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Abstract

Economic structure encompasses the composition of growth determinants of each industry and their aggregation to the growth of the gross value added in the present dissertation. Changes in the composition of determinants impact the growth rate of the individual industries and the total economy. Industrial growth determinants are composed of hours worked and particular labour productivity constituents. The growth determinants of different economies are central to both the research and political agendas. The main object of the present research is the determinants of industrial growth and their impact for economic growth. The main goal of the dissertation is to estimate the composition of industrial growth determinants and evaluate their impact on the growth of the total economy. The dissertation encompasses the following tasks: to research industrial performance and economic growth interrelations; to evaluate critically the methods of labour productivity measurement, to ground the reasons of the new method application and its improvement possibilities; to compose a methodology, in order to estimate industrial growth determinants and labour productivity constituents for the growth of the total economy; to apply the methodology for countries researched; to perform a comparative analysis of Lithuania in the context of more developed countries.

The dissertation consists of an introduction, three chapters, general conclusions, references, summary in Lithuania, a list of publications by the author on the topic of the dissertation and three annexes. The introduction presents the investigated problem, the relevance of the dissertation, the object and the aim of the research, describes the research methodology used for the task, the scientific importance of the research, the results which are of practical significance and the statements to be defended. Chapter 1 presents a theoretical studio of industrial performance and economic growth attitudes. Chapter 2 presents the main groups of methods for estimating industrial labour productivity. Chapter 3 presents the newly composed methodology and empirical estimation results of Lithuania in the context of more developed countries. The general conclusions are presented at the end of the dissertation.

Ten articles focusing on the subject of the dissertation have been published: eight articles were published in scientific journals, two articles – in other editions. Three presentations on the thesis have been presented at the Business management faculty of Vilnius Gediminas technical university during seminars for doctoral students, and a further two at international conferences. Discussions on the calculations have been carried out during a scientific internship (16/09/2014–16/11/2014) at the IVIE research centre (Valencia, Spain) and at the University of Valencia (Valencia, Spain) with researchers after the presentations had been given.

Reziumė

Disertacijoje ūkio struktūrą sudaro kiekvienos ūkio šakos pridėtinės vertės augimą lemiančių veiksnių sudėtis ir jų agregavimas į bendros pridėtinės vertės augimą. Veiksnių sudėties kitimas įtakoja atskirų ūkio šakų ir viso ūkio ekonominio augimo tempą. Augimą lemiančius veiksnius sudaro darbo valandos ir darbo produktyvumo komponentai. Skirtingų šalių ekonomikų augimo veiksniai yra itin aktualūs tiek tyrimų, tiek politiniuose lygmenyse. Disertacijos objektas – ūkio šakų augimą lemiantys veiksniai ir jų poveikis ekonominiam augimui. Pagrindinis disertacijos tikslas – nustatyti ūkio šakų augimą lemiančių veiksnių sudėtį ir jų poveikį ūkio ekonominiam augimui.

Tikslui pasiekti disertacijoje iškelti uždaviniai: ištirti ūkio šakų veiklos ir ekonominio augimo sąryšį; išanalizuoti darbo produktyvumo apskaičiavimo metodus; pagrįsti naujo darbo produktyvumo apskaičiavimo metodo pritaikymo priežastis ir tobulinimo galimybes; sudaryti metodiką, leidžiančią įvertinti ūkio šakų augimą lemiančių veiksnių ir darbo produktyvumo komponentų sudėtį bei jų poveikį viso ūkio ekonominiam augimui; patikrinti metodiką tyrimui pasirinktoms šalims; atlikti Lietuvos atvejo analizę labiau išsivysčiusių šalių kontekste.

Disertaciją sudaro įvadas, trys skyriai, bendrosios išvados, naudotos literatūros šaltinių sąrašas, autorės mokslinių publikacijų disertacijos tema sąrašas ir trys priedai. Įvade atskleidžiama tiriamoji problema, darbo aktualumas, aprašomas tyrimų objektas, formuluojamas darbo tikslas bei uždaviniai. Taip pat aprašoma tyrimų metodika, darbo mokslinis naujumas, darbo rezultatų praktinė reikšmė ir ginamieji teiginiai. Pirmame disertacijos skyriuje analizuojami teoriniai ūkio šakų veiklos ekonominio augimo procese požiūriai. Antrajame disertacijos skyriuje atliekama ūkio šakų darbo produktyvumo apskaičiavimo metodų kritinė analizė ir išskiriamos pagrindinės metodų grupės. Trečiajame skyriuje pateikiama naujai sudaryta metodika, norint įvertinti šalių ūkių augimą lemiančių veiksnių poveikį ekonominiam augimui. Disertacijos pabaigoje pateiktos bendrosios išvados.

Disertacijos tematika paskelbta dešimt straipsnių: aštuoni – tarptautiniuose mokslo žurnaluose, du – kituose mokslo leidiniuose. Viešinant disertacijos rezultatus buvo pristatyti dvejose tarptautinėse konferencijose. Skaičiavimų klausimais buvo diskutuojama mokslinės stažuotės metu (2014/09/16–2014/11/16) tyrimų centre IVIE (Valensija, Ispanija) bei Valensijos universitete (Valensija, Ispanija).

Notations

Abbreviations

C – consumption;
CAP – capital compensation;
CEEC – central and eastern countries;
CLVL – chain linked volume;
COMP – compensation of employees;
Contr – contribution;
CT – communications equipment;
ESA – European System of Accounts;
EU – European Union;
FCE – final consumption expenditure;
FDI – foreign direct investment;
FES – fundamental economic structure;
G – government spending;
GDI – gross domestic income;
GDP– gross domestic product;
GMI – gross mixed income;
GNI – gross national income;
GCF – gross capital formation;
GFCF – gross fixed capital formation;
GPT – general purposed technologies;
GOS – gross operating surplus;

GVA – gross value added;
H – hours;
I – investment;
ICT– information capital group (IT, CT, Softw);
Int – intangibles;
IT – computing equipment,
KLEMS – the project of capital, labour, energy, material, services data;
Knowlg – knowledge based capital group (LC, IT, CT, Int, MFP);
LAB – labour compensation;
LC – labour composition;
LP – labour productivity;
M – imports;
MFP – multi-factor productivity;
Nom – nominal;
NonICT – non-information capital group (Tr, OMash, NResid, Resid, Other);
NResid – non-residential structures;
OECD – the Organization for Economic Co-operation and Development;
OMash – Other machinery and equipment;
RCA – related comparative advantage;
ROA – return on assets;
Resid – residential structures;
R&D – research and development;
Softw – software;
Stock – capital stock;
Tr – transport equipment;
VA – value added;
X – exports.

Contents

[1]The annexes are available in the CD attached to the dissertation

Introduction

Problem formulation

Economic structure encompasses the composition of growth determinants of each industry and their aggregation to the growth of the gross value added in the present dissertation. Changes in the composition of determinants impact the growth rate of individual industries and the total economy. Industrial growth determinants are composed of hours worked the and particular labour productivity constituents. Particular labour productivity constituents reflect different types of labour and capital (labour composition (LC), computing equipment (IT), communications equipment (CT), transport equipment (Tr), Other machinery and equipment (OMash), non-residential structures (NResid), residential structures (Resid), intangibles (Intang)). Furthermore, the estimation of multi-factor productivity (MFP) is of vital importance, as it reflects the efficiency of all inputs.

Classically industrial labour productivity (LP) is expressed as the value added (VA) created per time unit (hour worked). This measurement is still used by the Lithuanian statistics department and Eurostat. With regard to the latest attitude towards the measurement of labour productivity, labour productivity constituents are considered to be important facets for a comparative economic analysis and should, therefore, be accounted.

The scientific problem of the present thesis – classical measurement of labour productivity does not reveal the constituents of labour productivity and lack of methodologies, enabling to estimate the composition of detailed economic growth determinants and their impact on the growth of the total economy.

Relevance of the thesis

The problem investigated in the dissertation is relevant for several reasons.

Firstly, the national statistical departments of the European Union countries are recommended to estimate industrial growth determinants and labour productivity constituents, and compose growth and productivity accounts in the latest European Parliament and Council Regulation due the preparation of national accounts (No. 549/2013, p. 525). The Lithuanian statistics department only started using this regulation at the beginning of September 2014, and is not working on the preparation on these accounts.

Secondly, the EU KLEMS and WORLD KLEMS projects lack detailed results of the application of growth accounting method for the less developed countries (including Lithuania), which could complement international academic standards.

Finally, particular industrial growth determinants of labour productivity are notably at the centre of both the contemporary research and political agendas. Moreover, the importance of labour productivity is emphasised in economic growth and development theories, and in contemporary approaches to sustainable development.

The object of the research

The main object of the present research is the determinants of industrial growth and their impact on economic growth.

The aim of the thesis

The main aim of the thesis is to estimate the composition of industrial growth determinants and evaluate their impact for the growth on the total economy.

The objectives of the thesis

In order to achieve the aim – the following objectives had to be solved:

1. To research industrial performance and economic growth interrelations.
2. To evaluate critically the methods of labour productivity measurement.
3. To ground the reasons of the new method application and ways of its improvement.
4. To compose a methodology, in order to estimate industrial growth determinants and labour productivity constituents for the growth of the total economy.
5. To apply methodology for countries researched.
6. To perform a comparative analysis of Lithuania in the context of more developed countries.

Research methodology

To investigate the object, the following research methods were chosen:

– In the first chapter of the thesis context analysis, grouping analysis, comparative analysis, generalization analysis, induction, and deduction methods were applied.

– In the second chapter of the thesis grouping, comparative, and generalization analysis were applied.

– In the third chapter the growth accounting method was employed in the empirical section. A comparative analysis was performed for the evaluation of results. The MS Office EXCEL 2013 package was used to perform calculations.

Scientific novelty of the thesis

The scientific importance of the research accomplished for the science of economics is as follows:

1. In the present thesis reasoned new methodology is appropriate for each country, purposed to evaluate its value added growth determinants (hours worked and particular labour productivity constituents), and the pattern of economic structure, combining different kinds of industrial classifiers (i.e. ISIC 3, ISIC 4, NACE rev. 1, NACE rev. 2).
2. In the present thesis grounded new labour productivity indicators, labour productivity constituents (IT, CT, Tr, OMash, NResid, Resid, Intang), supplement the indicators, provided by the databases (e.g. Lithuanian statistics department, Eurostat).

3. The evaluation of capital services is motivated at national level.
4. Derived detail capital contributors to economic growth (according ESA'95 asset classifier), not only ICT and nonICT capital groups.
5. Extended knowledge based capital conception – for labour composition (LC), computer equipment (IT), communications equipment (CT), and multi-factor productivity (MFP) could be added all the group of intangible capital (Int).

Practical value of research findings

The methodology composed in the present thesis could be practically useful for Lithuanian statistics department or Eurostat due to the supplement the contemporary data bases by productivity measurement accounts and estimation of capital services.

The results of the research can be benevolent for interested parties when forming industrial policies for the entire economy, or its separate industries. The research results can be used for forecasting and encouraging some purposive structural changes in the Lithuanian economy.

The statements to be defended

Based on the results of present investigation the following statements may serve as the official hypotheses to be defended:

1. In the present thesis reasoned new attitude estimates the composition of economic structure growth determinants and their impact for growth of the total economy.
2. The composition of growth determinants impact the growth rate of individual industries and the latter in their turn affect the growth rate of the total economy.
3. In the present thesis grounded new labour productivity indicators, labour productivity constituents, enable to measure labour productivity in more depth and complement the one provided by Lithuanian statistics department and Eurostat databases.
4. In the present thesis motivated new attitude estimates the proximate sources of growth of different economies. Its implication for less developed country decreased the heterogeneity of the issue.

Approval of the reseach findings

There are ten scientific publications on the topic of the dissertation: eight articles were published in scientific journals (Lankauskiene & Tvaronaviciene 2011; Tvaronaviciene & Lankauskiene 2011; Tvaronaviciene & Lankauskiene 2011; Tvaronaviciene & Lankauskiene 2012; Lankauskiene & Tvaronaviciene 2012; Tvaronaviciene & Lankauskiene 2013; Lankauskiene & Tvaronaviciene 2013; Lankauskiene 2014), two articles – in other editions (Lankauskiene & Tvaronaviciene 2012; Lankauskiene & Tvaronaviciene 2014). The results of the research have been announced at two international conferences:

– "Contemporary issues in Business, Management and Education'2012", held in Vilnius in 2012;

– "Business and Management 2014", held in Vilnius in 2014.

Three presentations on the thesis have been given at the Business management faculty of Vilnius Gediminas technical university during seminars for doctoral students and two at international conferences. Discussions on the calculations have been carried out during a scientific internship (16/09/2014– 16/11/2014) at the IVIE research centre (Valencia, Spain) and the University of Valencia (Valencia, Spain) with researchers after the presentations had been given.

Structure of the thesis

The dissertation is composed of an introduction, three chapters and general conclusions, the list of references, the list of publications by the author on the dissertation topic and annexes.

Dissertation volume – 110 pages, including the summary but excluding annexes, in which forty two formulas, four figures and seven tables were used. 174 literature references were used when preparing the dissertation.

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I am very thankful to my supervisor Prof Dr Manuela Tvaronavičienė for encouraging me to cope with all the challenges arising while preparing the thesis and providing the cognition of science in a rousing way, inspiring to go further.

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1

Industrial performance in the economic growth process: theoretical approaches

1.1. Economic growth and sustainable development

The research area of economic growth has a long history. Studies on the origin of economic growth date back to the XVIIIth century. Economic growth is most generally regarded as an increase in the standard of living of a nation's population associated with its growth from a simple, low-income economy to a modern, high-income economy. The scope of economic growth includes the process and policies by which a nation improves the economic, political, and social well-being of its people.

Economic growth is measured by GDP (gross domestic product) or GDP per inhabitant. There are three methods to determine GDP, which are provided in Table 1.1.

All the estimations of GDP accounted by different methods should provide the same value. In practice, however, errors in measurement usually occur, and estimates differ when provided by national statistical agencies.

Economic progress is considered to be an essential factor in the development of countries. Most generally, economic development encompasses extensive economic growth (output enlargement, using more resources) and intensive economic growth, namely an increase in productivity, the implementation of innovation, and the creation of new jobs. Economic development is a process which can be defined as the appointive mobilisation of social, financial, organisational, physical, and natural resources in order to improve the quality of competitive services and products, and to increase their quantity for the community. As a result, many different factors can determine the economic growth of a country (Ginevicius & Podvezko 2006; Lankauskiene & Tvaronaviciene 2011; Tvaronaviciene & Lankauskiene 2011). The main goal of economic growth and development is to foster the speed of asset creation. Furthermore, every nation tries to put all its efforts into reaching the maximum results and improving its developmental level, as the well-being of its people depends on this (Lankauskiene & Tvaronaviciene 2011). Development is not a purely economic phenomenon, it is perceived as a multi-dimensional process involving the reorganisation and reorientation of the entire economic and social system. By adding the dimension of the environment, the term "sustainable development" is obtained, which is now extremely popular in contemporary scientific literature (Tvaronaviciene & Lankauskiene 2011; Tvaronaviciene & Lankauskiene 2012).

Table 1.1. GDP accounting methods in economics (Blanchard 2007)

Production approach	*Gross value added* = gross value of output – the value of intermediate consumption. Value of output = the value of the total sales of goods and services plus the value of changes in the inventories. Value of intermediate consumption = an accounting flow which consists of the total monetary value of goods and services consumed or used up as inputs in production by enterprises, including raw materials, services, and various other operating expenses. In order to measure gross value added all economic activities (i.e. industries) are classified into various sectors. After classifying economic activities, the gross value added is calculated as the sum of the value added of each industry. It measures the value of GDP at basic prices. GDP at basic prices plus indirect taxes less subsidies on products = GDP at market prices.

End of Table 1.1

Income approach	GDP = COMP + GOS + GMI Compensation of employees (COMP) measures the total remuneration paid to employees for work done. It includes wages and salaries, as well as employer contributions to social security and other such programmes. Gross operating surplus (GOS) is the surplus due to owners of incorporated businesses. It is often called profit. Gross mixed income (GMI) is the same measure as GOS, but for unincorporated businesses. This often includes most small businesses. The sum of the COE, GOS and GMI is called the total factor income; this is the income of all of the factors of production in a society. It measures the value of GDP at basic prices. GDP at basic prices plus indirect taxes less subsidies on products = GDP at market prices.
Expenditure approach	The sum of the final uses of goods and services measured in purchasers prices. GDP = C + I + G + (X − M) Consumption (C) is normally the largest GDP component in the economy, consisting of private (household final consumption) expenditure in the economy. These personal expenditures fall into one of the following categories: durable goods, non-durable goods, and services. Investment (I) includes, for instance, business investment in equipment, but does not include exchanges of existing assets. Examples might include the construction of a new mine, the purchase of software, or the purchase of machinery and equipment for a factory. Spending by households (not the government) on new houses is also included in investment. In contrast to its colloquial meaning, "investment" in terms of GDP does not mean purchases of financial products. The buying of financial products is classed as 'saving', as opposed to investment. This avoids double-counting: if one buys shares in a company, and that company uses the money received to buy plants, equipment, etc., then the amount will be counted toward GDP when the company spends the money on those things; to also count it when one gives it to a company would mean that an amount which corresponds to one group of products would be be counted twice. The buying of bonds or stocks is a swapping of deeds, a transfer of claims on future production, not an expenditure on products directly. G (government spending) is the sum of government expenditures on final goods and services. It includes the salaries of public servants, purchases of weapons for the military and any investment expenditure by a government. It does not include any transfer payments, such as social security or unemployment benefits. X (exports) represents gross exports. GDP captures the amount a country produces, including goods and services produced for consumption by other nations. For this reason exports are added. M (imports) represents gross imports. Imports are subtracted since imported goods will be included in the terms G, I, or C, and must be deducted to avoid counting foreign supply as domestic. GDP = FCE + GCF + (X – M) Final consumption expenditure (FCE) can then be further broken down into three sectors (households, governments, and non-profit institutions serving households) and gross capital formation (GCF) into five sectors (non-financial corporations, financial corporations, households, governments and non-profit institutions serving households). The advantage of this second definition is that expenditure is systematically broken down. Firstly, into its type of final use (final consumption or capital formation). Secondly, into the sectors which make up the expenditure. The first definition only partly follows a mixed delimitation concept by is type of final use and sector.

Sustainable development is a complex notion, which one is treated differently (Rutkauskas *et al.* 2014). On one hand, it is very broad as it may be related to the competitiveness of a given country (Balkyte & Tvaronaviciene 2010). While on the other hand, sustainable development is estimated by a broad array of indicators (Tvaronaviciene & Lankauskiene 2011; Stankeviciene *et al.* 2014). Moreover, Stankeviciene and Cepulyte provide facets of sustainable value creation (Stankeviciene & Cepulyte 2014). The term "sustainable development" emerged in the context of the development and insecure economic activity of humanity (Lankauskiene & Tvaronaviciene 2012). This concept became rather widespread around the end of the XXth century. It was realised that although economic growth was of vital importance, it had to be a different kind of growth, e.g. one targeted at a combination of the needs of people, while at the same time and sensitive to the needs of the environment. The concept states that it is sufficiency and not economic efficiency that should be the goal. A distinction needs to be drawn between growth, i.e. quantitative change, and development, i.e. qualitative change (Du Pisani & Jacobus 2006). The concept of sustainable development is more profound and comprehensive than economic growth. The essence of sustainable development is clear enough – most generally it is perceived as economic development meeting human needs at present and not reducing its wealth opportunities in the future (Ciegis & Ramanauskiene 2009). According to the World Bank's 1992 definition, "sustainable development is a development that continues". Another scientific article states that "sustainable development is a development that meets the needs at present without compromising the ability of future generations to meet their own needs" (Du Pisani & Jacobus 2006). Ruchi (2009) cited sustainable development as "development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life". Although the concept of sustainable development has been created for a more sophisticated society, which cares about the wealth-being of the next generations, this issue has some opponents. The term "sustainable development" is often criticized because of its vagueness. The philosopher Luc Ferry described this term as obligatory, but he also found it absurd or rather so vague, that it said nothing. He also added that the above-mentioned term was trivial as proof of its contradiction and presented the idea of sustainable development as untenable development, claiming that this term was more charming than meaningful (Ruchi 2009). Most people point to the positive impact that sustainable development has had, and the author will reasonably focus on its beneficial side. Furthermore, the concept of sustainable development, according to Dietrich Bonhoeffer, is defined as "the ultimate test of a moral society is the kind of the world that it leaves to its children" (Ruchi 2009; Tvaronaviciene & Lankauskiene 2011).

