communication services in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.1840	2.4469	0.5296	Failed
Denmark	2	0.6206	2.4469	2.2385	Failed
Germany	3	0.8017	2.4469	3.7937	Passed
Finland	4	0.1082	2.4469	0.3079	Failed
United Kingdom	5	0.4731	2.4469	1.5191	Failed
Belgium	6	0.8461	2.4469	4.4889	Passed
Austria	7	0.8697	2.4469	4.9842	Passed
Netherlands	8	0.7529	2.4469	3.2359	Passed
Ireland	9	0.8854	2.4469	5.3868	Passed
Luxembourg	10	0.7007	2.4469	2.7778	Passed
France	11	0.5936	2.4469	2.0861	Failed
Cyprus	12	0.8457	2.4469	4.4828	Passed
Slovenia	13	0.9485	2.4469	8.4652	Passed
Estonia	14	0.8846	2.4469	5.3644	Passed
Portugal	15	0.9590	2.4469	9.5762	Passed
Italy	16	0.8327	2.4469	4.2532	Passed
Czech Republic	17	0.8361	2.4469	4.3112	Passed
Spain	18	0.9455	2.4469	8.2145	Passed
Greece	19	0.9733	2.4469	11.9938	Passed
Malta	20	0.8690	2.4469	4.9675	Passed
Hungary	21	0.8937	2.4469	5.6354	Passed
Poland	22	0.5204	2.4469	1.7238	Failed
Slovakia	23	0.6640	2.4469	2.5119	Passed
Romania	24	0.8305	2.4469	4.2167	Passed
Lithuania	25	−0.4483	2.4469	−1.4187	Failed
Bulgaria	26	0.4702	2.4469	1.5068	Failed
Latvia	27	0.3842	2.4469	1.1769	Failed

Results of correlative analysis show that the relationship between summary innovation index and gross value added of trade, transport and communication services is very strong in 4 countries, strong – in 13 and moderate – in 7 European Union member country. The t-test show that relationships are reliable and economic growth in the context of trade, transport and communication services is directly related to innovations in these countries: Germany, Belgium, Austria, Netherlands, Ireland, Luxembourg, Cyprus, Slovenia, Estonia, Portugal, Italy, Czech Republic, Spain, Greece, Malta, Hungary, Slovakia, Romania.

From the results it is noticeable that 4 of 5 most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010) do not reveal strong relationships between gross value added of trade, transport and communication services and innovations or these relationships are unreliable according to the results of the t-test (except of Germany, which is ranked No. 3 by

SII in 2010 and where a strong and reliable relationship between analyzed variables exist). Relationships between gross domestic product sector (in the context of trade, transport and communication services) and innovations also exists in 5 of 6 moderate innovative (No. 6–11 by SII in 2010) countries as well as in 11 of 16 less innovative (No. 11–27 by SII in 2010) European Union member countries.

According to the results of the analysis it may be declared that the relationship between innovativeness and economic growth in the context of trade, transport and communication services exists, but mostly in less and moderate developed countries. In most developed and innovative countries such relationship in the environment of this analysis in general does not exist. So the sub-hypothesis "innovativeness is directly related to economic growth of the country in the context of trade, transport and communication services" was proven partially – for less developed and innovative countries.

The next sub-hypothesis aims to the presumption that innovativeness of the country directly impacts the branch of business activities and financial services of the gross value added of the country.

Hypothesis 2.4: *Innovativeness is directly related to economic growth of the country in the context of business activities and financial services (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlative analysis show that the relationship between summary innovation index and gross value added of business activities and financial services is very strong in 7 countries, strong – in 11 and moderate – in 6 European Union countries. The t-test show that 19 relationships are reliable and economic growth in the context of business activities and financial services is directly related to innovations in these countries: Germany, Belgium, Austria, Netherlands, Ireland, Luxembourg, France, Cyprus, Slovenia, Estonia, Portugal, Italy, Czech Republic, Spain, Greece, Malta, Hungary, Slovakia, Romania.

From the results it is noticeable that 4 of 5 most innovative countries (top 5 countries, ranked by summary innovation index in EU-27 in 2010) do not reveal strong relationships between gross value added of business activities and financial services and innovations or these relationships are unreliable according to the results of the t-test (except of Germany, which is ranked No. 3 by SII in 2010 and where a strong and reliable relationship between analyzed variables exist). Relationships between gross domestic product sector (in the context of business activities and financial services) and innovations also exists in all 6 moderate innovative (No. 6–11 by SII in 2010) countries as well as in 12 of 16 less innovative (No. 11–27 by SII in 2010) European Union member countries.

Results of correlation analysis between summary innovation index and gross value added of business activities and financial services in European Union member countries and also the t-test analysis are presented in Table 4.12.

Table 4.12. Results of correlation analysis between summary innovation index and gross value added of business activities and financial services in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.2648	2.4469	0.7767	Failed
Denmark	2	0.6305	2.4469	2.2975	Failed
Germany	3	0.7687	2.4469	3.3995	Passed
Finland	4	0.3803	2.4469	1.1630	Failed
United Kingdom	5	0.6111	2.4469	2.1834	Failed
Belgium	6	0.8365	2.4469	4.3186	Passed
Austria	7	0.9379	2.4469	7.6457	Passed
Netherlands	8	0.8331	2.4469	4.2599	Passed
Ireland	9	0.8764	2.4469	5.1482	Passed
Luxembourg	10	0.7959	2.4469	3.7182	Passed
France	11	0.7224	2.4469	2.9545	Passed
Cyprus	12	0.8918	2.4469	5.5758	Passed
Slovenia	13	0.9649	2.4469	10.3968	Passed
Estonia	14	0.8844	2.4469	5.3603	Passed
Portugal	15	0.9539	2.4469	8.9935	Passed
Italy	16	0.8619	2.4469	4.8079	Passed
Czech Republic	17	0.8510	2.4469	4.5828	Passed
Spain	18	0.9162	2.4469	6.4671	Passed
Greece	19	0.9476	2.4469	8.3880	Passed
Malta	20	0.9640	2.4469	10.2610	Passed
Hungary	21	0.9277	2.4469	7.0259	Passed
Poland	22	0.4882	2.4469	1.5821	Failed
Slovakia	23	0.6839	2.4469	2.6511	Passed
Romania	24	0.8238	2.4469	4.1107	Passed
Lithuania	25	−0.5172	2.4469	−1.7094	Failed
Bulgaria	26	0.5892	2.4469	2.0624	Failed
Latvia	27	0.4392	2.4469	1.3828	Failed

According to the results of the analysis it may be declared that the relationship between innovativeness and economic growth in the context of business activities and financial services exists, but mostly in less and moderate developed countries. In more developed and innovative countries such relationship in the environment of this analysis in general does not exist. So the sub-hypothesis "innovativeness is directly related to economic growth of the country in the context of business activities and financial services" was proven partially – for less developed and innovative countries.

All four sub-hypothesis regarding interrelationship between innovativeness and economic growth by structure (2.1. innovativeness is directly related to economic growth of the country in the context of industry, including energy; 2.2. innovativeness is directly related to economic growth of the country in the context of construction; 2.3. innovativeness is directly related to economic growth of the country in the context of trade, transport and communication services; 2.4. innovativeness is directly related to economic growth of the country in the context of business activities and financial services) in general showed the same results: all of them were partially proven – for less and some moderate developed and innovative countries.

4.7. Interrelationship between Fixed Investments and Economic Growth

According to the literature, fixed investments are one of the main factors stimulating economic growth of the country. Although the role of fixed investments in nowadays world economy cannot be doubted, the third hypothesis in this work aims to verify this relationship in conditions of this research.

Hypothesis 3: *Fixed investments are directly related to economic growth of the country (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlative analysis show that the relationship between gross fixed capital formation and gross domestic product is very strong in 15 countries, strong – in 7 and moderate – in 3 European Union countries. The t-test show that 23 relationships are reliable and economic growth is directly related to gross fixed capital formation in most of the European Union member countries (except of Portugal and Malta). It is also noticeable that the relationship does not depend on the country's rank by SII.