1.2. Industrial performance

Each economy consists of economic sectors. Economic sectors are composed of economic branches or industries. Hereinafter in this thesis economic branches will be regarded as industries. The term economic structure reflects the composition of industries and the share of value added they bring to the gross value added. In the empirical part of the thesis economic structure will encompass and the detailed sources of gross value added growth (this is covered in more in depth in 3.1).

Economic growth and the generation of income ultimately depend on the competitive performance of individual enterprises. The competitiveness of these enterprises in turn depends on the relative abundance (and hence cost) of resources, as well as the incentives and capabilities to use them in a productive and sustainable manner. Even though many determinants, such as macroeconomic stability, the corporate tax rate, or the operation of factor markets, are thus shaped by the general business environment, the relative intensity in factor use, the incentives to pursue opportunities, and the specific capabilities required for transforming them into successful business vary between sectors and industries.

As a consequence, countries differ greatly in their industrial growth and performance. Within an identical macroeconomic setting, they show considerable strength in some industries and weaknesses in others. Based on the goals of the Lisbon Agenda, a comparison of aggregate measures can only provide an incomplete picture of the competitiveness of European countries. Competitiveness is a multifaceted target for which no single and fully comprehensive measure currently exists. A multitude of objectives must be taken into account when striving for a "general" picture (Peneder 2009). Researchers assess the competitive performance of industries along the following set of ten selected indicators:

Growth

> The growth of value added indicates an economy's success in creating income and thus its ability to increase material well-being. For given constraints with respect to a society's non-economic goals, such as social fairness or ecological sustainability, it is probably the most straightforward target of economic activity.
>
> The growth of employment or hours worked indicates not only success in mobilising productive resources, but also the ability to offer people jobs and participation. As labour input is also a cost factor in production, its growth is not unconditional. If it is meant to be sustained, the growth of value added and productivity must keep pace accordingly.

Productivity

Classically labour productivity (LP) is measured as the ratio of output (either gross output or value added) per labour input (either employment or hours worked). But there more factors which determine labour productivity growth not only labour input, e.g. capital input. Capital input to labour productivity is not separated by national statistical agencies. The relevant scientific literature provides the latest newly composed method of labour productivity measurement in the growth rate of value added (this is covered in more in depth in 2.3). In the empirical part of the present thesis the author uses labour productivity accounting by new method (this is covered in more in depth in the third section).

Multifactor productivity (MFP) is derived by the latest labour productivity measurement approach which is described above. It nets out the returns to all other inputs, i.e. capital (and intermediates in the case of a gross output specification), and is, therefore, the most comprehensive measure of the efficiency of operations. Multifactor productivity is calculated as a residual, i.e. the gain in output which cannot be assigned to any measurable input.

Profitability

The net profit margin is the ratio of the after-tax revenue net of extraordinary items (and associated taxes) to sales. Indicating the efficient translation of sales into profits, the net profit margin tells how much profit is made for every dollar of revenue generated.

Indicating the efficient use of assets to generate profits, the return on assets (ROA) is calculated as the ratio of after-tax profit net of extraordinary items to assets. The ROA figure offers an idea of how effectively a company is converting its available investment funds into net income, both through debt and equity financing.

International trade

The revealed comparative advantage (RCA) indicator measures trade specialisation. It is defined as the logarithm of the export to import relation of one sector divided by the export to import relation of all sectors. Positive RCA values indicate the comparative advantages and negative values represent the comparative disadvantages of a particular industry.

Export market shares reflect the capacity to respond to external demand or open up new markets in direct comparison to international competitors. They show how much of the total “world” export is covered by the export.

Foreign direct investments (FDI)

The ratio of inward FDI stock to value added indicates the contribution of FDIs to the formation of capital, stimulating value added and employment but also the acquisition of new technology and management practices in the host market.

Analogously, the ratio of outward FDI stocks to value added reflects a corresponding outflow of capital. However, it can also be an indication of corporate strength, in which companies venture abroad to seize opportunities from foreign markets and resources (Peneder 2009).

Industrial performance is driven by a myriad of distinct sources. At present, no single, comprehensive theory exists which can explain the role of these elements within a jointly integrated economic model. However, many of them are the subject matter of different strands.

Peneder (2009) organised six groups of related determinants: macroeconomic conditions, demand side factors, inputs to production, R & D and innovation, market structure, and, finally, openness and barriers to trade (Peneder 2009). Figure 1.1 illiustrates the six major determinants of sectorial performance.

The following industrial performance possibilities in the structure of the economy targeted at economic growth, can be distinguished in the relevant scientific literature: structural change, structural transformation, structural growth, and structural development. It is important to note that structural change and transformation are quite similar expressions, as are structural growth and development.

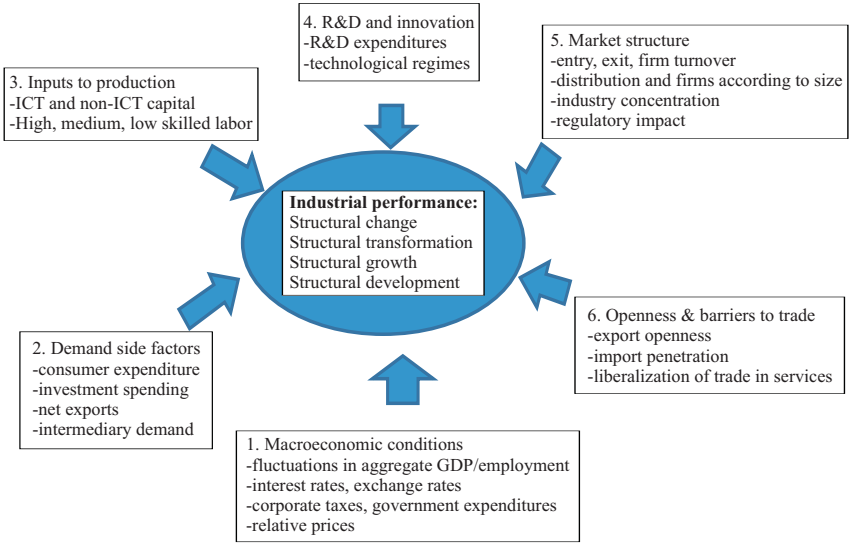


Fig.1.1. The stylised model of selected sectorial performance drivers (edited by the author with reference to Peneder 2009)

1.3. The findings of Lithuanian researchers

Independently of industrial performance possibilities, the most important aspect for economic growth remains unchanged, i.e. the growth rate of VA they compose annually and carry to the GVA growth rate. Moreover, as was indicated in 1.2, the growth of GVA is considered to be sustained if it keeps pace with labour productivity growth accordingly. And for the process of sustainable development to elabourate (e.g. Lankauskiene & Tvaronaviciene 2012), it is of vital importance that economic sectors develop in a sustainable manner. Sustainable development is now associated with an increase in the living standards through economic progress (Lankauskiene & Tvaronaviciene 2011; Lankauskiene & Tvaronaviciene 2012), encompassing the development of knowledge-based and innovation susceptible sectors, but not by exploiting non-renewable natural resources (Tvaronaviciene & Lankauskiene 2013).

The processes of modern economic growth and catch-up do not merely involve significant increase in productivity levels, and also entail changes in the distribution of inputs and outputs across sectors. Kuznets stated that "it is impossible to attain high rates of growth per capita or per worker without commensurate the substantial shifts in the shares of various sectors" (Kuznets 1979). The hypothesis that structural change is an important source of growth, and productivity improvement is a central tenet of growth accounting literature, and is derived from classical dual economy models of (Lewis 1954). The performance of economic sectors is a rather new trend in economics and is called "structural economics". Economic growth cannot be perceived without the role of economic sectors, as they are the constituents of economy. Structural change is the central insight of development economics. Economic growth is reflected in economic sector performance and entails structural change. Structural change, narrowly defined as the reallocation of labour across economic sectors, featured in Kuznets's the early literature on economic development (1966). As labour and other resources move from traditional to modern economic activities, overall productivity rises and income expands. The nature and speed with which structural transformation takes place is considered to be one of the key factors which differentiate successful countries from unsuccessful ones. Therefore, the new structural economists argue that economic structures should be the starting point for a comparative economic analysis and the design of appropriate policies. The process of structural change has been widely discussed in the relevant foreign scientific literature starting with the factors which determine the performance of economic sectors and structural changes (e.g. Kummel *et al.* 2002; Yudha & Masaru 2012; Peneder *et al.* 2003; Dumenil & Levy 1995; Domingo & Tonella 2000), and the impact of its performance (e.g. Cornwall 1994; Sánchez & Duarte 2006; Christiaensen & Jesper 2011; Padoan 1998; Vaona 2011; Murshed & Se-

rino 2011; Nakatani 2007), ending with the actual insights and various conclusions about the relevant economic structure targeted at a countries development (Jorgenson & Timmer 2009; Sauramo & Maliranta 2011; Freeman & Soete 1997; Perez 1983; Perez 1985; Gualerzi 1996), and particular research methods of the topic (Fisher 1939; Baumol 1967; Ninomiya & Yoshimoto 2008; Andersen 2001; Hartwig 2010; Hishiyama 1996). On the contrary, the issue of economic structure fostering economic growth is only vaguely analysed in the relevant Lithuanian scientific literature. Only a small number of researchers have focused on the analysis of the relevant GDP structure targeted to foster its economic growth. Vilkas *et al.* researches economic growth and structural development strategy. Stankevicius (2006) provided an overview of the structure of the Lithuanian economy and its changes following World War I. Balciunas (2000), Misiunas, and Kaminskiene (1999) researched the structure of the Lithuanian economy when the Baltic countries created a market economy. Matuzeviciute, Skuncikiene, and Tamosaityte (2010) analysed the structure of the economy, but the changes were not evaluated purposively in the context of Lithuania's economic growth.

The first Lithuanian researcher to research this issue in the more depth was A. Vitas, who defended off PhD thesis, entitled "The economy structural changes analysis and evaluation in the Baltic states" in 2012. A. Vitas proposed a macroeconomic model for evaluating structural changes, i. e. the effectiveness of structural changes:

$$\begin{aligned} Y_{evm}^{t} = {} & x_1 \times (\alpha_1 + \beta_1 + \#W - \#\mathrm{P}_{pr}) \times t + \\ & x_2 \times (\alpha_2 + \beta_2 + \#N + \#\mathrm{W}) \times t + \\ & x_3 \times (\alpha_3 + \beta_3 - \#\mathrm{r}_{\mathrm{EUR}} + \#W) \times t + \\ & x_4 \times (\alpha_4 + \beta_4 - \#\mathrm{P}_z) \times t + \\ & x_5 \times (\alpha_5 + \beta_5 + \#N + \#W - \#\mathrm{r}_{EUR}) \times t + \\ & x_6 \times (\alpha_6 + \beta_6 + \#N + \#\mathrm{W}) \times t \end{aligned} \tag{1.1}$$

where Y^{t}_{evm} – GDP change at the moment in time t, x_1 – industry sector part of the economic structure, x_2 – service sector part of the economic structure, x_3 – finance sector part of the economic structure, x_4 – agriculture sector part of the economic structure, x_5 – construction sector part of the economic structure, x_6 – other sector parts of the economic structure, α_i – productivity change in the relevant i – th sector, β_i – change of capital return in the relevant i – th sector, $\#P_z$ – change in prices in agriculture production, $\#P_{pr}$ – change in prices in industry production, $\#N$ – change in population number, $\#W$ – change in average wage level in the country, $\#r_{EUR}$ – change in interest rate (EURIBOR), t – number of years, used for forecasting the economic structure changes (Vitas 2012).

Two more publications focused on the subject of economic sectors (Lankauskiene & Tvaronaviciene 2012; Tvaronaviciene & Lankauskiene 2013). As economic sector performance, structural changes are the main contributors to a country's economic growth – this competitive advantage has already been recognised and well developed by advanced nations, while in Lithuania this issue attracts only vague attention. As a result, it is of vital importance for Lithuania to dedicate relevant attention to industrial performance targeted at the country's economic growth.

1.4. Genesis of economic growth and development theories

There have been many discussions about production factors fostering economic growth (Bond et al. 2010; Sarkar 2007; Briec & Cavaignac 2007; Kosempel 2004), and the economic sectors which compose economies (Jaimovich 2011; Halkos & Tzeremes 2008; Tanuwidjaja & Thangavelu 2007; Sonobe et al. 2004) in the contemporary scientific literature. Moreover, there are many opinions and thoughts how different factors determine the development of industries (e.g. Karnitis 2011; Stańczyk 2011; Grybaite 2011; Korsakiene et al. 2011; Balkyte & Tvaronaviciene 2011; Kaźmierczyk 2012). The roots of the discussions mentioned above can be found in long-term economic growth and development theories (Lankaukiene & Tvaronaviciene 2012; Tvaronaviciene & Lankauskiene 2012). Therefore, this section provides the overview of economic growth and development theories in order to distinguish those, which are of vital importance for economic growth. The purpose of this section is to provide an overview of the theories of economic growth and development, which could be found in the relevant scientific literature, and present matters of substance for development economists through the prism of production factors and economic sectors. The major and often competing growth and development theories will be overviewed, insights into which will be provided and useful perspectives on the nature of development will be emphasised.

Theories of economic growth and development

It is important to mention that the history of economic growth and development theories dates back to the XVIIIth century and elaborated upon economic, political, and sociological theories which had existed from ancient times onwards.

One of the key theorists was Adam Smith, who influenced the later ideas on economic growth and development. His book "An inquiry into the nature and causes of the wealth of nations" was published in 1776. In the XVIIIth century, trade was the major force for economic growth. Merchants and, in particular, the

large trading companies wanted to safeguard their interests in order to avoid unnecessary competition. Protectionism included high import tariffs for goods produced outside the country. This made it cheaper for customers to buy domestically produced goods. Adam Smith argued that this form of regulation was detrimental for the economic growth of a country and greater wealth for all citizens. He insisted that greater attention should be paid to production, rather than trade in economic development. He claimed that divisions of labour would help to improve productivity and, therefore, economic growth and wealth creation. He also argued that the operation of the system would be better regulated by the "invisible hand of market" rather than by the state (Willis 2005). Smith's work is still very influential in contemporary science because of his theories on the role of the market in economic development. As a result, Adam Smith's discussion of the division of labour led to implication that economic development can be implied as a process of sectorial diversification and increasing specialisation within the economy. Such a dynamic pattern is also described by Allyn Young (1928), who writes that "industrial differentiation has been and remains the type of change characteristically associated with the growth of production". Similarly, Landes (1969) argues that the most evident effects brought about by the Industrial Revolution were the increase in the variety of products and the gains made in productivity (Jaimovich 2011).

Another highly influential classical economist was David Ricardo. He was a great advocate of free trade and developed theory of "comparative advantage". According to his theory, countries should concentrate on producing and then selling those goods in which they have an advantage in terms of their assets, such as land, mineral resources, labour, technical, or scientific expertise. Ricardo argued that is more beneficial for the economic growth of a country to specialise in this way, rather than to attempt to produce everything. The next theory to become influential was that of the British economist John Maynard Keynes, who published his "General theory of employment, interest and money" in 1936. Keynes' argument was that the free market was not necessarily the positive force that many, following Adam Smith, believed. Keynes argued that the key to growth was real investment, i.e. investment in new (rather than replacement) infrastructure projects. This investment he claimed, would have a positive effect on job creation and the further generation of wealth (Willis 2005).

It can be noticed that the state has an important role to play in the different approaches to economic growth, it can even be an interventionist, on which all the further development depends. In Marx's theory of development the following stages of development could be presented: ancient feudalism, capitalism, and then socialism (Willis 2005). Jorge Larrain (1989) presents the following theories of development: capitalism, colonialism, and dependency. Another distribution of development theories is according to continental models (e.g. Lee 2006).

The following groups of growth and development theories can be suggested from an analysis of the vast amount of relevant scientific literature on post –1945 development theories:

1. The linear stages of growth theories.
2. Theories and patterns of structural change.
3. The international dependence revolution.
4. The neoclassical, free market counterrevolution.
5. The new growth theory.
6. The unified growth theory.

Each of the above group of theories will be described hereinafter in order to provide the main features of each.

The linear stages of growth theories

After the Second World War, economists in the industrialised nations were lost. There was no conceptual idea how to analyse the process of economic growth in large agrarian societies which lacked modern economic structures. Even so, the undeniable fact is that all modern industrial nations were once undeveloped agrarian societies. Surely, their historical experience in transforming their economies from poor agricultural subsistence societies to modern industrial giants had important lessons for countries in Asia, Africa, and Latin America. The logical answer to this phenomenon, presented above, leads to the idea that the capital and historical experience of the now developed countries would allow these countries to reach their contemporary status.

The American historian Walt W. Rostow provided the most influential stages-of-growth model of development. According to his model, the transition from underdevelopment to development can be described in terms of a series of steps or stages through which all countries must proceed. As Rostow wrote in the opening chapter of The Stages of Economic Growth:

"This book presents an economic historian's way of generalising the sweep of modern history…it is possible to identify all societies, in their economic dimensions, as lying within one of five categories; the traditional society, the preconditions for "take-off" into "self-sustaining" growth, the "take-off", the drive to maturity and the age of high mass consumption…These stages are not merely descriptive. They are not merely a way of generalising certain factual observations about the sequence of development of modern societies. They have an inner logic and continuity…They constitute, in the end, both a theory about economic growth and a more general, if still highly partial, theory about modern history as a whole" (Rowstow 1960).

Rostow implies, that country has to accumulate the amount of savings needed, in order for country to enter what he called the "take-off" stage as part of the path from underdevelopment (traditional society) to "self-sustaining

growth". Moreover, the idea of the economy sectors can be seen in his model as well. Rostow wrote that a traditional society (which he indicated as one which had not yet reached the stage of self-sustaining development or even "take-off" stage) was one based on agriculture. The "take-off" stage had the features of technical innovation, changing international economic development, investments, and the accumulation of savings, a substantial manufacturing sector, and appropriate institutional arrangements e.g. a banking system. The maturity phase had to contain the following features: an extended range of technology, savings accounting for 10–20 percent of national income. The age of mass consumption provided the following features: the widespread consumption of durable goods and services, increased spending on welfare services. Advanced countries, it was argued, had all passed the stage of "take-off" into "self-sustaining growth" whereas underdeveloped countries were still in either the traditional society or the "preconditions" stage and had only to follow a certain set of development rules to bring about their "take-off" in their turn into "self-sustaining economic growth" (Theobald 1961; Willis 2005). Rostow's stages theory is usually taken as "the pre-eminent theory of development through the early 1960s" (Dietz 1983). One of the principal strategies of development necessary for any "take-off" was the mobilisation of domestic and foreign savings in order to generate sufficient investment to accelerate economic growth.

The economic mechanism by which more investment leads to more growth can described in terms of the Harrod-Domar growth model, often referred to today as the AK model, due to the fact that it is based on a linear production function. The main question elaborated by Harrod and Domar was about the circumstances, under which an economy could be capable of achieving steady growth. Researchers viewed instability in economic growth as a result of a failure to equate a "warranted" and a "natural" rate of growth. The warranted rate of growth is dependent on the savings rate and given capital requirement per unit of output. The natural rate is the maximum long-term sustainable rate of growth (Todaro & Smith 2011; Vernon 1988). In order to grow, economies must save and invest a certain proportion of their GDP. The more they can invest, the faster they can growth. But the actual rate, at which they can grow for any saving and investment, depends on how much additional output can be had from an additional unit of investment.