Results of correlation analysis between gross fixed capital formation and gross domestic product in European Union member countries and also the t-test analysis are presented in Table 4.13.

According to the results of the analysis it may be declared that the third hypothesis "fixed investments are directly related to economic growth of the country" was proven in most researched cases.

Table 4.13. Results of correlation analysis between gross fixed capital formation and gross domestic product in EU-27

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.9541	2.2622	10.0709	Passed
Denmark	2	0.7588	2.2622	3.6844	Passed
Germany	3	0.6005	2.2622	2.3750	Passed
Finland	4	0.9375	2.2622	8.5202	Passed
United Kingdom	5	0.9366	2.2622	8.4546	Passed
Belgium	6	0.9584	2.2622	10.6182	Passed
Austria	7	0.9576	2.2622	10.5067	Passed
Netherlands	8	0.8720	2.2622	5.6332	Passed
Ireland	9	0.6828	2.2622	2.9550	Passed
Luxembourg	10	0.8964	2.2622	6.3969	Passed
France	11	0.9699	2.2622	12.6014	Passed
Cyprus	12	0.9656	2.2622	11.7477	Passed
Slovenia	13	0.9270	2.2622	7.8165	Passed
Estonia	14	0.8119	2.2622	4.3977	Passed
Portugal	15	0.0710	2.2622	0.2250	Failed
Italy	16	0.9334	2.2622	8.2284	Passed
Czech Republic	17	0.9735	2.2622	13.4732	Passed
Spain	18	0.8752	2.2622	5.7221	Passed
Greece	19	0.6957	2.2622	3.0627	Passed
Malta	20	0.4433	2.2622	1.5641	Failed
Hungary	21	0.9685	2.2622	12.2948	Passed
Poland	22	0.9630	2.2622	11.2990	Passed
Slovakia	23	0.9551	2.2622	10.1901	Passed
Romania	24	0.9762	2.2622	14.2319	Passed
Lithuania	25	0.8780	2.2622	5.8017	Passed
Bulgaria	26	0.9503	2.2622	9.6558	Passed
Latvia	27	0.8847	2.2622	6.0015	Passed

Further in this work the interrelationship between fixed investments (gross fixed capital formation) and country's' economic growth by structure (gross value added by structure) will be investigated. The following sub-hypothesis aims to the presumption that gross fixed capital formation of the country directly impacts the branch of industry, including energy of the gross value added.

Hypothesis 3.1: *Fixed investments are directly related to economic growth of the country in the context of industry, including energy (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlation analysis between gross fixed capital formation and gross value added of industry, including energy in European Union member countries and also the t-test analysis are presented in Table 4.14.

Table 4.14. Results of correlation analysis between gross fixed capital formation and gross value added of industry, including energy in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.9126	2.4469	7.0585	Passed
Denmark	2	0.9610	2.4469	10.9910	Passed
Germany	3	0.8122	2.4469	4.4026	Passed
Finland	4	0.7353	2.4469	3.4305	Passed
United Kingdom	5	0.8680	2.4469	5.5283	Passed
Belgium	6	0.6990	2.4469	3.0909	Passed
Austria	7	0.9752	2.4469	13.9234	Passed
Netherlands	8	0.9789	2.4469	15.1641	Passed
Ireland	9	−0.0163	2.4469	−0.0515	Failed
Luxembourg	10	0.8962	2.4469	6.3888	Passed
France	11	0.2485	2.4469	0.8112	Failed
Cyprus	12	0.8903	2.4469	6.1811	Passed
Slovenia	13	0.9821	2.4469	16.4674	Passed
Estonia	14	0.8877	2.4469	6.0957	Passed
Portugal	15	0.6211	2.4469	2.5063	Passed
Italy	16	0.9433	2.4469	8.9866	Passed
Czech Republic	17	0.9875	2.4469	19.8440	Passed
Spain	18	0.9688	2.4469	12.3557	Passed
Greece	19	0.6093	2.4469	2.4298	Failed
Malta	20	0.0563	2.4469	0.1782	Failed
Hungary	21	0.9792	2.4469	15.2757	Passed
Poland	22	0.9821	2.4469	16.4879	Passed
Slovakia	23	0.9859	2.4469	18.6308	Passed
Romania	24	0.9783	2.4469	14.9212	Passed
Lithuania	25	0.9426	2.4469	8.9286	Passed
Bulgaria	26	0.9840	2.4469	17.4676	Passed
Latvia	27	0.9190	2.4469	7.3713	Passed