In addition to investment, two other components of economic growth are labour force growth and technological progress. In the context of the Harrod-Domar model labour force is not described explicitly. This is because labour is assumed to be abundant in the context of a developing country and can be hired as needed in a given proportion to capital investments (this assumption is not always valid). In a general way, technological progress can be expressed in the

Harrod-Domar model context as a decrease in the required capital-output ratio, giving more growth for a given level of investment.

Moreover, critics of this model claim that the mechanisms of development embodied in the theory of the stages of growth model do not always work. The basic reason why it does not work was not because more saving and investment is not a necessary condition for accelerated rates of economic growth, but rather because it is not a sufficient condition (Todaro & Smith 2011).

Theories of patterns and structural change

Structural-change theory concentrates on the process through which underdeveloped economies transform their domestic economic structures from traditional subsistence agriculture to a more modern, more urbanised, and more industrially diverse manufacturing and service economy. It employs the tools of neoclassical price, resource allocation theory, and econometrics to describe how this transformation process takes place. Two well-known representative examples of the structural-change approach are the "two-sector surplus labour" theoretical model of W. Arthur Lewis, later on expanded on by Choo, John Fei, and Gustav Ranis, and the "patterns of development" empirical analysis of Chenery (Chenery 1960; Chenery & Syrquin 1975; Chenery & Taylor 1968) and his co-researchers.

One of the best known early theoretical models of development to focuse on the structural transformation of a primary subsistence economy that formulated by the Nobel laureate W. Arthur Lewis in the mid-1950s and later modified, formalised and extended by John Fei and Gustav Ranis. The Lewis two-sector model became the general theory of the development process in surplus-labour developing nations for most of the 1960s and early 1970s and is sometimes still applied, particularly to study the recent growth experience in China and the labour markets in other developing countries. This model illuminates important aspects of many underdeveloped economies much more than any more models currently proposed. Lewis' major condition is the emergence and growth of a capitalist sector, as a condition of economic development, as this sector alone generates the required savings and investment. According to Lewis, capitalists (who may be state capitalists or wealthy industrialists, including companies) are the only source of productive saving; other classes or groups do not save or invest significantly. Professor Lewis also writes (p. 335): "the proportion engaged in manufacturing is therefore, like the proportion engaged in agriculture, one of the clearest indicates of degree of economic growth" (Lewis 1955). In the Lewis model, underdeveloped economies consist of two sectors: a traditional, overpopulated rural subsistence sector, characterised by zero marginal labour productivity and a high productivity modern urban industrial sector into which labour from the subsistence sector is gradually transferred. The primary focus of the model is on both the process of labour transfer and the growth of output and employment

in the modern sector. The speed by which this expansion occurs is determined by the rate of industrial investment and capital accumulation in the modern sector. Such investment is made possible by the excess of modern-sector profits over wages on the assumption that capitalists reinvest all their profits. This process of modern-sector self-sustaining growth and employment expansion is assumed to continue until all surplus rural labour is absorbed in the new industrial sector (Todaro & Smith 2011).

In recent years, Gustav Ranis and John C. H. Fei have advanced a theory of economic development based on the celebrated W. Arthur Lewis model of development with unlimited supplies of labour. Their model of development emphasises the role of Lewis' neglected the agricultural sector focusing on the Rostovian stage of "take-off" to sustained growth and the impacts of technology on development during this period. They believed that an underdeveloped country can successfully shift its centre of gravity from the agricultural sector to the industrial sector by allocating its investible resources to maintain the balanced-growth path, by maintaining the subsistence wage level and by adopting labour-intensive technology until the "turning point" is reached. The Ranis-Fei model may be theoretically consistent, but it is not empirically relevant (Choo 1971).

As with the earlier Lewis model, the patterns-of-development analysis of structural change focuses on the sequential process through which the economic, industrial, and institutional structure of underdeveloped economy is transformed over time to permit new industries to replace traditional agriculture as the engine of economic growth. However, in contrast to the Lewis model and the original stages view of development, increased savings and investment are perceived by patterns of development analysts being a necessary, but not sufficient conditions for economic growth. In addition to the accumulation of capital, both physical and human, a set of interrelated changes in the economic structure of a country are required for the transition from a traditional economic system to a modern one (Todaro & Smith 2011). The major hypothesis of the structural change model is that development is an identifiable process of growth and change whose main features are similar in all countries. However, the model does recognise that differences can arise among countries in the pace and pattern of development, depending on their particular set of circumstances. Factors, influencing the development process, include a country's resource endowment and size, its government's policies, objectives, the availability of external capital, technology, and the international trade environment.

The international dependence revolution

During the 1970s, international dependence models gained in popularity (especially among country intellectuals in developing countries), as a result of growing disenchantment with both linear-stages and structural-change models. While

this theory largely degree went out of favour during the 1980s and 1990s, versions of it have enjoyed a resurgence in the XXIst century as some of its views have been adopted by theorists and leaders of the anti-globalisation movement. Essentially, international dependence models view developing countries as a set by institutional, political, and economic rigidities, both domestic and international, and caught up in a dependence and dominance relationship with rich countries.

Whatever their ideological differences, the advocates of dependence models of neoclassical dependence reject the emphasis on traditional economic theories designed to accelerate the growth of GDP as the principal index of development. They question the validity of the Lewis-type two sector models of modernisation and industrialisation in light of their questionable assumptions and the recent history of the developing world. They further reject the claims made by Chenery and others that there are well defined empirical patterns of development which should be pursued by most poor countries. Instead, dependence theorists place more emphasis on international power imbalances and on the fundamental economic, political, and institutional reforms, which are needed both domestically, and worldwide. Moreover, dependence theories have two major weaknesses. Firstly, although they offer an appealing explanation as to why many poor countries remain underdeveloped, they give no insight into how countries initiate and sustain development. Secondly, and perhaps more importantly, the actual economic experience of developing countries which have pursued revolutionary campaigns of industrial nationalisation and state-run production has been mostly negative. If dependence theory is taken at face value, it could be concluded that the best course for developing countries is to become entangled with developed countries as little as possible and instead pursue a policy of autarky, or inwardly directed development, or at most only trade with other developing countries. But those large countries which embarked on autarkic policies, such as China and, to a significant extent, India, experienced stagnant growth and ultimately decided to open their economies. China began this process after 1978 and India after 1990. At the opposite extreme, economies such as Taiwan and South Korea, and more recently China, which have emphasised exports to developed countries have grown strongly.

Traditional neoclassical growth theory

The neoclassical growth theory supports Adam Smith's ideas about the "free market". One of the most influential representatives of this theory is Robert Solow, who has won the Nobel Prize for economics. The Solow neoclassical growth model in particular represented the seminal contribution to the neoclassical theory of growth. It differed from the Harrod-Domar model formulation by adding a second factor, namely labour, and introducing a third independent vari-

able, technology, to the growth equation. Technological progress became the important factor in explaining long-term growth, and its level was assumed by Solow and other neoclassical growth theorists to be determined exogenously, that is, independently of all other factors in the model. According to traditional neoclassical growth theory, output growth results from one or more of three factors: increases in labour quantity and quality (through population growth and education), increases in capital (through savings and investment) and improvements in technology (Smith & Todaro 2011). Solow was motivated by his scepticism that a sustained rise in the savings rate is the key to the transition from a slow to a fast growth path and by a concern that the capital-output ratio be replaced by a richer and more realistic representation of technology (Solow 1988). Solow's departure from the Harrod-Domar model was to substitute a variable capital-output ratio for the fixed coefficient capital-output ratio of the Harrod-Domar model. He insisted that the primary effort in his 1956 paper "is devoted to a model long run growth which accepts all the Harrod-Domar model assumptions except that of fixed proportions" (Solow 1956; Vernon 1998).

The initial version of the Solow neo-classical model has been succinctly described by Prescott. "The model has constant returns to scale aggregate production with substitution between two inputs, capital, and labour. The model is completed by assuming that a constant fraction of output is invested (Prescott 1988; Vernon 1998).

As with the dependence revolution of 1970s, the roots of the neoclassical counterrevolution of the 1980s, lie in an economics-ideological view of the developing world and its problems. Whereas dependence theorists (many, but not all, of whom were economists from developing countries) saw underdevelopment as an externally induced phenomenon, neoclassical revisionists (most, but not all, of whom were Western economists) saw the problem as an internally induced phenomenon of developing countries, caused by too much government intervention and bad economic policies. Such finger-pointing on both sides is not uncommon in issues as contentious as those which divide rich and poor nations. The problem is that many developing economies are so different in terms of their structure and organisation from their Western counterparts, that the behavioural assumptions and policy precepts of traditional neoclassical theory are sometimes questionable and often incorrect.

New growth theory – endogenous growth

The new growth theory endogenises growth (King & Rebelo 1993; Eltis 2000) and provides the theoretical framework for analysing endogenous growth, persistent GNI growth which is determined by the system, governing the production of the initial process rather than by forces outside the system. In contrast to traditional neoclassical theory, these models hold GNI growth to be a natural con-

sequence of long-term equilibrium. More precisely, endogenous growth models tend to explain the factors, which determine the rate of growth of GDP which are left unexplained and exogenously determined in the Solow neoclassical growth model.

The new growth theory was initially motivated by the apparent inconsistency between implications of the neoclassical theory's lack of evidence of convergence towards state growth even among presently developed economies (Romer 1986) and by the inability to successfully account for differences in income growth rates levels across countries (Romer 1986). "By assigning such a great a role to technology as a source of growth, the theory is obliged to assign correspondingly minor roles to everything else and so has very little ability to account for the wide diversity in growth rates that the author observes" (Lucas 1988). Lucas (1988) stresses the spill-over effects of human capital by modelling the externalities accruing to the production process from "learning by doing" (Sarkar 2007). Romer argued that what is needed is "an equilibrium model in which long-term growth is driven primarily by the accumulation of knowledge by forward-looking, profit maximising agents" (Romer 1986). The initial endogenous growth models advanced by Romer (1986) suggest that long-term growth is driven primarily by the accumulation of knowledge. However, the creation of new knowledge by one firm is assumed to generate positive-external effects on the production technology of other forms. Furthermore, the production of goods for consumption, which is a function of both the stock of knowledge and other inputs, exhibits increasing returns. Lucas proposed a second alternative of the neoclassical model. In his assumption, human capital serves as an engine of economic growth. He employed a two sector model in which human capital is produced by a single input, namely, human capital and which the final output is produced by both human and physical capital. In both the "Lucas" and "Romer" models in addition to the "internal effects" on the workers own productivity, "external effects" represent the source of scale economies and enhance the productivity of other factors of production. In both cases the accumulation of human capital involves the sacrifice of current utility.

In 1990 Romer advanced the alternative endogenous growth model in which he followed Lucas in emphasising the importance of human capital in the development of new knowledge economy. He departed from Lucas in that the basic inputs in the model were capital, raw labour, human capital, and an index of the level of technology. According to Romer "neoclassical growth theory explains growth in terms of interactions between two basic types of factors: technology and conventional inputs. The new theory divides the world into two fundamentally different types of productive inputs which the author can call "ideas" and "things". Ideas are non-rival goods, things are rival goods. Ideas are goods that are produced and distributed just as other goods are (Romer 1996).

In researchers' judgement the most important substantive contribution of these new growth theories was the endogenisation of human capital formation. Thus, the incentive to accumulate both human and physical capital may persist indefinitely and long-term growth in per capita income can be sustained. Following Lucas' and Romer' s suggestions that the industrial research not only generates the specific technical information that allows a firm to produce new products, but also contributes to the general scientific knowledge which can be explained by other economic agents in order to develop R&D activities which are essential to maintain the growth of alternative models of technical competition.

An important shortcoming in the new growth theories is that they remain dependent on a number of traditional neoclassical assumptions which are often inappropriate for developing countries. For example, it assumes that there is, but in a single sector of production or that sectors are symmetrical. This does not permit the crucial growth-generating reallocation of labour and capital among those sectors which are transformed during the process of structural change. Moreover, economic growth in developing countries is frequently impeded by inefficiencies arising from poor infrastructure, inadequate institutional structures, imperfect capital and goods markets. As endogenous growth models overlook these very influential factors, its applicability for the study of economic development is limited, especially when country-to-country comparisons are involved.

Unified growth theory

The inconsistency of exogenous and endogenous growth models with some of the most fundamental features of the growth process led to the development of a unified theory of economic growth, providing the underlying driving forces which trigger the transition from stagnation to growth and the divergence in income per capita across regions of the world. Unified growth theory was first advanced by Oded Galor and his co-researchers who were able to characterise an initial stable Malthusian equilibrium in a single dynamical system which due to the evolution of latent state variables, ultimately vanishes endogenously, causing a transitional growth take off before the system gradually converges to a modern growth steady-state equilibrium. The Malthusian state is characterised by slow technological progress and population growth, where the benefits of technological progress are offset by population growth. In the modern growth state technological progress does not encourage population growth, but the accumulation of human capital instead which then further spurs technological progress.

Unified Growth Theory sheds light on three fundamental aspects of comparative economic development. Firstly, it identifies the factors which govern the pace of the transition from stagnation to growth and contribute to the observed worldwide differences in economic development. Secondly, it uncovers

the forces which spark the emergence of multiple growth regimes and convergence clubs. Thirdly, it underlines the persistent effects that variations in prehistorical bio geographical conditions have generated on the global composition of human capital and economic development (Galor 2010).

1.5. Contemporary approaches in the context of sustainable development

This section provides an overview of contemporary approaches to industrial performance in the structure of the economy targeted at economic growth. In order to determine, which common approach is being adopted most frequently by foreign researchers while researching this issue, all articles in the Structural Change and Economic Dynamics journal from the period between 1996–2013 will be overviewed, including some other scientific papers.

Peneder's paper "Industrial structure and aggregate growth" aimed to give an empirical validation of the impact of industrial structure on aggregate income and growth. Various mechanisms for the linkage between meso-structure and macro-performance were identified: the income elasticity of demand, the structural bonus versus burden hypotheses, differential propensities towards entrepreneurial discovery, and producer or user related spill-overs. Following a discussion on detailed results from conventional shift-share analysis, dynamic panel estimations were applied to a standard growth model augmented by structural variables. Based on data from 28 OECD countries, the results confirmed that industrial structure has been a significant determinant of macroeconomic development and growth in the 1990s (Peneder 2003).

One more paper examines the role of structural change in explaining aggregate productivity growth in the manufacturing sector of four Asian countries over the period 1963–1993. The paper used a conventional shift-share analysis to measure the impact of shifts in both labour and capital inputs. The results did not support the structural-bonus hypothesis, which states that during industrial development, factor inputs shift to more productive branches (Timmer & Szirmai 2000).

A further paper implied that the structural characteristics of an economy belong to the most important indicators of a country's or regions economic development. The shares of manufacturing, agriculture, and services in total employment, as well as the shares of employment in different occupational and educational groups are closely correlated to aggregate indicators of wealth. It is also widely known that the economies of the former socialist Central and Eastern European countries (CEEC) have faced substantial problems in reallocating resources from unproductive to more productive uses on their way to a closer

integration into the world economy. They started their transition to market economies with an employment structure that was heavily centred on industrial (and in some countries also agricultural) employment, extremely large enterprises, and an almost complete predominance of state owned firms. It, thus, comes as no surprise that these countries and their regions have experienced substantial structural change since the start of market-oriented reforms (Huber & Mayerhofer 2006).

Another paper entitled "Structural change and the growth of industrial sectors. Empirical Test of a GPT Model" investigated the empirical relevance of a model of structural change and the growth of industrial sectors. The model analysed the process of the diffusion of general-purpose technologies (GPTs) and how this affects the dynamic performance of manufacturing and service industries. An empirical analysis studied the dynamics and the determinants of labour productivity growth for a large number of sectors in 18 OECD countries over the period 1970–2005. The results of a dynamic panel data and cross-sectional analysis provided support for the empirical validity of the model. Industries which are close to the core of ICT-related GPTs are characterised by greater innovative capabilities and have recently experienced a more dynamic performance. Similarly, countries, which have been able to shift their industrial structure toward these high-opportunity manufacturing and service industries, have grown more rapidly (Castellacci 2010).

Another paper implied that there are obvious gaps between long-term change in economic structure and its principal driving force-technological progress. History has shown the influence of technological progress on the economy and current insights in technological development can almost predict the technological waves of the next 50 years, but their potential impact on the economy has not yet been assessed. In this paper, researchers aimed to simulate the evolution of economic structure as represented by input-output structure under specific technological change. A new version of a dynamic input-output model was developed, in which both technological progress and deployment are endogenous. Investment in R&D drives the development of new technologies, the installation of capital stock brings new technical processes into sector production, new and old technical processes within a sector exchange their relative weights in production as they are phased in or out, and sectors evolve or transform over time. A scenario analysis using this model was applied to the Chinese electric power industry to show that the phasing-in of non-fossil energy technology will greatly change the structure of both the sector and the economy over the next 100 years (Pan 2006).

The researchers of another scientific article developed a tractable, three-sector model to study structural changes in an open economy. Their model features an endogenous pattern of trade dictated by comparative advantage. The

researchers derived an intuitive expression linking sectorial employment shares to sectorial expenditure shares and to sectorial net export shares of total GDP. They show how these driving forces can generate the "hump" pattern that characterises the manufacturing employment share as a country develops, even when manufacturing is the sector with the highest productivity growth (Yi & Zhang 2010).

A further paper employed an input-output framework to identify the contribution of economy-wide changes in technology and international trade to sectorial output growth in the German economy in the 1990s. By distinguishing two manufacturing sectors, a manufacturing core of export-oriented sectors and the rest of manufacturing, it subsequently formulated several scenarios about the structural changes that are assumed to take place in each of these subsectors. Comparing the resulting output and employment to actual base-year values, the researchers were thus able to identify the impact of the most important changes within manufacturing on, in particular, two subsectors of business-related services. The quantitative analysis established the order of magnitude – which is considerable – by which the latter have profited from structural changes in the manufacturing sector (Franke & Kalmbach 2005).

Another paper examined the emergence of manufacturing in developing countries in the period 1950–2005. It presented new data on structural change in a sample of 67 developing countries and 21 advanced economies. The paper examined the theoretical and empirical evidence for the proposition that industrialisation acts as an engine of growth in developing countries and attempts to quantify different aspects of this debate. The statistical evidence is not completely straightforward. Manufacturing has been important for growth in developing countries, but not all expectations of the "engine of growth hypotheses are borne out by the data". The more general historical evidence provides more support for the industrialisation thesis (Szirmai 2012).

The diversity of technological activities which contribute to a growth in labour productivity is examined in another article. Its researchers test the relevance of two "engines of growth", i.e., the strategies of technological competitiveness (based on innovation in products and markets) and cost competitiveness (relying on innovation in processes and machinery) and their impact on economic performance. The researchers proposed models for the determinants of changes in labour productivity. They carried out empirical tests for both the whole economy and for the four Revised Pavitt classes that group manufacturing and services industries with distinct patterns of innovation. The tests were carried out by pooling industries, countries and three time periods, using innovation survey data linked to economic variables. The results confirmed the specificity of the two "engines of growth"; economic performances in European industries appear

as the result of different innovation models, with strong specificities of the four Revised Pavitt classes (Bogliacino & Pianta 2011).