Results of correlative analysis show that the relationship between gross fixed capital formation and gross value added of industry, including energy is very strong in 15 countries, strong – in 6 and moderate – in 3 European Union countries. The t-test for shows that 23 relationships are reliable and economic growth in the context of industry, including energy is directly related to fixed investments in most EU countries. It is also noticeable that the relationship does not obviously depend on the country's rank by SII.

According to the results of the analysis it may be declared that the sub-hypothesis "fixed investments are directly related to economic growth of the country in the context of industry, including energy" was proven in most researched cases.

The following sub-hypothesis aims to the presumption that gross fixed capital formation of the country directly impacts the branch of construction of the gross value added of the country.

Hypothesis 3.2: *Fixed investments are directly related to economic growth of the country in the context of construction (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlation analysis between gross fixed capital formation and gross value added of construction in European Union member countries and also the t-test analysis are presented in Table 4.15.

Table 4.15. Results of correlation analysis between gross fixed capital formation and gross value added of construction in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.9073	2.4469	6.8216	Passed
Denmark	2	0.9847	2.4469	17.8817	Passed
Germany	3	0.3748	2.4469	1.2784	Failed
Finland	4	0.9705	2.4469	12.7385	Passed
United Kingdom	5	0.8939	2.4469	6.3075	Passed
Belgium	6	0.9771	2.4469	14.5081	Passed
Austria	7	0.9682	2.4469	12.2311	Passed
Netherlands	8	0.9249	2.4469	7.6913	Passed
Ireland	9	0.9922	2.4469	25.2350	Passed
Luxembourg	10	0.9273	2.4469	7.8359	Passed
France	11	0.9815	2.4469	16.2095	Passed
Cyprus	12	0.9970	2.4469	40.8459	Passed
Slovenia	13	0.9673	2.4469	12.0564	Passed
Estonia	14	0.9270	2.4469	7.8185	Passed
Portugal	15	0.8541	2.4469	5.1920	Passed
Italy	16	0.8292	2.4469	4.6919	Passed
Czech Republic	17	0.9295	2.4469	7.9671	Passed
Spain	18	0.9390	2.4469	8.6349	Passed
Greece	19	0.8302	2.4469	4.7100	Passed
Malta	20	0.3393	2.4469	1.1406	Failed
Hungary	21	0.9704	2.4469	12.7132	Passed
Poland	22	0.9953	2.4469	32.5511	Passed
Slovakia	23	0.9226	2.4469	7.5651	Passed
Romania	24	0.9849	2.4469	17.9820	Passed
Lithuania	25	0.9930	2.4469	26.5060	Passed
Bulgaria	26	0.9642	2.4469	11.4956	Passed
Latvia	27	0.9558	2.4469	10.2747	Passed

The following sub-hypothesis aims to the presumption that gross fixed capital formation of the country directly impacts the branch of trade, transport and communication services of the gross value added of the country.

Hypothesis 3.3: *Fixed investments are directly related to economic growth of the country in the context of trade, transport and communication services (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlation analysis between gross fixed capital formation and gross value added of trade, transport and communication services in European Union member countries and also the t-test analysis are presented in Table 4.16.

Table 4.16. Results of correlation analysis between gross fixed capital formation and gross value added of trade, transport and communication services in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.9098	2.4469	6.9300	Passed
Denmark	2	0.9646	2.4469	11.5638	Passed
Germany	3	0.9450	2.4469	9.1337	Passed
Finland	4	0.9719	2.4469	13.0661	Passed
United Kingdom	5	0.9853	2.4469	18.2464	Passed
Belgium	6	0.9803	2.4469	15.7127	Passed
Austria	7	0.9876	2.4469	19.9009	Passed
Netherlands	8	0.9668	2.4469	11.9717	Passed
Ireland	9	0.7666	2.4469	3.7748	Passed
Luxembourg	10	0.8458	2.4469	5.0136	Passed
France	11	0.9597	2.4469	10.7990	Passed
Cyprus	12	0.9970	2.4469	40.6346	Passed
Slovenia	13	0.9735	2.4469	13.4569	Passed
Estonia	14	0.8918	2.4469	6.2324	Passed
Portugal	15	0.3922	2.4469	1.3482	Failed
Italy	16	0.9202	2.4469	7.4360	Passed
Czech Republic	17	0.9882	2.4469	20.4396	Passed
Spain	18	0.8247	2.4469	4.6103	Passed
Greece	19	0.8113	2.4469	4.3886	Passed
Malta	20	0.5765	2.4469	2.2311	Failed
Hungary	21	0.9431	2.4469	8.9673	Passed
Poland	22	0.9902	2.4469	22.3910	Passed
Slovakia	23	0.9460	2.4469	9.2325	Passed
Romania	24	0.9888	2.4469	20.9119	Passed
Lithuania	25	0.8808	2.4469	5.8825	Passed
Bulgaria	26	0.9491	2.4469	9.5246	Passed
Latvia	27	0.9800	2.4469	15.5643	Passed

Results of correlative analysis show that the relationship between gross fixed capital formation and gross value added of trade, transport and communication services is very strong in 19 countries and strong – in 6 and moderate – in 1 European Union country. The t-test show that 25 relationships are reliable and economic growth in the context of trade, transport and communication services is directly related to fixed investments in most EU countries. It is also noticeable that the relationship does not obviously depend on the country's rank by SII.

According to the results of the analysis it may be declared that the sub-hypothesis "fixed investments are directly related to economic growth of the country in the context of trade, transport and communication services" was proven in most researched cases.

The following sub-hypothesis aims to the presumption that gross fixed capital formation of the country directly impacts the branch of business activities and financial services of the gross value added of the country.

Hypothesis 3.4: *Fixed investments are directly related to economic growth of the country in the context of business activities and financial services (novelty of hypothesis underlies in its theoretical grounding: in scientific literature discussion has not been wrapped up).*

Results of correlative analysis show that the relationship between gross fixed capital formation and gross value added of business activities and financial services is very strong in 12 countries and strong – in 10 and moderate – in 3 European Union countries.

The t-test show that 25 relationships are reliable and economic growth in the context of business activities and financial services is directly related to fixed investments in most EU countries. It is also noticeable that the relationship does not obviously depend on the country's rank by SII.

According to the results of the analysis it may be declared that the sub-hypothesis "fixed investments are directly related to economic growth of the country in the context of business activities and financial services" was proven in most researched cases.

Results of correlation analysis between gross fixed capital formation and gross value added of business activities and financial services in European Union member countries and also the t-test analysis are presented in Table 4.17.

Table 4.17. Results of correlation analysis between gross fixed capital formation and gross value added of business activities and financial services in EU-27 and the t-test