The paper described below analysed the determinants of structural change and aggregate productivity growth on the basis of the aggregation of the behaviour of heterogeneous firms in different economic sectors. At the same time, this model accounts for the evolution of market by providing a consistent generalisation of standard replicator dynamic models, focusing only on a single industry. This paper showed that understanding structural change has to be grounded on a macroeconomic consistent aggregation mechanism reflecting the underlying theory of sorting and selection. It also shows that the combined effect on sectorial output growth of selection on firms' unit costs and sorting by income elasticity of sectorial demand depends upon the specific institutional characteristics of the market, upon the specific position that a sector occupies in the whole economy, in terms of product characteristics and substitutability and, finally, upon the output growth and average unit costs of substitute sectors. Moreover, the selection process and the institutional settings in which it unfolds, combined with sectorial income elasticities, guide aggregate productivity growth, which can display positive values even without technological change at firm level (Montobbio 2002).

One further paper investigates how countries become specialised in exporting specific producer services, particularly financial, communication, and business services. The researchers found that a country's ability to develop a competitive service economy depends on the structure of its manufacturing sector, as some manufacturing industries are more intensive users of these services. Moreover, the researchers found a virtuous cycle, as the same service producers are also intensive users of these producer services. Finally, the researchers found that information and communication technologies have a significant impact on trade performance of these producer services (Guerrieri & Meliciani 2005).

A study entitled "Engines of growth in the US economy" implied that there is good reason to believe that R&D influences on MFP (multi-factor productivity) growth in other sectors are indirect. For R&D to spill over, it must first be successful in the home sector. Indeed, observed spill-overs conform better to MFP growth than to R&D in the upstream sectors. Sectorial MFP growth rates are thus inter-related. Solving the inter-sectorial MFP equation resolves overall MFP growth into sources of growth. The solution essentially eliminates spill-overs and amounts to a novel decomposition of MFP growth. The top 10 sectors are designated "engines of growth" led by computers and office machinery. The results are contrasted with the standard, Domar decomposition of MFP growth (Raa & Wolff 2000).

One further piece of research explored the relationship between countries' pattern of trade specialisation and long-term economic growth. It shows that

countries specialising in the export of natural resource based products only fail to grow if they do not succeed in diversifying their economies and export structure. This conclusion follows from an empirical investigation that has three innovative features. Firstly, it used a dynamic panel data analysis. Secondly, it employed disaggregated trade data sets to elabourate the different measures of trade specialisation which distinguish between unprocessed and manufactured natural resource products and are informative about the countries' trade diversification experience, their link to world demand trends and involvement in intra-industry trade. The final innovative aspect of the paper relates to its empirical findings: it is only specialisation in unprocessed natural resource products which down economic growth, as this impedes the emergence of more dynamic patterns of trade specialisation (Mursheda & Serinoc 2011).

In a piece of research entitled "Structural convergence of European countries", the researchers investigated the development of economic structures of Western European countries over the last three decades using employment data. The authors tested for structural convergence on the aggregate level as well as specifically for manufacturing and service industries. For this the researchers implemented both time-series and panel data methods. The results showed strong and persistent inter-sectorial convergence patterns as lagging countries shift from industrialised to service economies. In contrast, the results regarding inter-industry convergence are mixed: due to one-country specialization effects, increasing divergence is dominant in technology-intensive manufacturing industries, which are characterized by economies of scale, path-dependency and strong economic growth. In less technology intensive industries both convergence and divergence trends were found, depending on the existence of economies of scale. In traditional service branches, country-specific differences do not change to a significant extent, whereas in some industries with potential for rationalisation, convergence prevails (Palana & Schmiedebergb 2010).

A 2012 study contributed to the understanding of the regional structure of the Chilean economy utilising the fundamental economic structure (FES) approach. The regional FES construct implies the selected characteristics of an economy will vary predictably with economic size, as measured by regions: domestic product, population, total value added, and total sector output. The overarching problem addressed in this piece of research was whether identifiable patterns of relations among regional macro aggregates and economic transactions can be revealed via regional input-output tables. Jensen, West, and Hewings discussed the tiered, partitioned, and temporal approaches to the identification of FES using regional input-output table and spatial economic data. This research addressed the following four research questions: Does a regional FES exist for the Chilean economy? What proportions of the cells are predictable? Can stability patterns in the intermediate transaction table be identified for Chil-

ean regional economy? Which economic transactions are the most important across regional economies in Chile? Four regression models: linear-linear, linear-logarithmic, linear-inverse, and linear-logarithmic of inverse are run to identified the largest proportion of predictable FES cells for the Chilean regional economy. The regional input-output tables (1996) for the 13 regions compiled by the National Institute of Statistics of Chile provide data for the analysis. A FES analysis showed that 75% cells are predictable, 34% are stable, and 25% are important for Chilean regional economies. A further, 7% of the total fundamental economic activities were predictable, were stable and were important simultaneously. These strong FES-based economic activities consisted of chemicals, rubber, petroleum, and plastics as well as public services among several other fundamental industries (Thakur & Alvayay 2012).

Another paper presented a structural North-South model on structural change, industrialisation and economic convergence. In a balance-of-payments-constrained macro-setting, researchers assume a cumulative process between industrialisation and growth. In different manner from the traditional post-Keynesian models, the researchers endogenised the productive structure of developing countries. The researchers enquired as to how industrialisation affects uneven development and convergence processes. Multiple growth paths and a long-term path-dependent equilibrium emerged. Industrialisation proved to be a necessary but not sufficient condition for catching-up. Good management by the domestic institutions of domestic industrialisation was seen to be a complementary requirement (Botta 2009).

One more paper proposed an economic model to analyse the dynamic interaction among capital accumulation, economic structure, and preference in a perfectly competitive economic system. The system consists of three sectors: agriculture, industry, and service. A typical consumer's utility is dependent on consumption of agricultural and industrial goods, services, housing and wealth. The size of the territory is given and public land ownership is assumed. The model in this study was influenced by the structural approaches of, for example, Leontief, Sraffa and Pasinetti. The traditional neoclassical growth models, such as the Solow-Swan one-sector model, the Uzawa two-sector model and the Ricardian models of Samuelson and Pasinetti, may be considered, from a structural point of view, as special cases of the model in this study. Conditions for the existence of equilibria and stability were provided. The effects of changes in some parameters on the long-term economic structure are examined (Zhang 1996).

The objective of the next paper was to summarise the essential aspects and types of structural change which may contribute to the development of a general theory. First, a brief ontological introduction presented the underlying worldview and clarified the meaning of key terms. Secondly, the basic general mechanisms of structural change were explored and the relationships between

them pointed out. Finally, some considerations were made about the use of the developed concepts in the prediction, analysis, and management of structural change situations (Domingo & Tonella 2000).

Another paper showed that levels and trends of comparative labour productivity in manufacturing differ from levels and trends of labour productivity at the whole economy level, suggesting that structure and structural change play an important role in the growth process. Persistent differences in productivity levels are related to the choice between standardised mass production and craft flexible production technologies. These technological choices are shown to affect the development of human capital because of the different requirements of the two systems for shop floor, management, and research skills (Broadberry 1995).

The main characteristics of economic growth of nations are a sustained increase in the growth of output and factor productivity, and a widespread process of structural transformation. In their paper, the researchers contrasted two of the important researchers who do not ignore structural change: Kuznets and Pasinetti. Over several decades, the two approaches have developed in an almost orthogonal manner. The researchers discussed the reasons and evaluated the relevance of the approaches for the study of economic development (Syrquin 2010).

The relationship between economic structure and productivity growth has been the subject of increasing interest over recent decades. The innovative focus of another paper concernsed the role of the service sector in this relationship. Services play a core role in advanced economies, both from a quantitative and a strategic point of view. However, empirical research in this area lies considerably behind the research into the agricultural and manufacturing sectors. This paper focused on the impact of tertiarisation on overall productivity growth, using a sample of 37 OECD countries in the period between 1980 and 2005. The results partially refuted traditional knowledge on the productivity of services. Contrary to what conventional theories suggest, this research demonstrates that several tertiary activities have shown dynamic productivity growth rates, while their contribution to overall productivity growth plays a more important role than was historically believed (Maroto-Sanchez & Cuadrado-Roura 2009).

In his article, Fagerberg (2000) found changes in the employment share of the electrical machinery industry to positively impact the manufacturing sector productivity growth. Fagerberg's approach has some methodological drawbacks, however. This note seeks to complement Fagerberg's analysis by estimating the impact of the employment share of technologically progressive industries using a more adequate methodology (Fagerberg 2000).

Fagerberg's claim that the share of the "electronics" industry positively affects manufacturing is confirmed. However, the size of the impact, and as a consequence the extent of spill-overs, is found to be much smaller than was estimated by Fagerberg (Carree 2003).

The next paper investigated the driving forces behind the recent stages of this development. Focusing on international input-output data from the early 1970s to the 1990s, a decomposition analysis separated the quantitative impact of demand, technology, and trade determinants of output growth. The findings confirmed the rise of knowledge-based services as the most dynamic component, thus strengthening the case for "quarterisation", as a process which is distinctly characterised by the substantial contribution of technological and organisational change to structural development (Peneder *et al.* 2001).

In a further paper the researchers estimated multi-factor productivity (MFP) growth in agriculture, industry, and services in new European Union Member States. Moreover, show how structural change contributes to growth. Because of the difficulties in measuring the capital stock of transition economies, they developed a model which estimates sectorial MFPs from data on sectorial employment and GDP per capita. Compared to Austria, new EU Member States have lower MFP levels, but their MFP growth is largely higher. Inter-sectorial movements of labour do not play a large role in aggregate MFP growth, and capital accumulation is an important component of convergence to EU levels of per capita GDP (Bah & Brada 2009).

Another paper documented the comparative productivity performance of the United States and Britain since 1870, showing the importance of developments in services. The researchers identified the transition in market services from customised, low-volume, high margin business organised on a network basis to standardised, high-volume, low-margin business with hierarchical management, as a key factor. A model of the interaction between technology, organisation and economic performance is then provided, focusing on the transition from networks to hierarchies. Four general lessons were drawn: developments in services must be analysed if the major changes in comparative productivity performance among nations are to be understood fully; different technologies and organizational forms can co-exist efficiently; technological change can cause difficulties of adjustment in technology-using sectors if it is not suited to the social capabilities of the society; the reversal of technological trends can lead to reversal of comparative productivity performance (Broadberry & Ghosal 2005).

A piece of research entitled "The service paradox and endogenous economic growth" (2006) it is stated that "stagnant services" are characterised by low productivity growth and rising prices, but also, and paradoxically, by output growth proportional to the rest of the economy, and hence by an expanding employment share, with a negative effect on aggregate productivity growth. The paper considered that many of these services, inclusive of education, health and cultural services, contribute to human capital formation, thus enhancing growth. This effect is distinguished according to whether it is a side-effect of spending on services or an intentional investment by households, as in Lucas' model.

Preferences for services are assumed to rise with income. The main result is that the productivity of stagnant services and their quality displayed in raising human capital play a central role in opposing the negative Baumol effect on growth, and in reinforcing the explanation of the paradox (Pugno 2006).

The other paper investigated empirically whether the growing service sector in China has led to cost disease, a likely consequence of tertiarisation according to Baumol's unbalanced growth model. The investigation uses a panel data set of 30 provinces. The key findings are: the currently positive contribution of the service sector to growth is largely due to shifts of labour from the primary sector into services; however, signs of cost disease are discernible from weak responses to price signals in demand for services, in wage determination and labour input demand of the service sector (Qin 2006).

1.6. Conclusions of Chapter 1 and formulation of objectives

1. Economic growth is the increase in the market value of the goods and services produced by an economy over time. It is conventionally measured as the growth of the percentage rate of GDP. There are three main methods for its accounting in the science of economics: production, income, and expenditure.
2. Economies are composed of economic sectors, and the latter are composed of economic branches – industries. Industrial performance in the structure of economy encompasses the following concepts: growth, development, transformation, and structural changes. The latter is most generally used in contemporary scientific literature.
3. Industrial performance targeted at economic growth is most generally measured by the growth of the percentage rate of gross value added.
4. Many different factors determine the performance of industries: macroeconomic conditions, demand side factors, inputs to production, R&D and innovations, market structure, openness and barriers to trade, etc. The author focuses on inputs to production in the present thesis.
5. Scrutinised economic growth and development theories through the lenses of inputs to production and structural changes have conveyed the following observations:
   5.1. In the oldest theories the inputs to production could be preferred to be those in which a country is abundant or has the comparative advantage. Moreover, investments were considered to be of vital importance. Later on with the emergence of the relevant groups of economic growth and development theories after the Second World War

the following inputs to production can be distinguished: the accumulation of savings and reinvestment, capital accumulation (both human and physical), technological change, innovation, and knowledge. Furthermore, labour productivity is considered to be of vital importance.

5.2. The process of sectorial diversification and increasing specialisation within the economy could be found in an idea that dates back to oldest development theorists. Structural change models with their representatives provide the profound ideas that structural changes are needed for country, targeted to reach self-sustained development. According to those theories, development could be reached only by transferring the traditional agriculture sector to the manufacturing sector and then to the diversified services sector. Another implication could be noticed, that there are common structural change patterns of development that each country has to overcome, in order to reach sustainable development.

5.3. Generalizing, even though the development and economic growth theories may seem contradictory, each of them has valuable insights to offer for development economics. Furthermore, theories vary due to the context and the priority sequence of inputs to production. Moreover, they are not abundant. On the contrast, when talking about economy sectors, a consistency could be noticed in the structural change of economy.

6. Research into economic structure and growth is widespread in foreign scientific literature. The roots of economic structure and growth rates are considered to be important for the sustainable growth of a country. Moreover, there are many on-going discussions beginning from the factors, determining the performance of economic branches, and ending with insights into the relevant economic structure fostering growth and productivity. The insufficient attention paid to the impact of economic sectors on Lithuania's economic development has encouraged a very reasonable necessity for more in-depth research on this issue.
7. The most relevant approach which could be distinguished in the contemporary approaches of industrial performance and economic growth in the context of sustainable development is productivity.
8. An overview of industrial labour productivity measurement methods is needed for the further elaboration of this issue.

The following objectives have been defined after the research of theoretical approaches of industrial performance and economic growth interrelations:

1. To evaluate critically the methods of labour productivity measurement;

2. To ground the reasons of the new method application and ways of its improvement;
3. To compose a methodology, in order to estimate industrial growth determinants and labour productivity constituents for the growth of the total economy;
4. To apply methodology for countries researched;
5. To perform a comparative analysis of Lithuania in the context of more developed countries.

2

Industrial labour productivity estimation methods

2.1. The aggregate productivity growth evaluation method

What is the impact of structural change on labour productivity growth? In response to this question many researchers use an empirical methodology, designed to analyse such issues, often referred to as "shift-share analyses". It has been frequently used by among others economic geographers, economic historians, industrial economists, and trade analysts. Essentially, it is a purely descriptive technique which attempts to decompose the change of an aggregate into a structural component, reflecting changes in the composition of the aggregate, and changes within the individual units which make up the aggregate. As such, it is closely related to an analysis of variance. There are many versions of this methodology, the main difference being the choice of the base year or "weights": initial year, final year, some kind of "average", linked, etc. Each of the version usually has its critics as well as defenders. The reason for this is the well-known result in index number theory that if, for example, initial or final year weights are applied throughout in decomposition, a residual will. Therefore, many versions of this methodology try to reduce this residual as much as possible (Tanuwidjaja & Thangavelu 2007; Lankauskiene & Tvaronaviciene 2014).

Many researchers examine the effects of recent structural changes on the growth of labour productivity. The traditional assumption of the growth accounting literature is that structural change is an important source of growth and overall productivity improvements. The standard hypothesis assumes a surplus of labour in some (less productive) parts of the economy (such as agriculture), meaning that shifts towards higher productivity sectors (industry), are beneficial for aggregate productivity growth. Even within industry, shifts towards more productive branches should boost aggregate productivity. On the other hand, structural change may have a negative impact on aggregate productivity growth, if labour shifts to industries with slower productivity growth. The "structural bonus and burden" hypotheses were examined using by the example of Asian economies by Timmer and Szirmai (2000), a large sample of OECD and developing countries (Fagerberg 2000), and more recently by Peneder for the USA, Japan and the EU Member States (Peneder 2009). The overall developments regarding output, employment, and productivity described above mask substantial structural changes within economies and their individual sectors. Structural changes reflect inter alia different speeds of restructuring and resulting efficiency gains or losses at industrial level.

The impact of structural change on aggregate productivity growth is evaluated by the frequently applied shift-share analysis in an analogy by Timmer and Szirmai (2000), Fagerberg (2000), Peneder (2003), and others. The shift-share analysis provides a convenient tool for investigating how aggregate growth is linked to differential growth of labour productivity at the sectorial level, and to the reallocation of labour between industries. It is particularly useful for an analysis of productivity developments in countries where data limitations prevent more sophisticated econometric approaches being used (Havlik 2005).

Using the same notation as presented by Peneder (2003), researchers have decomposed the aggregate growth of labour productivity into three separate effects:

$$growth(LP_T) = \frac{LP_{T,fy} - LP_{T,by}}{LP_{T,by}} = \underbrace{\frac{\sum_{i=1}^{n} LP_{i,by} \cdot (S_{i,fy} - S_{i,by})}{LP_{T,by}}}_{I:static.shift.effect}$$

$$+ \underbrace{\frac{\sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by}) \cdot (S_{i,fy} - S_{i,by})}{LP_{T,by}}}_{II:dynamic.shift.effect} + \underbrace{\frac{\sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by}) \cdot S_{i,by}}{LP_{T,by}}}_{III:within.growth.effect}, \quad (2.1)$$

where LP – labour productivity; by – base year; fy – final year; T – $\sum$over industries i; S_i – share of the industry in total employment.

Firstly, the structural component is calculated as the sum of the relative changes in the allocation of labour across industries between the final year and the base year, weighted by the value of the sector's labour productivity in the base year. This component is known as the static shift effect. It is positive/negative if industries with high levels of productivity (and usually also high capital intensity) attract more/less labour resources and, hence, increase/decrease their share of total employment. The standard structural bonus hypothesis of industrial growth postulates a positive relationship between structural change and economic growth as economies upgrade from low to higher productivity industries. The structural bonus hypothesis thus corresponds to an expected positive contribution of the static shift effect to aggregate growth of labour productivity (Havlik 2005).

The structural bonus hypothesis:

$$\sum_{i=1}^{n} LP_{i,by}(S_{i,fy} - S_{i,by}) > 0 \ . \tag{2.2}$$

Secondly, dynamic shift effects are captured by the sum of interactions of changes in employment shares and changes in the labour productivity of individual sectors/industries. If industries increase both labour productivity and their share of total employment, the combined effect is a positive contribution to overall productivity growth. In other words, the interaction term becomes larger, the more labour resources move toward industries with fast productivity growth. The interaction effect is, however, negative if industries with fast growing labour productivity cannot maintain their shares in the total employment. Thus, the interaction term can be used to evaluate Baumol's hypothesis of a structural burden of labour reallocation which predicts that employment shares shift away from progressive industries towards those with a lower growth of labour productivity (Baumol 1967; Havlik 2005). The author would expect to confirm the validity of the structural burden hypothesis in the NMS due to the above-sketched shifts from industry to services (with lower productivity levels) at the macro level, and due to shifts from heavy (and capital-intensive) to light industries within manufacturing, respectively (Havlik 2005).

The structural burden hypothesis:

$$\sum_{i=1}^{n} (LP_{i,fy} - LP_{i,by})(S_{i,fy} - S_{i,by}) < 0 \ . \tag{2.3}$$

Thirdly, the "within-growth" effect corresponds to growth in aggregate labour productivity under the assumption that no structural shifts in labour have taken place and that each industry (sector) has maintained the same share in total employment as in the base year. Researchers, however, recall that the frequently

observed near equivalence of the within-growth effect and aggregate productivity growth cannot be used as evidence against differential growth between industries. Even in cases all the positive and negative structural effects net out, much variation in productivity growth can be present at the more detailed level of activities (Havlik 2005).