Country	# of SII in 2010	Relationship strength	t-critical	t-observed	t-test
Sweden	1	0.8757	2.4469	5.7342	Passed
Denmark	2	0.6728	2.4469	2.8760	Passed
Germany	3	0.8136	2.4469	4.4249	Passed
Finland	4	0.8983	2.4469	6.4662	Passed
United Kingdom	5	0.7936	2.4469	4.1241	Passed
Belgium	6	0.9760	2.4469	14.1641	Passed
Austria	7	0.9581	2.4469	10.5805	Passed
Netherlands	8	0.9406	2.4469	8.7618	Passed
Ireland	9	0.6985	2.4469	3.0869	Passed
Luxembourg	10	0.8856	2.4469	6.0292	Passed
France	11	0.9750	2.4469	13.8782	Passed
Cyprus	12	0.9717	2.4469	13.0032	Passed
Slovenia	13	0.9338	2.4469	8.2497	Passed
Estonia	14	0.8211	2.4469	4.5489	Passed
Portugal	15	0.3907	2.4469	1.3420	Failed
Italy	16	0.7586	2.4469	3.6818	Passed
Czech Republic	17	0.9707	2.4469	12.7637	Passed
Spain	18	0.7816	2.4469	3.9617	Passed
Greece	19	0.6365	2.4469	2.6100	Passed
Malta	20	0.3591	2.4469	1.2169	Failed
Hungary	21	0.9481	2.4469	9.4299	Passed
Poland	22	0.9972	2.4469	42.3204	Passed
Slovakia	23	0.9103	2.4469	6.9531	Passed
Romania	24	0.9846	2.4469	17.7811	Passed
Lithuania	25	0.8852	2.4469	6.0174	Passed
Bulgaria	26	0.9680	2.4469	12.2035	Passed
Latvia	27	0.8366	2.4469	4.8287	Passed

All four sub-hypothesis regarding interrelationship between fixed investments (gross fixed capital formation) and economic growth by structure (3.1.fixed investments are directly related to economic growth of the country in the context of industry, including energy; 3.2. fixed investments are directly related to economic growth of the country in the context of construction; 3.3. fixed investments are directly related to economic growth of the country in the context of trade, transport and communication services; 3.4. fixed investments are directly related to economic growth of the country in the context of business activities and financial services) in general showed the same results: all of them were proven in most researched cases, not depending on country's level development and innovation.

4.8. Conclusions for Chapter 4

According to H. Dellas and V. Koubi, economic growth involves several phases – the early ones associated with the industrialization of labor, the later ones with the industrialization of capital and the shift in the technological frontier. The later stage involves countries that have already reached the technological frontier. Such countries can advance to achieve high growth only through the invention and implementation of new technologies and then technological innovation become the critical factors for growth. This and other economic growth and development theories designate the dependence of innovations to fixed investments and show their undoubted relationship.

First main hypothesis "1. fixed investments are directly related to innovativeness of the country" and three additional sub-hypotheses "1.1. fixed investments in the context of machinery are directly related to innovativeness of the country", "1.2. fixed investments in the context of construction work (housing) are directly related to innovativeness of the country" and "1.3. fixed investments in the context of construction work (other constructions) are directly related to innovativeness of the country" were brought forward. The first one analyses the impact of fixed investments (gross fixed capital formation) to the summary innovation index of the European Union member countries, other three sub-hypotheses – the impact of fixed investments by structure to the innovativeness of the country. Results of the research show that this is not always the case – fixed investments are one of the main conditions for innovativeness for countries that are less innovative. For countries that are in top ten five by summary innovation index the relationship was not identified in most cases. The first hypothesis, as well as other three sub-hypotheses was proven partially – fixed investments are directly related to innovativeness of the country, but only for less (and some moderately) developed and innovative countries.

While interpreting obtained results economically, it was revealed that fixed investment in less innovative countries impact innovativeness more considerably if to compare to the same relationship in more innovative countries. From economic point of view it could be explained in the following way. When the country is underdeveloped in the context of innovativeness, fixed investment is the main condition to build necessary infrastructure for the functioning of innovations. Hence, fixed investment conditions growth of innovativeness at the particular stage of development (impact of fixed investment on innovativeness is significant). When a country develops and the infrastructure is already built, impact of fixed investment on innovations naturally diminishes. Role of fixed investment here changes: fixed investment is used mainly not for creating, but for maintenance of already built (in the context of the country) infrastructure.

Maintenance in general can guarantee proper functioning, but not the growth of innovativeness.

The second main hypothesis "2. innovativeness is directly related to economic growth of the country" and four additional sub-hypotheses "2.1. innovativeness is directly related to economic growth of the country in the context of industry, including energy", "2.2. Innovativeness is directly related to economic growth of the country in the context of construction", "2.3. innovativeness is directly related to economic growth of the country in the context of trade, transport and communication services" and "2.4. innovativeness is directly related to economic growth of the country in the context of business activities and financial services" were set. The main hypothesis refers to the impact of innovativeness (summary innovation index) to economic growth (gross value added), four sub-hypotheses – the impact of innovativeness to economic growth of the country by structure. Results of the research show that innovativeness is actually one of the main conditions for economic growth, but again for countries that are less or moderate innovative. For SII top five positions in most of the cases this relationship was not identified. As the first hypothesis, as well as four sub-hypotheses was proven partially: only for less and moderately developed and innovative countries.

It was revealed that innovativeness in less innovative countries impact economic growth more considerably if to compare to the same relationship in more innovative countries. From economic point of view it could be explained in the following way. Innovations are usually being created in more developed countries. Less developed countries usually adopt and implement innovations rather than create them (this is the consistent pattern, but not without exceptions). While countries are in the process of implementation of innovations, they enjoy the effects of spillovers and due to them grow faster. When countries achieve the high level of development in terms of innovation, they encounter the need to create new innovations. That process is more complicated and costly. Hence, in countries that create innovations (mode developed countries) economic growth is affected by innovations less comparing with countries that adopt and implement created innovations.

The third main hypothesis "3. fixed investments are directly related to economic growth of the country" and four additional sub-hypotheses "3.1. Fixed investments are directly related to economic growth of the country in the context of industry, including energy", "3.2. fixed investments are directly related to economic growth of the country in the context of construction", "3.3. fixed investments are directly related to economic growth of the country in the context of trade, transport and communication services" and "3.4. Fixed investments are directly related to economic growth of the country in the context of business activities and financial services" were risen. The main hypothesis defines the

impact of fixed investments (gross fixed capital formation) to economic growth (gross value added), sub-hypotheses – the impact of fixed investments to economic growth of the country by structure. Research results show that in most cases fixed investments are actually one of the main factors stimulating economic growth of EU countries, not depending on their level of innovativeness. As well as the main hypothesis, all other sub-hypotheses were proven. A summary of all hypotheses testing results is provided in Table 4.18.

Table 4.18. Summary of all hypotheses testing results

No.	Hypothesis	Result
1.	Fixed investments are directly related to innovativeness of the country.	Partially proven – for less and moderately developed and innovative countries.
1.1.	Fixed investments in the context of machinery are directly related to innovativeness of the country.	Partially proven – for less developed and innovative countries.
1.2.	Fixed investments in the context of construction work (housing) are directly related to innovativeness of the country.	Partially proven – for less and moderately developed and innovative countries.
1.3.	Fixed investments in the context of construction work (other constructions) are directly related to innovativeness of the country.	Partially proven – for less and moderately developed and innovative countries.
2.	Innovativeness is directly related to economic growth of the country.	Partially proven – for less and moderately developed and innovative countries.
2.1.	Innovativeness is directly related to economic growth of the country in the context of industry, including energy.	Partially proven – for less and moderately developed and innovative countries.
2.2.	Innovativeness is directly related to economic growth of the country in the context of construction.	Partially proven – for less and moderately developed and innovative countries.
2.3.	Innovativeness is directly related to economic growth of the country in the context of trade, transport and communication services.	Partially proven – for less and moderately developed and innovative countries.
2.4.	Innovativeness is directly related to economic growth of the country in the context of business activities and financial services.	Partially proven – for less and moderately developed and innovative countries.

End of Table 4.18.

3.	Fixed investments are directly related to economic growth of the country.	Proven in most cases.
3.1.	Fixed investments are directly related to economic growth of the country in the context of industry, including energy.	Proven in most cases.
3.2.	Fixed investments are directly related to economic growth of the country in the context of construction.	Proven in most cases.
3.3.	Fixed investments are directly related to economic growth of the country in the context of trade, transport and communication services.	Proven in most cases.
3.4.	Fixed investments are directly related to economic growth of the country in the context of business activities and financial services.	Proven in most cases.