As productivity has a robust tendency to grow, the within-growth effect is practically a summation over positive contributions only. On the contrary, for each industry the sign of the contribution to both shift effects depends on whether labour shares have increased or decreased. The shift effects, therefore, capture only the comparatively small increment to aggregate growth which is generated by the net difference in productivity performance of the shifting share of the labour resources. Even that increment can either be positive (structural bonus) or negative (structural burden). In short, offsetting the effects of shifts in employment shares of industries with high and low levels of labour productivity, as well as high and low productivity increases, explains why shift-share analyses regularly fail to reveal substantial direct contributions of structural change to aggregate growth (Havlik 2005; Lankauskiene & Tvaronaviciene 2014).

The decomposition method can be found in the scientific research "Structural change in the Centrope region" (Hurber & Mayerhofer 2006) and in "Is growth of services an obstacle to productivity growth? A comparative analysis" (Maroto-Sanchez & Cuadrado-Roura 2009). Both of these pieces of research provide relationship between economy structure and productivity growth has been the subject of increasing interest over recent decades. The innovative focus of these paper concerns the role of the service sector in this relationship. Services play a core role in advanced economies, both from a quantitative and a strategic point of view. However, empirical research in this area lags considerably behind research into the agricultural and manufacturing sectors. Their paper focuses on the impact of tertiarisation on overall productivity growth, using a sample of 37 OECD countries in the period between 1980 and 2005. The results partially refute traditional knowledge of the productivity of services. Contrary, to what conventional theories suggested, namely that the service sector usually has a negative impact on aggregate labour productivity growth, this research demonstrated that several tertiary activities had shown dynamic productivity growth rates, while their contribution to overall productivity growth played a more important role than had been historically believed (Maroto-Sanchez & Cuadrado-Roura 2009).

As stated above, Fagerberg (2000) also tried to answer the question "What is the impact of structural change and productivity growth?". He used "shift-share analysis" as well. Formally, the method applied is similar to the one, presented above, but there is a difference in the sequence of variables. He uses the following method:

$$P = \frac{Q}{N} = \frac{\sum Q_i}{\sum_i N_i} = \sum_i \left[\frac{Q_i}{N_i} \times \frac{N_i}{\sum_i N_i} \right], \tag{2.4}$$

where P – labour productivity; Q – value added; N – labour input; i – industry.

Define

$$P_i = \frac{Q_i}{N_i}; \tag{2.5}$$

$$S_i = \frac{N_i}{\sum_i N_i}, \tag{2.6}$$

where P_i – labour productivity in industry i; S_i – the share of industry i in total em ployment.

Then, by substituting the formula (2.5) and (2.6) to the formula (2.7):

$$\begin{aligned} &P = \sum_i \left[P_i \cdot S_i \right]; \\ &Assume \\ &\Delta P = P_i - P_0; \Delta S = S_i - S_0, etc. \end{aligned} \tag{2.7}$$

Then, researchers give the "in growth rate form":

$$\Delta P = \sum_i \left[\overset{I}{\frac{P_{i0} \cdot S_i}{P_0}} + \overset{II}{\frac{\Delta P_i \cdot \Delta S_i}{P_0}} + \overset{III}{\frac{S_{i0} \cdot \Delta P_i}{P_0}} \right]. \tag{2.8}$$

The first term (I) is the contribution to productivity growth from changes in the allocation of labour between industries. It will be positive if the share of high productivity industries in total employment increases at the expense of industries with low productivity. Thus, it reflects the ability of a country to move resources from low to high productivity activities. The second term (II) measures the interaction between changes in productivity in individual industries and changes in the allocation of labour across industries. This effect will be positive if the fast growing sectors in terms of productivity also increase their share of total employment. Hence, it reflects the ability of a country to reallocate its resources towards industries with rapid productivity growth. The third (III) is the contribution from productivity growth within individual industries (weighted by the share of these industries in total employment) (Fagerberg 2000). The same methods are being provided by Jalava (2006) and Van Ark, Hann (1997).

Furthermore, labour productivity growth in an economy can be achieved in one of two ways. Firstly, productivity can grow *within* economic sectors through capital accumulation, technological change, or the reduction of misallocation across plants. Secondly, labour can move across sectors, from low-productivity sectors to high-productivity sectors, increasing overall labour productivity in the economy. This can be expressed using the following decomposition:

$$\Delta Y_t = \sum_{i=n} O_{i,t-k} \cdot \Delta y_{i,t} + \sum_{i=n} y_{i,t} \cdot \Delta O_{i,t} , \qquad (2.9)$$

where Y_t ,$y_{i,\,t}$ – economy – wide and sectorial labour productivity levels; $\ddot{O}_{i,t}$ – the share of employment in sector i; Δ – the change in productivity or employment shares between $t - k$ and t.

The first term in the decomposition is the weighted sum of productivity growth within individual sectors, where the weights are the employment share of each sector at the beginning of the time period. Researchers call this the "within" component of productivity growth. The second term captures the productivity effect of labour reallocations across different sectors. It is essentially the inner product of productivity levels (at the end of the time period) with the change in employment shares across sectors. Researchers call this second term the "structural change" term. When changes in employment shares are positively correlated with productivity levels, this term will be positive, and structural change will increase economy-wide productivity growth (McMillan & Rodrij 2011).

The article "Deconstructing the BRICs: structural transformation and aggregate productivity growth" studied structural transformation and its implications for productivity growth in the BRIC countries based on a new database that provides trends in value added and employment at a detailed 35 industrial level. Vries *et al.* (2012) found that for China, India, and Russia the reallocation of labour across sectors is contributing to aggregate productivity growth, whereas, in Brazil it is not. However, this result is overturned when a distinction is made between formal and informal activities. The increasing formalisation of the Brazilian economy since 2000 appears to be growth-enhancing, while in India the increase in informality after the reforms is growth-reducing (Vries *et al.* 2012).

To measure the contribution of structural change to growth, the researchers start with the canonical decomposition originating from Fabricant (1942). The change in aggregate labour productivity levels (ΔP) can be written as:

$$\Delta P = \sum \Delta P_i L_i + R , \qquad (2.10)$$

where L^{-}_{i} – the average share of sector i in overall employment; R – the reallocation term.

In the formula (2.10) the change in aggregate productivity is decomposed into within-sector productivity changes (the first term on the right-hand side which researchers call the "within-effect" or "intra-effect"), and the effect of changes in the sectorial allocation of labour which researchers call the "reallocation-effect", (the second term, also known as the "shift-effect" or "structural-change effect"). The "within-effect" is positive (negative) when the weighted change in labour productivity levels in sectors is positive (negative). The "reallocation-effect" is a residual term, which measures the contribution of labour reallocation across sectors, being positive (negative) when labour moves from less (more) to more (less) productive sectors. One advantage of this approach above partial analyses of productivity performance within individual sectors is that it accounts for aggregate effects. For example, a high rate of productivity growth within say manufacturing can have ambiguous implications for overall economic performance if manufacturing's share of employment shrinks rather than expands. If the displaced labour ends up in activities with lower productivity, economy-wide growth will suffer. It should be noted that this reallocation term is only a static measure of the allocation effect as it depends on differences in productivity levels across sectors, not growth rates. Growth and levels are often, but not necessarily, correlated. The reallocation term is often used as an indicator for the success of structural transformation (Bosworth & Collins 2008; IADB 2010; McMillan & Rodrik 2011; Vries *et al.* 2011). Their paper investigated whether the reallocation term is affected by a change in the level of aggregation used in the decomposition. Typically, decompositions are carried out at the level of broad sectors. This paper uses a more detailed dataset finding different decomposition results. For example, aggregate trends in manufacturing might hide considerable variation at a lower level. Aggregate manufacturing productivity growth might be the result of a shrinking formal sector, outsourcing labour-intensive activities to small informal firms. This effect is picked up as a negative reallocation effect in our more detailed decomposition analysis, but not by an analysis based on aggregate manufacturing data. Structural change will be growth-reducing when the shift of labour from formal to informal activities is properly accounted for. In the following sections researchers were able to show that this is indeed the case for India after the reforms. Put more formally, let each sector *i* consists of a number of subsectors *j*. As before, for each sector *i* the change in labour productivity is given by a weighted growth of subsectors j, with share of *j* in *i* employment as weights, and a residual term measuring the reallocation across industries in a sector i (R_i):

$$\Delta P = \sum \Delta P_i L_i + R_i \,, \tag{2.11}$$

where $\bar{L}_{i;j}$ is the average share of subsector *j* in sector i employment.

Substituting the formula (2.10) with (2.11) to (2.12), it is easily shown that them change in aggregate productivity can be decomposed in an employment weighted change of productivity levels in all subsectors j plus a new reallocation term:

$$\Delta P = \sum_{j} \Delta\left(P_j L_j\right) + \left(\sum P_i L_i + R\right), \tag{2.12}$$

where L_j is the average share of subsector j in overall employment.

Formula (2.12) shows that the new overall reallocation effect consists of the reallocation of labour between sectors i (the old R), and the reallocation effects between subsectors j within each sector i (R_i summed over all sectors). In the example above, R_i is negative for manufacturing bringing down the overall reallocation effect. This indicates the importance of having a detailed sector database to analyse the role of structural change in economic growth (Vries *et al.* 2011; Vries *et al.* 2012).

2.2. Accelerations in the aggregate productivity growth evaluation method

Recent studies of economic growth have moved away from explaining average trends in long-term growth to study growth accelerations and decelerations due to the great instability in growth rates within countries. Researchers argue that the standard shift-share analysis is inadequate for measuring the contribution of sectors to accelerations in productivity. Very few countries have experienced consistently high growth rates over long periods. Rather, the more typical pattern is that countries experience phases of growth, stagnation, or decline of varying length. A study of these separate periods seems more revealing for a study of the determinants of growth than a long-period average (Pritchett 2000). This raises the natural question of which sectors in the economy contribute most to accelerations and decelerations in growth. For example, Jones and Olken (2008) suggested that employment reallocation to more productive sectors lies behind accelerations and decelerations of growth in many developing countries. However, because of missing sectorial data, they were unable to test this hypothesis. Researchers provide empirical evidence on the significance of various sectors in generating aggregate productivity growth by introducing a novel shift-share analysis and by applying this method to a new sectorial database for 19 countries in Asia and Latin America, spanning the period from 1950 to 2005. Each sector can contribute to aggregate growth in two ways: by productivity

growth within the sector (the within-effect) and by expanding its share of aggregate inputs (the between-or shift-effect). To measure these contributions researchers modified a standard tool in the economic historians' tool-box: the shift-share analysis introduced by Fabricant (1942). The shift-share analysis is used in many studies to measure the contribution of structural change to aggregate growth. For example, it features prominently in the discussion about the extent of Britain's decline relative to Germany and the US since the end of the nineteenth century (Broadberry 1995). Unfortunately, the interpretation of results from the traditional shift-share method is not straightforward (Timmer & Vries 2008; Timmer & Vries 2007; Lankauskiene 2014).

Researchers have proposed two modifications to the traditional shift-share analysis, which make its results more useful. First, the standard method does not allow for disequilibria in factor markets in which average productivity differs from marginal productivity. Especially in early stages of development, the agricultural sector is characterised by wide-spread disguised unemployment (Broadberry 1995). Researchers use estimates of the shadow price of labour to measure this wedge and adjust the shift share method accordingly. This adjustment increases the measured importance of structural change to growth. Second, the traditional method does not properly account for differences in productivity levels between sectors. For example, the expansion of a low-productive sector such as government services would show up as being positive for aggregate growth. Researchers account for differences in productivity levels between sectors and derive more meaningful measures of the contribution of particular sectors to aggregate productivity growth. Researchers have found that resource reallocation is not the main driver of accelerations and decelerations in aggregate economic growth. Productivity improvements within sectors, in particular within manufacturing and market services, appear to have been much more important for growth in Asia and Latin America since the 1950s (Timmer & Vries 2008; Timmer & Vries 2007).

For a long time, the importance of sectorial development patterns for economic growth has been recognised. Changes in the sectorial composition of production and employment and their interaction with the pattern of productivity growth feature prominently. Technological change typically takes place at the level of industries and induces differential patterns of sectorial productivity growth. At the same time, changes in domestic demand and international trade patterns drive a process of structural transformation in which labour, capital, and intermediate inputs are continuously relocated between firms, sectors, and countries (Kuznets 1966). One of the best documented patterns of structural change is the shift of labour and capital from the production of primary goods to manufacturing and services. Another finding is that the level and growth rate of labour productivity in agriculture is considerably lower than in the rest of the

economy (at least at low levels of income), reflecting differences in the nature of the production function, in investment opportunities, and in the rate of technical change (Syrquin 2000). Taken together these findings suggest a potentially important, albeit temporary, role for resource allocation from lower to higher productive activities to boost aggregate productivity growth. This potential growth bonus was already identified in classical dual economy models such as Lewis (1954) and Fei and Ranis (1964). These models presumed that in early stages of development, agricultural labourers shift to the industrial sector without any reduction in the total agricultural output. The existence of this source of inefficiency can be explained by the immobility of agricultural labour vis-a-vis the industrial sector caused by the discrepancy between private costs, approximated by the average product in agriculture, and social costs. Differences in the potential for structural change have featured prominently in explanations of differential growth within European countries in the post-World War II period. However, the quantification of its importance has been hampered by a clear methodology to measure the effect of structural change on aggregate productivity growth. The standard method to measure this is the shift-share decomposition originating from Fabricant (1942). This method is part of the standard tool kit of economic historians and is used in many studies. One major problem of the traditional shift share method is the assumption that productivity growth within each sector is not affected by structural change. Clearly productivity growth rates are affected since, for example, productivity growth in agriculture is largely possible due to the reallocation of employment to manufacturing and services. For example, labour productivity in South Korean agriculture increased 5% annually during the period 1963–2005. It is not likely that this high growth rate could have been sustained when 63% of the population was still working in agriculture in 2005, as it was in 1963. Broadberry & Ghosal (2005) argued that the shift-share analysis should be modified by assuming that the marginal productivity of workers leaving shrinking sectors is equal to zero. Although this adjustment overestimated the effect of sectorial expansions, researchers proposed an extension and improvement of the traditional shift-share analysis in a similar direction without overstating sectorial employment reallocation.

Researchers suggest the following modified shift-share analysis:

$$P^T - P^O = \sum_{i \in K,J} (P_i^{\mathrm{T}} - P_i^O) * S_i^- + \sum_{i \in K} (S_i^T - S_i^O) * (P^- - P^-_J), \qquad (2.13)$$

where P being labour productivity, S i sectorial employment shares in the *i-th* sector (1,…,10), T indicating the end of a period, 0 the beginning of a period, and a bar indicating period average.

The first term on the right hand side measures the contribution of within-sector productivity growth (the intra effect). The second term on the right hand side measures the contribution of sectorial reallocation of employment to aggregate productivity growth (the shift effect).

With average labour productivity in shrinking sectors:

$$P_J^- = \frac{\sum_{i \in J} \left(S_i^T - S_i^O \right) \times P_i^-}{\sum_{i \in J} \left(S_i^T - S_i^O \right)}, \tag{2.14}$$

where J the set of shrinking sectors, K the set of shrinking sectors.

The modified shift-share analysis decomposes growth in GDP per worker into improvements within industries and improvements due to the reallocation of labour across industries (Lankauskiene 2014). In the decomposition, researchers account for surplus labour. Furthermore, expanding sectors only contribute to productivity growth if their productivity level is higher than the economy's average (Timmer & Vries 2008; Timmer & Vries 2007).

2.3. The growth accounting method

The roots of this method date back to the famous neoclassical economic growth and development theories of Robert Solow (1956). In 1987, Prof. Dale Jorgenson, Gollop and Fraumeni (Harvard University) published their standard work outlining the growth accounting approach based on the KLEMS methodology. Researchers use growth accounting method for various types of research (e.g. Inklaar *et al.* 2008; Inklaar *et al.* 2007; Inklaar & Timmer 2007; Inklaar & Timmer 2008; Maudos *et al.* 2008; Kratena 2007; Aulin-Ahmavaara & Pakarinen 2007; O'Mahony *et al.* 2009; Broersma & Moergastel 2007; Erumban 2009). In the thesis the author basically followed the EU KLEMS methodology of growth accounting (Timmer *et al.* 2007; Timmer *et al.* 2013; Mas & Stehrer 2012).

Analysis of the economic growth relies on measures of capital, labour, and productivity. The growth accounting approach appears to be especially useful in this regard. Using this method, measures of value added growth can be decomposed into contributions of inputs and productivity within a consistent framework. It allows an assessment of the relative importance of labour, capital, and measures of multi-factor productivity (MFP) growth to be derived. MFP growth is measured as the difference between the volume growth of outputs and the volume growth of inputs. As such, it captures increases in the amount of value added that can be created by a given quantity of inputs. To put it in ano-

ther way, it captures the reduction in input costs to create a given amount of value added. Under strict neo-classical assumptions MFP growth measures disembodied technological changes (Timmer *et al.* 2007; Inklaar & Timmer 2008).

Growth accounting is based on production possibility frontiers where industry gross output is a function of capital, labour, intermediate inputs, and technology, which is indexed by time, *t*. Specifically, in the thesis author use defined a more restrictive industry value added function, which gives the quantity of value added as a function of capital, labour, and time as:

$$V_j = g_j(K_j, L_j, T), \tag{2.15}$$

where V_j is the quantity of industry value added. Value added consists of capital and labour inputs, and the nominal value is:

$$P^V{}_j V_j = P^K{}_j K_j + P^L{}_j L_j, \tag{2.16}$$

where P^V is the nominal price of value added. Under the strict neoclassical assumptions, industry value added growth can be decomposed into the contribution of capital, labour, and MFP (A^V).

$$\Delta \ln V_{jt} = w^K{}_{jt} \Delta \ln K_{jt} + w^L{}_{jt} \Delta \ln L_{jt} + \Delta \ln A^V{}_{jt}, \tag{2.17}$$

where *w* is the two period average share of the input in nominal value added, Δ*ln*-natural logarithm growth rates. The value share of each input is defined as follows:

$$w^L{}_{jt} = (P^V{}_{jt} V_{jt})^{-1} P^L{}_{jt} L_{jt}; w^K{}_{jt} = (P^V{}_{jt} V_{jt})^{-1} P^K{}_{jt} K_{jt}. \tag{2.18}$$

To derive the factor input weights in the growth accounts the following nominal value added components are needed: the compensation of employees (COMP), and the gross operating surplus (GOS). Labour compensation (LAB) is derived by applying the ratio of hours worked by the total number of persons engaged to the hours worked by employees to the compensation of employees. Capital compensation (CAP) is derived as value added minus LAB (Timmer *et al.* 2007).

Capital input

For the measurement of capital services the author needs capital stock estimates for detailed assets and the shares of capital remuneration in total output value.

Construction of capital stock estimates for all asset types

The most commonly employed approach in capital stock measurement is the Perpetual Inventory Method (PIM). In the PIM, capital stock (A) is defined as a weighted sum of past investments with weights given by the relative efficiencies of capital goods at different ages.

$$A_{k,t} = (1-\partial_k)A_{k,t-1} + I_{k,t}\,, \tag{2.19}$$

where $A_{k,t}$ the capital stock for a particular asset type k at time t, – depreciation different for each asset type, I investment in period t. Depreciation rates for different asset types could be found in EU KLEMS (Timmer *et al.* 2007; O'Mahony & Timmer 2009).

Aggregation over asset types

For the aggregation of capital services over the different asset types it is assumed that aggregate services are a translog function of the services of individual assets. It is further assumed that the flow of capital services for each asset type is proportional to its stock, independent of time. Hence the corresponding index of capital input K is a translog *Tornqvist* quantity index of individual assets in a particular industry given by

$$\Delta \ln Kt = \sum_k v_{k,t} \Delta \ln A_{k,t}\,, \tag{2.20}$$

where weights are given by the average shares of each component in the value of capital compensation

$$v_{k,t} = 0.5*(v_{k,t} + v_{k,t-1})\,; \tag{2.21}$$

$$v_{k,t} = (\sum_k p^K{}_{kt} A_{kt})^{-1} p^K{}_{kt} A_{kt}\,, \tag{2.22}$$

with $p^K{}_{kt}$ the price of capital services from asset type k. In this way, aggregation takes into account the widely different marginal products from the heterogeneous stock of assets. Rental prices, or user-cost of capital, equation:

$$p^K{}_{k,t} = p^I{}_{k,t-1} i_t + \partial_k p^I{}_{k,t} - (p^I{}_{k,t} - p^I{}_{k,t-1})\,, \tag{2.23}$$

This formula shows that the rental fee is determined by the i nominal rate of return, $\eth_k$ the rate of economic depreciation, and the asset specific capital gains (Timmer *et al.* 2007).

The rate of depreciation is identical to the rate used in the construction of the capital stock estimates in as in the case of geometric depreciation, the age-

price and age-efficiency profile follow the same geometric pattern (Timmer *et al.* 2007).

Rate of return

The nominal rate of return can be estimated in two different ways. The first is to use the opportunity, or ex-ante, approach, which is based on some exogenous value for the rate of return, for example interest rates on government bonds (Oulton 2007). The second approach is the residual, or ex-post approach, which estimates the internal rate of return as a residual given the value of capital compensation from the national accounts, depreciation and the capital gains. The attractive property of the latter approach is that it ensures complete consistency between income and production accounts. For this reason, an ex post approach is employed. It is assumed that the total value of capital services for each industry equals its compensation for all assets. This procedure yields an internal rate of return which exhausts capital income and is consistent with constant returns to scale. This nominal rate of return is the same for all assets in an industry, but is allowed to vary across industries (Timmer *et al.* 2007).
It is derived as a residual as follows:

$$i_{j,t} = \frac{p^K{}_{j,t}K_{j,t} + \sum_k (p^I{}_{k,j,t} - p^I{}_{k,j,t-1})A_{k,j,t} - \sum_k p^I{}_{k,j,t}\partial_k A_{k,j,t}}{\sum_k p^I{}_{k,j,t-1}\ A_{k,j,t}}, \quad (2.24)$$

where the first term $p^K{}_{j,t}K_{j,t}$, is the capital compensation in industry j, which under constant returns to scale can be derived as value added substracted the compensation of labour (see 2.3.); $p^I{}_{k,j,t}$ – price level of asset in year *t;* $A_{k,j,t}$ – real value of capital asset stock; $\eth_k$ – depreciation rate which differs for different kind of assets.

Labour input

The aim of the labour accounts is to estimate total labour input, so that it reflects the actual changes in the amount and quality of labour input over time. In short, in this thesis the labour force is subdivided into types based on educational attainment. Hereinafter methodology to derive series for labour services is outlined (Timmer *et al.* 2007).

The productivity of various types of labour, such as low-versus high-skilled, will differ. Standard measures of labour input, such as the number of people employed or the hours worked, will not account for such differences. Hence, it is important to have measures of labour input which take the heterogeneity of the labour force into account in analysing productivity and the contribu-

tion of labour to output growth. These measures are called labour services, as they allow for differences in the amount of services delivered per unit of labour. It is further assumed that the flow of labour services for each labour type is proportional to the number of hours worked, and workers are paid their marginal productivities. Hence, the corresponding index of labour services input L is a translog *Tornqvist* quantity index of individual types, indexed by l, and given by

$$\Delta \ln L_t = \sum_l v_{l,t} \Delta \ln H_{l,t}, \tag{2.25}$$

where weights are given by the average shares of each component in the value of labour compensation

$$v_{l,t} = 0.5(v_{l,t} + v_{l,t-1}); \tag{2.26}$$

$$v_{lt} = (\sum_l p^L{}_{lt} H_{lt})^{-1} p^L{}_{lt} H_{lt}, \tag{2.27}$$

with $p^L{}_{kt}$ the price of one hour work of labour type l.

In this way, aggregation takes into account the changing composition of the labour force. Typically, a shift in the share of hours worked by low-skilled workers to high-skilled workers will lead to a growth of labour services, which is bigger than the growth in total hours worked. The author refers to this difference as the labour composition effect (Timmer *et al.* 2007).

Productivity accounts

The following variables capture the contributions of inputs and MFP to value added growth:

$$VA\_Q = \ln \Delta V_{jt}; \tag{2.28}$$

$$VAconH = w^L{}_{jt} \Delta \ln H_{jt}; \tag{2.29}$$

$$VAconLC = w^L{}_{jt} (\Delta L_{jt} - \Delta \ln H_{jt}); \tag{2.30}$$

$$VAconK = w^K{}_{jt} \Delta \ln K_{jt}; \tag{2.31}$$

$$VAconL = w^L{}_{j,t} \Delta \ln L_{jt}; \tag{2.32}$$

$$VAconMFP = \Delta \ln A^V{}_{jt}, \tag{2.33}$$

with $w^K{}_{jt}$ indicating the share of capital in value added, and similarly for labour. VA_Q – logarithmic growth rate of value added; K – capital; L – labour; MFP – multi-factor productivity; H – hours; LC – labour composition.

2.4. Conclusions of Chapter 2

1. The author has systemized industrial labour productivity estimation methods. The groups which have been distinguished are the following:
   1.1. The aggregate productivity growth evaluation method.
      1.1.1. The method uses a standard shift-share analysis. It consists of three parts of hypothesis: structural bonus, structural burden, and the within growth effect. The structural bonus part evaluates the ability of the country to move resources from lower to higher productivity industries. The structural bonus part estimates weather industries maintaining high labour productivity growth rates also expand their share of employment. The last part, the within growth effect, corresponds to the growth in aggregate labour productivity under the assumption that no structural shifts in labour have taken place and each industry has maintained the same share in total employment as in the base year. As productivity has a robust tendency to grow, the within-growth effect is practically a summation of positive contributions only.
      1.1.2. Essentially, it is a purely descriptive technique which attempts to decompose the change of an aggregate into a structural component, reflecting changes in the composition of the aggregate, and changes within the individual units which make up the aggregate. As such, it is closely related to analysis of variance. There are many versions of this methodology, the main difference of them is the choice of base year or weights.
   1.2. Accelerations and decelerations in the aggregate productivity growth evaluation method.
      1.2.1. The method enables to determine the industries which accelerate aggregate productivity.
      1.2.2. Its founders imply that the standard shift-share analysis is inadequate to measure the contribution of industries to accelerations in productivity. This method is focused on estimating the impact of shrinking and expanding industries for aggregate labour productivity growth. The modified shift-share analysis decomposes growth in GDP per worker into improvements within industries and improvements due to the reallocation of labour across industries. In the decomposition, researchers account for surplus labour. Furthermore, expanding sectors only contribute to productivity growth if

their productivity level is higher than the economy's average.

1.3. The growth accounting method.

1.3.1. This is a useful tool, enabling the proximate sources of growth of economies to be estimated. It also provides a consistent structure in which data on output and input can be collected, both across industries and between variables and, as such, is a powerful organising principle.

1.3.2. The method presents the most recent approach towards labour productivity measurement. It enables to decompose the percentage growth rate of value added into the contributions of its determinants and particular labour productivity constituents. The obtained results of method employment enables to accomplish detail economic analysis of industrial labour productivity growth determinants for different economies from a comparative perspective.

1.3.3. The method refers to two GDP accounting approaches: production and income. Production in terms of gross value added estimation as the sum industrial value added. Income in terms of weights determination.

2. Classically, industrial labour productivity is measured as industrial value added per labour input (hour worked). This expression is still used in the databases, e.g. Lithuanian national statistics or Eurostat. Hence, the classical labour productivity measurement veils the constituents of labour productivity.
3. The 1.1 and 1.2 methods measure labour productivity by a classical approach, provided above. Whereas, the 1.3 – the growth accounting method – provides the latest approach towards industrial growth and labour productivity measurement and enables the determinants of value added growth to be obtained. The growth accounting method will be employed in the following section of the thesis.

3

Industrial growth determinants and their impact on economic growth evaluation

3.1. Research methodology formulation

Even though structural economics, the branch of development economics, is widespread in foreign scientific literature, inadequate attention has been paid to this subject by Lithuanian researchers (see 1.3 and 1.5). The importance of labour productivity is emphasised and in economic growth and development theories with their famous economists representatives (see 1.4), and in contemporary approach which is concerned about sustainable development (see 1.5). Moreover, the most relevant method to measure industrial labour productivity is the growth accounting (see the conclusions of the second chapter). As a result, the method provides the latest approach of labour productivity measurement and enables important results for comparative economic analysis to be obtained. Hence, there are more notable reasons for the growth accounting method to be applied in Lithuania's case. Firstly, it is recommended that growth and productivity accounts be composed in the latest European Parliament and Council Regulation for the preparation of National Accounts for European Union (EU) countries (EU Regulation 2013, p. 525). The Lithuania's statistics department only started using this regula-

tion at the beginning of September 2014. In addition, Lithuania's statistics department is not currently working on the composition of growth and productivity accounts. Secondly, the ambiguous WORLD KLEMS and EUKLEMS projects lack comparable growth accounting method results which fulfil the international academic standards for other less developed countries.

The growth accounting methodology newly composed in this thesis enables gross value added (GVA) contributors to be derived, namely the hours worked and particular labour productivity constituents (labour composition (LC), computing equipment (IT), communications equipment (CT), transport equipment (Tr), Other machinery and equipment (OMash), non-residential structures (NResid), residential structures (Resid), intangibles (Intang), multi-factor productivity (MFP)).

Hereinafter in the thesis economic structure will encompass the percentage growth rate of gross value added and its contributors (hours worked and particular labour productivity constituents) for each individual industry, and their aggregation to the percentage growth rate of the gross value added (i.e. their aggregation for the total economy).

In order to obtain comparable results to fulfil international academic standards, there were numerous of methodological aspects which the author had to overcome. The first was to become familiar with the scientific literature, presenting the growth accounting method, and, more specifically, with the relevant research questions under discussion. The second was to establish the relationship between theoretical foundations and their empirical implementation. These foundations rely on the most recent version of the theory of capital which emphasises the concept of capital services instead of traditional capital stock. This concept is the result of applying user cost as a capital measure as developed by Professor Dale Jorgenson (Harvard University), who is the head of the WORLD KLEMS project. Thirdly, in order to implement this new methodology it was necessary to be familiar with the required statistics available. Fourthly, the treatment of all data requires the certain methodological recommendations to be followed. And eventually, consistency checks have to be carried out in order to reassure that obtained results up-to-date international academic standards (see professor's Matilde Mas report on Annex 1). The process of the particular empirical research of present thesis is provided in the Figure 3.1.

Traditional databases such as Eurostat or OECD do not provide the relevant data needed for this research. The key point is that a special set of indicators is needed for the growth accounting method. Moreover, the further (i.e. needed for growth accounts arrangement) indicators (see the Figure 3.1) must be derived from the initial ones (from capital and labour accounts arrangement). More precisely, the growth accounting method requires a special framework and consistency. Firstly, labour and capital inputs have to be prepared. Labour input is

expressed in terms of labour services, and capital – in terms of capital services. The last step is the preparation of growth accounting accounts.

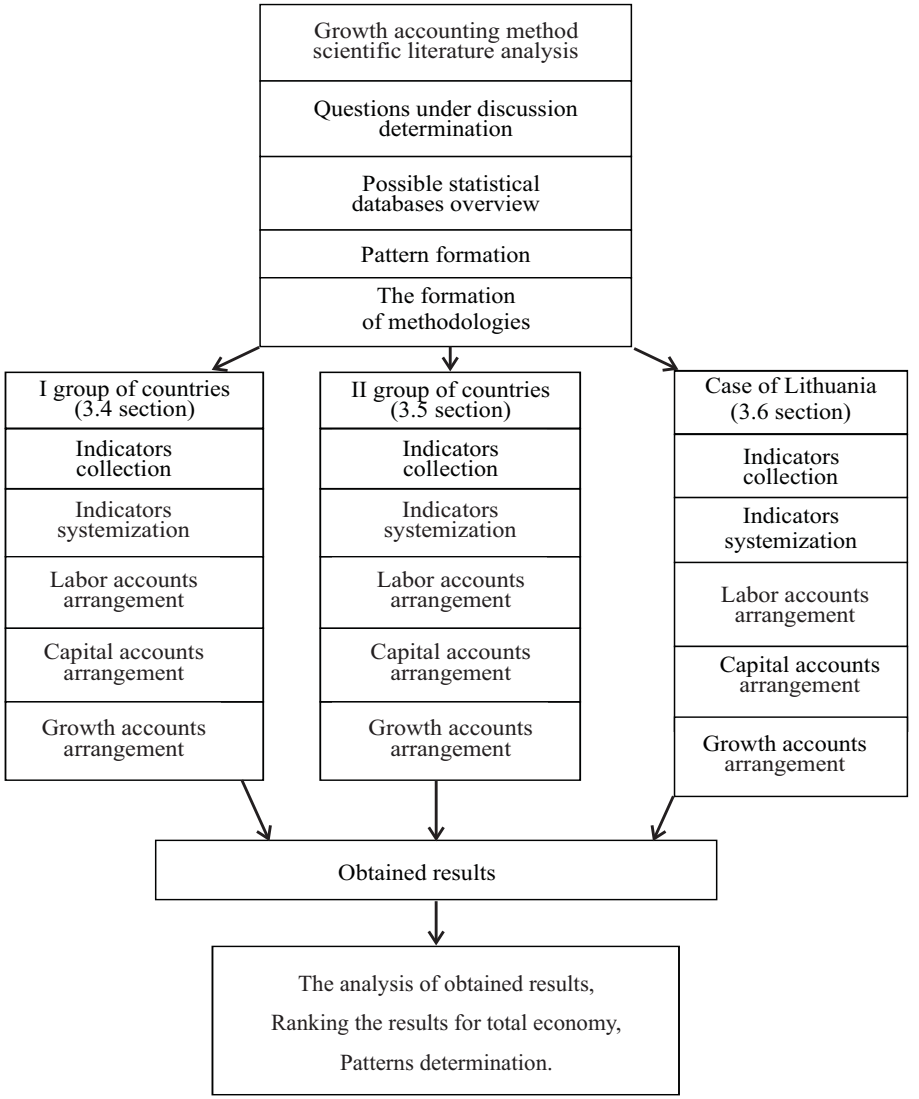


Fig. 3.1. The process of empirical research (the author)

The relevant databases for this research are the following: the EU KLEMS and the WIOD Social economic accounts (Timmer 2012; Gouma *et al.* 2014,

Erumban *et al.* 2012). For the case of Lithuania, initial indicators have been taken from the Lithuania's statistics National accounts department.

The growth accounting methodology proposed in this thesis enables gross value added (GVA) contributors to be derived, namely the hours worked and particular labour productivity constituents (LC, IT, CT, Tr, OMash, NResid, Resid, Int, MFP).

In the initial EU KLEMS method, composed by prof. Dale Jorgenson (Harvard University), the contributions of ICT and non ICT capital groups are estimated to the growth rate of value added (Mas & Javier 2005; Mas *et al.* 2008; Mas & Quesada 2005, Mas *et al.* 2008). In order to obtain detail results needed for comparative economic analysis of differently developed economies in the new methodology of the present thesis, each individual capital asset type contribution (IT, CT, Tr, OMash, NResid, Resid, Int) is evaluated rather than the ICT and nonICT capital groups only.

The main difference between the initial EU KLEMS method and newly composed methodology of the present thesis is provided in Figures 3.2. and 3.3. below.

Each detail capital input is derived by the formulas provided below:

$$VAconIT = w^{IT}{}_{jt}\Delta\ln IT_{jt}; \tag{3.1}$$

$$VAconCT = w^{CT}{}_{jt}\Delta\ln CT_{jt}; \tag{3.2}$$

$$VAconTr = w^{Tr}{}_{jt}\Delta\ln Tr_{jt}; \tag{3.3}$$

$$VAconOMash = w^{OMash}{}_{jt}\Delta\ln OMash_{jt}; \tag{3.4}$$

$$VAconN\,\mathrm{Re}sid = w^{N\,\mathrm{Re}sid}{}_{jt}\Delta\ln N\,\mathrm{Re}sid_{jt}; \tag{3.5}$$

$$VAcon\,\mathrm{Re}sid = w^{\mathrm{Re}sid}{}_{jt}\Delta\ln \mathrm{Re}sid_{jt}; \tag{3.6}$$

$$VAconInt = w^{Int}{}_{jt}\Delta\ln Int_{jt}. \tag{3.7}$$

Intangible capital (Mackevicius 2011) and its contribution has been emphasized as a very important factor in the growth of economies in recent years (Ahmed *et al.* 2015; Chen *et al.* 2015; Corrado *et al.* 2014; Corrado *et al.* 2015). Hence, one more novel perspective of the methodology composed in the present thesis when compared with initial growth accounting method is the estimation of all intangible capital by using the sum of software (Softw) and other intangible (Other) and in such a manner obtaining intangible capital (Int) contribution to industries value added growth. Knowledge based inputs have been a focus of research from different perspectives (Melnikas 2010; Melnikas 2012). In initial EU KLEMS method, the knowledge based inputs were the following: LC, ICT, and MFP. He-

reinafter, in the new methodology of the present thesis, the knowledge based inputs will encompass LC, IT, CT, Int, and MFP.

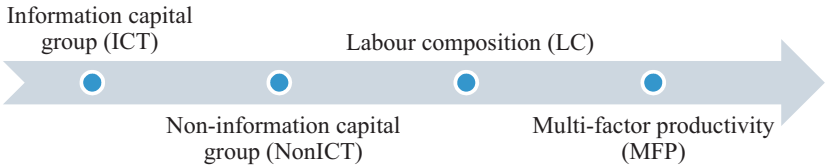


Fig. 3.2. Labour productivity constituents of the initial EU KLEMS method. The group of knowledge based determinants: ICT, LC, MFP (Timmer *et al.* 2007)

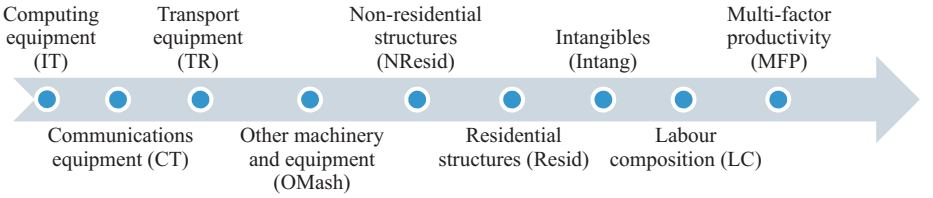


Fig. 3.3. Labour productivity constituents of the newly composed methodology in the present thesis. The group of knowledge based determinants: IT, CT, Int, LC, MFP (compiled by the author with reference to Timmer *et al.*2007)

The newly organised methodology consists of three major parts (see the Figure 3.1)

1. Adjusting the data for each country individually (Australia, the Czech Republic, Denmark, Sweden, the USA) for capital, labour input and derive growth accounting calculations. It is called as methodology for the first group of countries hereinafter in the thesis.
2. Adjusting the data for each country individually (Austria, Finland, Germany, Italy, Japan, the Netherlands, Spain, the UK) for capital, labour input and derive growth accounting calculations. It is called as methodology for the second group of countries hereinafter in the thesis.
3. Adjusting the data for Lithuanian capital and labour input accounts and derive growth accounting results. It is called as methodology for the Lithuanian case hereinafter in the thesis.

3.2. Economic structure pattern

As the relevant data that could be found in databases needed for research, came from the ISIC Rev. 3, ISIC Rev. 4 in the EU KLEMS database and NACE Rev. 2 in the WIOD and Lithuania's statistics department, i.e. from different types of economic activities classifiers and a different number of economic branches provided in them,

in order to obtain comparable results at the industrial level, all data have been aggregated according to pattern. The consistent economic structure pattern, hereinafter the pattern, is a newly organised economic structure which fulfils the differences of different classifiers and their number of economic industries (Table 3.1).