General Conclusions

1. As a result of systemical analysis of literature sources it was determined that the usage of a lot of multiple of terms and definitions supposed a formation of different standpoints in this topic. Over 100 different terms of innovation and different concepts were analyzed and three main innovation trends were distinguished: scientific concept (sources: scientific literature, articles); official trend (sources: legislation, institutions) and enterprise trend (source: a survey of innovativeness of Lithuanian enterprises).
2. A survey of innovativeness of Lithuanian enterprises was accomplished. It was identified that Lithuanian enterprises consider as innovations mostly modernization of technology (about 41 percent), development of information technologies (about 36 percent), and other activities concerning renewal of technologies.
3. A systemic research in this doctoral dissertation analyzed fixed investments as a main condition for innovation development. This approach sets the fixed investments as a basis or an infrastructure for innovation development. Results of the research show that this is not always the case - fixed investments are one of the main conditions for innovativeness for countries that are less and moderately innovative (SII ? 0.611). For countries, which are in top five positions by summary innovation index, the relationship in the environment of this analysis was not identified in most cases. The role of fixed investments and

innovations in more developed and innovative economies is declining. It may be explained by the fact that these economies made much fixed investments in the past, before the beginning of the research period and accumulated the "critical" infrastructure for innovation development. Innovations are frequently presented in the scientific literature as critical factors of growth or the driving force of development of the country. Implementation of any kinds of innovation is also often stimulated by governments in forms of various subsidies or reduction of taxes seemingly innovations would be one of the main or the most important factor providing competitive advantage.

4. Although the established opinion is that innovations unambiguously are the key point of economic growth of the country, this work revealed also other insights. The approach of innovations as one of the main factors conditioning economic growth of the country has been researched in this work and tested on cases of all European Union member countries. Results of the research show that innovativeness is actually one of the main conditions for economic growth, but again for countries that are less or moderately innovative (SII ? 0.611). For SII top five positions in most cases this relationship in the environment of this analysis was not identified. The role of innovations in nowadays world economy cannot be doubted, but some economies seems to be saturated by innovations and their impact on economic growth is not so obvious as on economies on countries that are less innovative. In these countries the policy of innovation motivation should be reconsidered and adapted to current state.

5. The third trend researched in this work was that fixed investments should be one of the main factors impacting economic growth of the country. This also was tested on cases of all European Union member countries. Research results show that in most cases fixed investments are actually one of the main factors stimulating economic growth of EU countries, not depending on the level of their innovativeness.

6. The results of the work will help to presume the character of impact of innovations and fixed investments, its constituents on particular economic sectors in order to formulate appropriate innovation and fixed investment stimulation policies for specific economic sectors (state programs, objective projects; objective support for business and other). The presumption of effect of factors considered in dissertation should be performed in the following way. Using the resulting interrelations and taking into account the level of development of country, and considering consistent patterns characteristic for different levels of development, we can indicate which factor makes the more considerable impact on the economic growth of country. Hence, at countries with higher level of innovativeness, innovations appears to be less important driving force of economic growth compared to countries with lower level of innovativeness. Scrutinizing main impacted economic sectors comprising GDP,

it must be stated that trade, transport and communication services also business activities and financial services are the sectors which are the most susceptible to innovativeness of the country. Considering fixed investment, it has been revealed that fixed investment appears to be a major driving force of economic growth irrespective to the level of countries' development in the context of innovativeness. Character of impact of fixed investment differs from the factor of innovativeness (different consistent patterns have been revealed). Scrutinizing constituents of fixed investment, it must be stated that investment into construction (infrastructure) and into trade, transport and communication service sectors play the major role in acceleration of economic growth. As country develops in the context of innovativeness, importance of fixed investment structure in principle remains of similar importance.

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ANNEXES[1]

Annex A. Innovativeness Survey Results

Annex B. Statistical Data of EU-27 Countries

Annex C. Kolmogorov-Smirnov Test Results

Annex D. Results of Relationship Analysis

[1] The annexes are supplied in the enclosed compact disc

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