Table 3.1. Economic structure pattern (compiled by the author with reference to the ISIC Rev. 3, ISIC Rev. 4, and NACE Rev. 2 classifiers of the EU KLEMS, the WIOD, and Lithuanian statistics department)

1.	The total economy.
2.	Agriculture, forestry and fishing.
3.	Mining and quarrying.
5.	Manufacture of food products; beverages and tobacco products.
6.	Manufacture of textiles, wearing apparel, leather and related products.
7.	Manufacture of wood, paper, printing and reproduction.
8.	Manufacture of coke and refined petroleum products.
9.	Manufacture of chemicals and chemical products. Manufacture of basic pharmaceutical products and pharmaceutical preparations.
10.	Manufacture of rubber and plastic products and other non-metallic mineral products.
11.	Manufacture of basic metals and fabricated metal products, except machinery and equipment.
12.	Manufacture of computer, electronic and optical products. Manufacture of electrical equipment.
13.	Manufacture of machinery and equipment .e.c..
14.	Manufacture of motor vehicles, trailers, semi-trailers and of other transport equipment.
15.	Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment.
16.	Electricity, gas, steam and air conditioning supply. Water supply; sewerage, waste management and remediation activities.
17.	Construction.
18.	Wholesale and retail trade; repair of motor vehicles and motorcycles.
19.	Transportation and storage.
20.	Accommodation and food service activities.
21.	Publishing, motion picture, video, television programme production. Sound recording, programming and broadcasting activities. Telecommunications; Computer programming, consultancy and information service activities.
22.	Financial and insurance activities.
23.	Real estate activities.

End of Table 3.1

24.	Legal and accounting activities; activities of head offices. Management consultancy activities; architectural and engineering activities. Scientific research and development. Advertising and market research; other professional, scientific and technical activities; veterinary activities. Administrative and support service activities.
25.	Public administration and defence; compulsory social security.
26.	Education.
27.	Human health activities. Residential care activities and social work activities without accommodation.
28.	Arts, entertainment and recreation. Other service activities.

In order to obtain the results, the following points had to be arranged according to pattern: capital input in terms of capital services, labour input data in terms of labour services and the growth accounting procedure. The Excel 2013 package was been used for the calculations.

3.3. Overview of the economies of the countries researched

More developed countries in this research are considered to be those, which have the GVA at basic prices significantly higher than Lithuania's (see Table 3.2). More developed countries have been selected from one point of view, namely that Lithuania's long-term target is to reach the wealth, which these countries have already attained. From another point of view – only the detail capital input indicators for more developed countries, needed for research, are available in the EU KLEMS database. Other less developed countries lack detailed capital input data. Hence, this existed heterogeneity will be diminished with the present thesis.

Table 3.2 shows that the estimations of Lithuania's annual gross value added per inhabitant in euros is significantly lower when compared with the data provided by more developed countries. Moreover, the research performed in the dissertation will enable to determine the proximate sources of growth of those economies.

Table 3.3 indicates real labour productivity measured in classic method as value added created per hour worked in euro.

From the data provided in the Tables 3.2 and 3.3, which come from traditional databases (e.g. Eurostat, OECD, the Lithuanian statistics department) it is not clear, which determinants and how the change of their composition impact the growth of value added and labour productivity of different economies. With the research of the present thesis this existed drawback will be diminished.

Table. 3.2. Economies gross value added per inhabitant at basic prices in euros (Eurostat; OECD)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Australia	22312	23095	24112	25461	26779	27939	29146	30327	31870	33332	35005	37039	38862	39165	40613	41645	43208	43060	
Czech Republic	3900	4500	4600	5100	5100	5600	6400	7500	7600	8100	9200	10400	11500	13400	12200	12900	13300	13100	12700
Denmark	23000	23700	24400	24900	26100	27900	28700	29400	30000	31200	32400	34000	35300	36600	34800	36700	37100	37800	38300
Sweden	19100	21500	22100	22400	24000	26600	25000	26200	27300	28500	28900	30700	32400	31700	27400	32600	35700	37600	38500
USA	28749	30033	31538	32913	34585	36419	37240	38122	39606	41857	44237	46369	47987	48330	46930	48307	49732	51435	52985
Austria	20700	20800	20700	21500	22400	23400	24100	24700	25100	25900	26900	28400	29900	30800	29900	30800	32300	32900	33500
Finland	17100	17200	18200	19500	20500	22200	23500	24100	24200	25400	26100	27300	29700	30600	28100	29000	30200	30500	30500
Germany	21400	21200	21000	21500	21900	22400	23000	23300	23400	24000	24300	25300	26500	27000	25900	27300	28600	29100	29900
Italy	13700	15900	16700	17200	17800	18800	19800	20500	21000	21600	22000	22600	23400	23700	22700	23000	23300	23000	22900
Japan	22945	23922	24660	24363	24615	25938	26564	27251	27963	29384	30446	31797	33320	33500	31875	33760	34312	35317	
Netherlands	18700	19000	19600	20500	21800	23500	24800	25700	26200	26800	28000	29300	31000	32100	30900	31600	32100	32100	32100
Spain	10700	11400	11700	12300	13100	14100	15200	16000	16800	17700	18700	19900	21100	21900	21200	20700	20800	20500	20300
United Kingdom	13900	15100	18700	20100	21500	24400	25000	25800	24900	26600	27700	29200	30500	26800	23300	24900	25000	26700	26200
Lithuania	1300	1700	2200	2500	2600	3200	3500	3900	4300	4900	5700	6700	8000	9100	7600	8000	9200	10000	10500

Table 3.3. Real labour productivity per hour worked in euros (Eurostat; OECD)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Australia	20	21	22	23	24	25	27	28	29	30	31	32	34	34	36	37	38	39	40
Czech Republic	8	9	9	9	9	9	10	10	11	11	12	12	13	13	13	13	13	13	13
Denmark	45	46	47	47	47	48	48	48	49	51	51	52	52	51	50	52	53	53	53
Sweden	32	33	34	35	36	37	37	39	40	42	43	44	44	43	42	44	44	45	46
USA	25	26	27	28	29	31	32	33	35	37	39	40	42	43	45	46	48	49	50
Austria	31	31	31	32	33	34	34	35	35	35	36	37	38	38	38	39	39	40	40
Finland	30	31	32	33	33	34	35	36	36	38	38	40	41	40	38	39	40	40	40
Germany	34	35	36	36	36	37	38	39	39	39	40	41	42	42	41	42	42	43	43
Italy	31	31	31	31	31	32	32	32	32	32	32	33	33	32	32	33	33	32	32
Japan	17	18	18	19	20	21	21	22	23	24	25	26	27	28	28	29	30	30	31
Netherlands	38	38	39	40	41	41	42	42	42	44	45	46	46	46	45	46	46	46	46
Spain	27	27	27	27	27	27	27	27	28	28	28	28	29	29	29	30	30	32	32
United Kingdom	30	31	32	33	33	35	35	36	37	38	39	40	40	40	39	40	40	39	39
Lithuania	5	5	5	5	6	6	6	7	7	8	8	8	9	9	8	9	10	10	11

3.4. Methodology for the first group of countries

In the case of the first group of countries data for capital input could be found in the ISIC Rev. 3 November 2009 Release; updated March 2011 in the EU KLEMS database. The selection of countries for this group depends on the avai-

lability of detailed capital input data which can be found there. Some of countries lack detailed capital input data, this is the reason why they have not been included in this research. Other possible countries such as Finland and Spain have not been selected in this part, as their updated data could be found in the ISIC Rev. 4 rolling updates in the EU KLEMS, and will, therefore, be used in the second group. The period, for which data can be obtained, is 1995–2007 for this first group of countries.

For the capital input data for each country of this group, the following steps were accomplished. Firstly, capital investment (or gross fixed capital formation) (GFCF) and stock estimates (Stock) of Software (Softw) were added to Other intangible (Other) capital. In such a way estimates of all intangible capital (Int) were derived for all industries over researched period. Then the nominal (nom GFCF) and real investment (real GFCF), and capital stock (Stock) data were adjusted to this pattern. Price levels for the newly organised economic structure pattern were recalculated accordingly: nom GFCF divided by real GFCF for each of type of asset. In such a manner the price level for the each of asset type was derived, with 1995 being taken as a reference. In case that the economic structure was adjusted according to pattern, a new industry rate of return indicators were calculated. The author calculated these using the formula (2.24). Where appropriate the author took the CAP indicator from the WIOD database and adjusted it to the pattern. Prices are taken as newly counted capital assets price levels. Depreciation for each of asset type as provided in capital input data from the EU KLEMS and is adjusted to pattern.

Capital stock estimates were taken as real capital stock adjusted to a pattern. Then new capital compensation estimates for each type of assets were calculated with new industry rate of return estimates using the (2.23) and (2.22) formulas. At this point it was important to ensure that the calculations had been carried out correctly-the sum of capital compensation estimates of the obtained detailed assets have to coincide with the CAP used in the rate of return calculation at the industrial level. Once capital compensation for each asset type had been calculated, the next step was to derive the part of each type of asset in the whole capital compensation part for the period researched – capital of individual asset compensation divided by all CAP (i.e. the sum of all asset types CAP). The sum of all capital asset type parts had to be equal to 1.

For labour input the author decided to use decomposition according to labour educational attainment (share of highly-skilled, medium-skilled, and low-skilled in total) as it is the most relevant approach from productivity perspective. Variables for labour input data were selected from the WIOD database (parts of labour compensation and hours worked by highly-skilled, medium skilled, low-skilled labour in total values). Those estimates were aggregated according to

pattern. After adjustment, it was important to make sure that each of the new estimates (separately compensation and hours worked) summed to one.

Table 3.4. Depreciation rates for types of assets at industrial level adjusted to pattern (compiled by the author with reference to Timmer *et al.* 2007)

Capital type	Computing equipment (IT)	Communica-tions equipment (CT)	Transport equipment (TR)	Other machinery and equipment (OMash)	Non-residential structures (NResid)	Residential structures (Resid)	Intangibles (Intang)
1.TOTAL							
2.	0.315	0.115	0.170	0.129	0.024	0.011	0.315
3.	0.315	0.115	0.170	0.129	0.024	0.011	0.315
5.	0.315	0.115	0.168	0.109	0.033	0.011	0.315
6.	0.315	0.115	0.184	0.109	0.033	0.011	0.315
7.	0.315	0.115	0.173	0.106	0.033	0.011	0.315
8.	0.315	0.115	0.154	0.110	0.032	0.011	0.315
9.	0.315	0.115	0.181	0.104	0.033	0.011	0.315
10.	0.315	0.115	0.191	0.112	0.033	0.011	0.315
11.	0.315	0.115	0.169	0.106	0.033	0.011	0.315
12.	0.315	0.115	0.166	0.108	0.033	0.011	0.315
13.	0.315	0.115	0.170	0.107	0.033	0.011	0.315
14.	0.315	0.115	0.167	0.109	0.033	0.011	0.315
15.	0.315	0.115	0.193	0.113	0.033	0.011	0.315
16.	0.315	0.115	0.191	0.094	0.023	0.011	0.315
17.	0.315	0.115	0.195	0.139	0.034	0.011	0.315
18.	0.315	0.115	0.216	0.133	0.030	0.011	0.315
19.	0.315	0.115	0.146	0.107	0.027	0.011	0.315
20.	0.315	0.115	0.203	0.140	0.028	0.011	0.315
21.	0.315	0.115	0.176	0.115	0.035	0.011	0.315
22.	0.315	0.115	0.187	0.149	0.044	0.011	0.315
23.	0.315	0.115	0.227	0.147	0.027	0.011	0.315
24.	0.315	0.115	0.155	0.144	0.044	0.011	0.315
25.	0.315	0.115	0.173	0.138	0.025	0.011	0.315
26.	0.315	0.115	0.173	0.138	0.025	0.011	0.315
27.	0.315	0.115	0.225	0.149	0.027	0.011	0.315
28.	0.315	0.115	0.223	0.136	0.051	0.011	0.315

The next step was to obtain the labour service volume, which would be needed for the growth accounting procedure. The growth rate of labour composition was expressed as the Tornqvist real growth rate.

The Tornqvist index was needed in the elaboration of assets and sectors aggregations. This index combines percentage structure and the growth rates of volume index (Timmer *et al.* 2007).

Imagine one economy T with 2 industries: A and B.

The Tornqvist real growth rate for total economy GVA in t (GT_t) needs to be calculated as follows:

$$GT_t = \left[0.5 \times (A_t / T_t + A_{t-1} / T_{t-1}) \times (\ln(A_t) - \ln(A_{t-1})\right] + \left[0.5 \times (B_t / T_t + B_{t-1} / T_{t-1}) \times (\ln(B_t) - \ln(B_{t-1})\right]. \quad (3.8)$$

Where the first part: $0.5\times(A_t/T_t+A_{t-1}/T_{t-1})$ or $0.5\times(B_t/T_t+B_{t-1}/T_{t-1})$ is the two periods the nominal GVA average share of each industry in the total economy (T), the second part $\ln(A_t) - \ln(A_{t-1})$ or $\ln(B_t) - \ln(B_{t-1})$ is the real growth rate of each industry.

The volume index (I) can be obtained following:

$$I_t = 100; I_{t+1} = I_t \times \exp(GT_{t+1}); I_{t+2} = I_{t+1} \times \exp\left(GT_{t+2}\right). \quad (3.9)$$

Exp(x) is an excel function: returns e raised to the power of number: e^x, i.e EXP is the inverse of LN, the natural logarithm of number.

By using the (3.8) formula the growth rate of labour composition was calculated. Then the labour composition volume was obtained using the (3.9) formula at the industrial level.

The annual growth rate of labour services was obtained by the sum of two components: the annual growth rate of hours worked and the annual growth rate of the labour composition change. The labour service volume was then obtained using the (3.9) formula.

The contribution of individual asset types to the total capital growth rate was calculated. The growth rate for this (individual) asset is only the difference between two period logarithms and so the (3.9) formula was used in that case.

For the growth accounting calculations the author needed the real growth rate of each input and its share of the nominal value added. Therefore, the labour service real growth rate had to be calculated. Capital input volumes of different asset types had to be taken and their real growth rates calculated. Moreover, it was important to make sure that the shares of the CAP and LAB in the nominal VA summed to one. In addition, each detail capital input share of capital had to be multiplied by the CAP part in value added of an industry, in such a manner that each detail capital input compensation part was derived. VA real growth rates were calculated. Then each input contribution to VA was calculated using the (2.28)–(2.33) formulas. VaConK was derived as the sum of the contributions

of each asset (i.e. summing the estimates derived using the (3.1)-(3.7) formulas to avoid differences. Finally, the VaConMFP was obtained using the (2.33) formula. All the growth rates of the variables in the growth accounting calculations are always real rates and shares in remunerations come from nominal value added.

The growth rate for the total economy and other aggregations were recalculated, and so hereinafter, the results will be provided not at the industrial level, but for the total economy. The aggregated industry (hereinafter the total economy) was obtained taking into account each industry and/or asset, i.e. if one prefers to obtain real growth rate of GVA for total economy, the shares and real growth rates of each industry should be taken into account, in this case 27 industries. To obtain the growth rate for total economy author needed the shares (each industry in total) and real growth rate by industry. The weights used were always VA shares: each individual sectorial growth rate multiplied by the VA share average.

In short, in the growth rate calculations for the total economy the author used the growth rate of each industry in all the variables in the total of this variable. In contribution calculations for the total economy, the weights are always the average period VA shares in all variables (employment, capital, etc.) multiplied by the individual sectorial contribution.

When all the calculations for the total economy had been accomplished, the following method was used to ensure that these results were correct. The result from VA_Q subtracting VaConH, subtracting VAConLC, and subtracting VAConK (i.e MFPconVA) for the total economy had to coincide (i.e to be equal) with the estimation of MFP for total economy using the new methodology as LC, K... (the sum of each industrial average period share of VA multiplied by sectorial MFP).

3.5. Methodology for the second group of countries

For the second group of countries (Austria, Finland, Germany, Italy, Japan, the Netherlands, Spain, and the UK) capital input data could be found in ISIC Rev. 4 rolling updates in the EU KLEMS database and were available for 1995 – 2009 year period. The difference between this group and the first group of countries is that the capital input for asset types is expressed in terms of volume indexes (OECD 2001; OECD 2009). Those volume indexes have been adjusted to pattern and their growth rates calculated. Capital compensation data for all and asset types were adjusted to pattern. Each part of an asset in the entire CAP was calculated by dividing each CAP detail by SUM CAP. SUM CAP was used as CAP in growth accounting calculations, and by using the following methodology LAB was derived (VA minus CAP).

As it was indicated above for labour input author decided to calculate decomposition according to labour educational attainment (the share of highly-skilled, medium-skilled, and low-skilled workers in total) as it is the most relevant approach from a productivity perspective. Variables for the labour input data were selected from the WIOD database (labour compensation and hours worked by highly-skilled, medium-skilled, and low-skilled workers). Those estimates were aggregated according to pattern. After adjustment, it was important to make sure that each of the new estimates (and compensation, and hours worked) summed to one.

The next step was to obtain the labour service volume, which is needed for growth accounting procedure. The growth rate of labour composition was expressed as a Tornqvist real growth rate.

The Tornqvist index was needed in the elaboration of assets and sectors aggregations. The index combines the percentage structure and growth rates of the volume index (Timmer *et al.* 2007).

By using the (3.8) formula the growth rate of labour composition was calculated. The labour composition volume was then obtained using the (3.9) formula at the industrial level.

The annual growth rate of labour services was obtained by the sum of two components: the annual growth rate of hours worked and the annual growth rate of the labour composition change. The labour service volume was then obtained using the (3.9) formula.

The contribution of individual asset types to the total capital growth rate have was calculated. The growth rate for this (individual) asset is only the difference between the two period logarithms and the (3.9) formula was used in that case.

For growth accounting calculations the author needed the real growth rate of each input and its share of the nominal value added. Therefore, the labour service real growth rate had to be calculated. The capital input volumes of different asset types were taken and their real growth rates calculated. Moreover, it was important to make sure that the shares of CAP and LAB in the nominal VA summed to one. In addition, each detailed capital input share of capital had to be multiplied by the CAP part in the value added of an industry, in such a manner that each detail capital input compensation part was derived. The VA real growth rates were calculated. The contribution of each input to VA was calculated using the (2.28)–(2.33) formulas. VaConK was derived as the sum of contributions of each asset (i.e. summing the estimates derived using the (3.1)–(3.7) formulas in order to avoid differences. Finally, VaConTFP was obtained using the (2.33) formula. All the growth rates of the variables in the growth accounting calculations are always real rates and their shares in remunerations come from the nominal value added.

The growth rate for the total economy and other aggregations were recalculated. Therefore, hereinafter, the results will be provided not at the industrial level, but for the total economy. The aggregated industry (hereinafter the total economy) was obtained taking into account each industry and/or asset, i.e. if one prefers to obtain real growth rate of GVA for total economy, the shares and real growth rates of each industry should be taken into account, in this case 27 industries. To obtain the growth rate for the total economy author needed the shares (each industry in total) and the real growth rate by industry. The weights used were always VA shares: each individual sectorial growth rate multiplied by the VA share average.

In short, for the growth rate calculations for the total economy the author used the growth rate of each industry and the average period shares of each industry in the total of this variable for each of the variables. In contribution calculations for the total economy, the weights were always the average period VA shares in all variables (employment, capital, etc.) multiplied by the individual sectorial contribution.

When all the calculations for the total economy had been accomplished, the following method was used to ensure that these results were correct. The result from VA_Q subtracting VaConH, subtracting VAConLC, and subtracting VAConK (i.e MFPconVA) for the total economy had to coincide (i.e to be equal) with the estimation of MFP for total economy using the new methodology as LC, K... (the sum of each industrial average period share of VA multiplied by sectorial MFP).

3.6. Methodology for the Lithuanian case

The third case is that of Lithuania. In order to obtain comparable results, the consistency is of vital importance. Moreover, in the case of Lithuania there needs to be special accuracy, as some of data, i.e. capital services, has to be constructed as Lithuania's statistics department does provide this indicator.

The author used capital input data as a starting point. GFCF investment data at nominal and chain linked volumes (CLVL), and nominal capital stock estimates were taken according to the following their codes of Council Regulation (EC) No. 2223/96 ESA' 95 asset classifier (IT (T111321), CT (T111322), Tr (T11131), Resid (T1111), NResid (T1112), Int (T112) from Lithuania's statistics department at the NACE Rev. 2, 38 economy branches for the 1995–2009 research period. OMash were been derived using (T11132 – T111321 – T111322 – T11131), i.e. from all transport and equipment subtracting IT, CT, and TR. All assets were then aggregated to pattern. Price levels for detailed asset types have been obtained following the initial methodology: dividing GFCF values at nominal values by chain linked volu-

me (CLVL) estimates. Those price levels were used in the industry rate of return, individual asset type's capital compensation estimates and for real stock estimates from nominal to derive. CAP compensation data for each industry for the period researched were calculated using the procedure provided below. As following the initial growth accounting methodological aspects: VA is equal for the sum of LAB and CAP. LAB estimates come from wages of employees and CAP comes from gross operating surplus (GOS) adjusted to self-employed income. To derive those estimates the author took the number of hours worked by engaged people, divided it by the total hours worked by employed persons and multiplied the estimate from the compensation of employees. Estimates came from Lithuanian statistics department. LAB and CAP estimates were subtracted from the VA values at industrial level. The values were adjusted to pattern. This methodology needs to be consistent, and so the CAP values derived had to be used for industry rates of return using the (2.24) formula. Using the (2.23) and (2.22) formula the author obtained capital compensation data for asset types at the industrial level. It was important to obtain detailed asset capital type shares in the total value of compensation for the growth accounting procedure and volumes for each of the detailed assets. The labour input data hours worked by people engaged were taken from National accounts, and adjusted to pattern. For the shares of compensation according to educational attainment, the author took them from the WIOD and adjusted them to pattern.

The next step was to obtain labour service volume, which is needed for the growth accounting procedure. The growth rate of labour composition is expressed as the Tornqvist real growth rate.

As a result, using the (3.8) formula the growth rate of labour composition was calculated. Then the labour composition volume was obtained using the (3.9) formula at the industrial level, i.e. pattern.

The annual growth rate of labour services was obtained by the sum of two components: the annual growth rate of hours worked and the annual growth rate of labour composition change. The labour service volume was then obtained using the (3.9) formula.

The contribution of individual asset types to the total capital growth was calculated. The growth rate for this (individual) asset is only the difference between the two period logarithms and the (3.9) formula was used in that case.

For growth accounting calculations the author needed the real growth rate of each input and its share of the nominal value added. So, the labour service real growth rate had to be calculated. From capital input volumes of different asset types had to be taken and their real growth rates calculated. Moreover, it was important to make sure that the shares of CAP and LAB in nominal VA summed to one. In addition, each detail capital input share of capital had to be multiplied by the CAP part in the value added of an industry, each detail capital input compensation part was derived in such a manner. VA real growth rates were calculated. The contribution of each input to the VA were calculated using the (2.26)–(2.31) for-

mulas. The VaConK was derived as sum of the contributions of each asset (i.e. summing the estimates derived using the (3.1)–(3.7) formulas to avoid differences). Finally, the VaConTFP was obtained using the (2.1) formula. All the growth rates for the variables in the growth accounting calculations are always the real rates and the shares in remunerations come from the nominal value added.

The growth rate for the total economy and other aggregations were recalculated, and hereinafter, the results will be provided not at the industrial level, but for the total economy. Figures for aggregated industry (hereinafter the total economy) were obtained taking into account each industry and/or asset, i.e. if one prefers to obtain the real growth rate of GVA for the total economy, the shares and real growth rates of each industry should be taken into account, in this case for 27 industries (according pattern). To obtain the growth rate for the total economy the author needed the shares (for each industry in total) and the real growth rate by industry. The weights used were always VA shares: each individual sectorial growth rate multiplied by the average VA share.

In brief, in the growth rate calculations for the total for all the possible variables the author used the growth rate of each industry and the average period shares of each industry in the total for this variable. For the calculation of their contribution for the total economy, the weights are always the average period VA shares for all variables (employment, capital, etc.) multiplied by their individual sectorial contribution.

When all the calculations for the total economy had been accomplished, the following method was used to ensure that these results were correct. The result from VA_Q subtracting VaConH, subtracting VAConLC, and subtracting VAConK (i.e MFPconVA) for the total economy had to coincide (i.e to be equal) with the estimation of MFP for total economy using the new methodology as LC, K... (the sum of each industrial average period share of VA multiplied by sectorial MFP).

After estimates for all countries for the period researched had been derived, the last results have been obtained.

3.7. The results of the research

The results of the new methodology application for the total economies of countries researched are provided in two tables below. In the Table 3.5 all the labour productivity constituents (LC, IT, CT, TR, OMash, NResid, Resid, Int, MFP), sum to labour productivity, and they are expressed in percentage points. GVA growth is the sum of the contributions of the hours worked (Contr H) and labour productivity (Contr LP). As our special area of interest is Lithuania, the figures for this country have been provided in the first line of the tables below. Special attention has been paid to the following labour productivity constituents: LC, IT,

CT, Int, and MFP, the sum of which is considered to a contribution of knowledge based determinants (Contr Knowld) to the growth rates of economies.

Table 3.5. The average annual growth rate of gross value added (GVA growth) (in percentage points) for the total economies is reflected by the contributions of hours worked (Contr H) and labour productivity (Contr LP); detailed labour productivity constituents (LP = 100 % with contributions of: labour composition (Contr LC), computing equipment (Contr IT), communications equipment (Contr CT), transport equipment (Contr TR), other machinery and equipment (Contr OMash), non-residential structures (Contr NResid), residential structures (Contr Resid), intangibles (Contr Intang), multi-factor productivity (Contr MFP)) and knowledge capital input (Contr Knowld) are expressed in percentage points; for Australia, the Czech Republic, Denmark, and the USA the research period is 1995–2007, for Austria, Finland, Germany, Italy, Japan, the Netherlands, Spain, the UK, and Lithuania – 1995–2009

Countries	GVA growth	Contr H	Contr LP	**Contr LC**	**Contr IT**	**Contr CT**	Contr TR	Contr OMash	Contr NResid	Contr Resid	**Contr Intang**	**Contr MFP**	**Contr Knowld**
1. Lithuania	4.5	– 0.1	**4.5**	2	3	3	13	28	31	1	3	16	**27**
2. Sweden	3.2	0.5	**2.7**	9	8	3	4	25	5	1	7	39	**65**
3. Australia	3.5	1.2	**2.3**	7	26	3	6	12	14	1	11	19	**67**
4. UK	2.3	0.3	**2.1**	17	22	2	2	5	15	1	4	32	**77**
5. Finland	2.5	0.5	**2.0**	5	5	4	1	5	6	– 1	9	67	**89**
6. USA	2.4	0.7	**1.7**	9	25	8	8	11	13	2	18	5	**66**
7. Netehrlands	2.3	0.6	**1.7**	14	20	2	6	4	9	3	14	29	**79**
8. Austria	2.0	0.5	**1.5**	12	15	2	6	– 4	13	2	5	48	**83**
9. Germany	1.2	– 0.3	**1.5**	11	17	2	8	9	7	1	14	33	**76**
10. Spain	2.9	1.4	**1.5**	20	13	8	15	24	38	28	5	– 52	**– 5**
11. Denmark	1.9	0.7	**1.2**	3	44	1	5	14	3	9	33	– 12	**69**
12. Japan	0.4	– 0.7	**1.1**	13	13	3	3	10	5	1	10	41	**81**
13. Italy	0.8	0.3	**0.5**	42	34	7	21	44	47	1	9	– 105	**– 13**
14. Czech Republic	2.8	0.0	**2.8**	4	15	3	13	23	15	6	– 4	25	**42**

In the Table 3.6 labour productivity contributors to the growth rate of value added have been ranked. The highest contributor obtained a value of 1 and the lowest value was 9 accordingly. LP is the sum of to the contributions of hours worked (Contr H) and labour productivity (Contr LP).

Table 3.6. Ranked labour productivity contributors for the total economies (contributions of: labour composition (Contr LC), computing equipment (Contr IT), communications equipment (Contr CT), transport equipment (Contr TR), other machinery and equipment (Contr OMash), non-residential structures (Contr NResid), residential structures (Contr Resid), intangibles (Contr Intang), multi-factor productivity (Contr MFP)); the highest contributor obtained a value of 1, and relatively the lowest 9; for Australia, the Czech Republic, Denmark, and the USA the research period is 1995–2007, for Austria, Finland, Germany, Italy, Japan, the Netherlands, Spain, the UK, and Lithuania 1995–2009

Countries	GVA growth	Contr H	Contr LP	**Contr LC**	**Contr IT**	**Contr CT**	Contr TR	Contr OMash	Contr NResid	Contr Resid	**Contr Intang**	**Contr MFP**
1. Lithuania	4.46	– 0.05	4.51	8	6	7	4	2	1	9	5	3
2. Sweden	3.19	0.46	2.73	3	4	8	7	2	6	9	5	1
3. Australia	3.46	1.15	2.31	6	1	8	7	4	3	9	5	2
4. UK	2.33	0.27	2.06	3	2	8	7	5	4	9	6	1
5. Finland	2.51	0.52	1.99	6	5	7	8	4	3	9	2	1
6. USA	2.40	0.69	1.71	5	1	7	6	4	3	9	2	8
7. Netehrlands	2.25	0.58	1.68	4	2	9	6	7	5	8	3	1
8. Austria	2.04	0.50	1.54	4	2	7	5	9	3	8	6	1
9. Germany	1.16	– 0.29	1.46	4	2	8	6	5	7	9	3	1
10. Spain	2.86	1.41	1.45	4	6	7	5	3	1	2	8	9
11. Denmark	1.93	0.75	1.18	7	1	8	5	3	6	4	2	9
12. Japan	0.39	– 0.70	1.09	2	3	7	8	5	6	9	4	1
13. Italy	0.78	0.28	0.50	3	4	7	5	2	1	8	6	9
14. Czech Republic	2.80	– 0.01	2.81	7	4	8	5	2	3	6	9	1

3.8. Conclusions of Chapter 3

1. The methodological problems that author had faced while applying the growth accounting method for Lithuania, seeking to derive comparable, fulfilling results which comply with international academic standards are the following: the specific questions under discussion had to be combined after a scientific analysis of relevant literature; the economic structure pattern had to be accomplished by combining different economic branch classifiers; the possible statistics had to be gathered and the further ones derived; methodologies for three groups of countries then had to be composed. Lithuania's case required special accuracy and attention.
2. The results of the empirically tested methodology showed that despite the highest Lithuania's average labour productivity growth rate compared

with more developed countries during the 1995–2009 research period, the sum of Lithuania's knowledge based contributors (i.e. labour composition (Contr LC), IT capital (Contr IT), communications equipment (Contr CT), intangibles (Contr Intang) and multifactor productivity (Contr MFP)) to labour productivity growth for the total economy is significantly lower compared to more developed countries – only 27%. The share of the more developed countries is undoubtedly much higher: Finland was the highest (89%), followed by Austria (83%), Japan (81%), the Netherlands (79%), the UK (77%), Germany (76%), Denmark (69%), Australia (67%), the USA (66%), Sweden (65%), and the Czech Republic (42%). Negative values were recorded for economies of Spain and Italy.

3. Ranked labour productivity constituents provided the following results:
   3.1. The highest contributors to Lithuania's labour productivity growth for the total economy is Contr NResid and Contr OMash (none come from knowledge based determinants).
   3.2. On the contrary, the both primary contributors of knowledge based determinants are of the following more developed countries: Australia, the UK, Finland, USA, the Netherlands, Austria, Germany, Denmark. Except Spain's and Italy's cases.
   3.3. Consequently, a consistent pattern of knowledge based determinants impact on economic growth of more developed countries can be indicated. Therefore, knowledge based determinants can be stated as proximate driving forces of those economies.
4. The research results provided a well noticed oneness of Lithuania's case in the context of more developed countries through the period researched.

General conclusions

1. Economic structure in the present thesis embraces the composition of growth determinants of each industry and their aggregation to the growth of the gross value added.
2. Industrial performance in the structure of economy encompasses the following concepts: growth, development, transformation, and structural changes. The latter is most generally used in contemporary scientific literature.
3. Classically industrial labour productivity is measured as value added per labour input (hours worked). This expression is still used in databases, e.g. Lithuania's statistics department or Eurostat. Hence, the classical labour productivity measurement does not reveal the constituents of labour productivity.
4. Systemized labour productivity estimation methods in the economic structure enabled to distinguish the following their groups:
   3.1. The aggregate productivity growth evaluation method. The method estimates industrial performance in the structure of economy by three parts of hypothesis and how their summation effects the growth of aggregate productivity.

3.2. Accelerations and decelerations in the aggregate productivity growth evaluation method. The method estimates which industries accelerate the aggregate productivity.

The 4.1 and 4.2 methods measure labour productivity with reference to classical approach, i.e. value added per hour worked.

3.3. The growth accounting method.

The method presents the most recent approach towards industrial labour productivity measurement. It enables to decompose the percentage growth rate of value added into the contributions of hours worked and labour productivity, and particular labour productivity constituents. The obtained results of method employment enable to accomplish detail economic analysis of growth determinants of differently developed economies from a comparative perspective. It also provides a consistent economic structure in which data on input and output can be collected, both across industries and between variables and, as such, is a powerful organising principle.

4. The scientific problem of the present thesis is that classical measurement of labour productivity does not reveal the constituents of labour productivity and lack of methodologies, enabling to estimate the composition of economic growth determinants and their impact for the growth of the total economy.
5. In order to solve the problem, the grounded methodology in this thesis enables gross value added (GVA) determinants to be derived, namely the hours worked and particular labour productivity constituents (labour composition (Contr LC), computing equipment (Contr IT), communications equipment (Contr CT), transport equipment (Contr Tr), other machinery and equipment (Contr OMash), non-residential structures (Contr NResid), residential structures (Contr Resid), intangibles (Contr Intang)). The proposed new methodology is appropriate for each country, purposed to estimate economic structure growth determinants, i.e. the contributors to value added and labour productivity.
6. The research provided actual results and the following recommendations for the Lithuanian case:
   6.1. The estimation of determinants composition affecting the growth rate of value added revealed the primary growth determinants of Lithuanian economic structure. It was obtained that none of them correspond to the knowledge based determinants. On the contrary, in most of more developed countries the primary contributors to growth come from knowledge based determinants.
   6.2. The change of determinants composition significance impacting different types of economies growth has been revealed: the higher level of development, the more impact is provided by the

knowledge based determinants. But their full potential is obtained after the creation of relevant infrastructure for economic development.

6.3. Lithuania is only at the stadium of its infrastructure for economic development creation. In order to accelerate its economic development, we should create infrastructure, and together encourage the determinants of computer, communications equipment, intangible capital, multifactor productivity, and labour composition.

7. In the present thesis grounded new labour productivity indicators, labour productivity constituents, present a more in depth perspective its measurement, and, therefore, complement indicators provided by Lithuanian national statistics and Eurostat.
8. In the present thesis motivated new attitude enables to estimate economic growth determinants and the impact of their composition for the growth of the total economy.
9. In the present thesis reasoned new attitude estimates the proximate sources of growth of different economies. Its implication for less developed country decreased the heterogeneity of the issue.
10. Many other factors not only inputs to production can determine the growth of industries and total economy, e.g. macroeconomic conditions, demand side factors, market structure, openness and barriers to trade, etc. The proposed methodology focuses on inputs to production (but land is not included).

    It is merely a descriptive method and says nothing about causality.
11. The following practical implementation difficulties of the methodology could be distinguished: a wide range of detail indicators are needed; due to its wide scope the most recent data are not available; the calculations are long-lasting followed by consistency checks and certain methodological recommendations.

References

Ahmed, B.; Tsutomu, M. 2015. Intangibles, market failure, and innovation performance. Springer: Springer international publishing Switzerland, pp. 1–30.

Andersen, E. S. 2001. Satiation in an evolutionary model of structural economic dynamics, *Journal of Evolutionary Economics* 11(1): 143–164.

Aulin-Ahmavaara, P.; Pakarinen, P. 2007. Integrated industry and economy-wide TFP measures with different prices in different uses, *Economic Systems Research* 19(3): 253–276.

Bah, M. E.; Brada, J. C. 2009. Total factor productivity growth, structural change and convergence in the new members of the European Union, *Comparative Economic Studies* 51: 421–446.

Balciunas, N. 2000. Lithuanian industry sector implementation priorities and necessary economic, social and financial basement for country supported programs planning, *Organization Theory: Systemic Researches* 7–17.

Balkyte, A.; Tvaronaviciene, M. 2010. Perception of competitiveness in the context of sustainable development: facets of "Sustainable competitiveness", *Journal of Business Economics and Management* 11(2): 341–365.

Balkyte, A.; Tvaronaviciene, M. 2011.The role of migration for sustainable developing economy: Lithuania in the EU Context, *Journal of Security and Sustainability Issues* 1(2): 133–145.

Blanchard, O. 2007. Macroeconomics, fourth edition. Pearson Education, Inc. Upper Saddle River: New Jersey, 07458, pp.75–83. ISBN 978–9986–16–545–3.

Bond, S.; Leblebiciog, A. L; Schiantarelli, F. 2010. Capital accumulation and growth: a new look at the empirical evidence, *Journal of Applied Econometrics* 25: 1073–1099.

Bosworth, B.; Collins, S. M. 2008. Accounting for growth: comparing China and India, *Journal of Economic Perspectives* 22(1): 45–66.

Bogliacinoa, F.; Piantac. M. 2011. Engines of growth. Innovation and productivity in industry groups, *Structural Change and Economic Dynamics* 22: 41–53.

Botta, A. 2009. A structuralist North–South model on structural change, economic growth and catching-up, *Structural Change and Economic Dynamics* 20: 61–73.

Broersma, L.; Moergastel, T. 2007. A shortcut method for generating time series of input data for productivity analysis, *Economic Systems Research* 19(3): 277–293.

Broadberry, S. N. 1995. Comparative productivity levels in manufacturing since the industrial revolution: lessons from Britain, America, Germany and Japan, *Structural Change and Economic Dynamics* 6: 71–95.

Broadberry, S.; Ghosal, S. 2005. Technology, organization and productivity performance in services: lessons from Britain and the United States since 1870, *Structural Change and Economic Dynamics* 16: 437–466.

Briec, W.; Cavaignac, L. 2009. An extension of the multi-output state-contingent production model, *Economic Theory* 39: 43–64.

Castellacci, F. 2010. Structural change and the growth of industrial sectors: empirical test of a GPT model, *Review of Income and Wealth* 56(3): 449–482.

Chenery, H. B. 1960. Patterns of industrial growth, *American Economic Review* 50(4): 624–654.

Chenery, H. B.; Syrquin, M. 1975. Patterns of development, 1957–1970. London: Oxford University Press.

Chenery, H. B.; Taylor, L. 1968. Development patterns: among countries and over time, *Review of Economics and Statistics* 50 (4): 391–416.

Chen, W., Niebel, T.; Saam, M. 2015. Are intangibles more productive in ICT intensive industries? Evidence from EU countries [online], ASSA Conference. Available from : http://www.spintan.net [Accessed 22 December 2014].

Choo, H. J. 1971. On the empirical relevancy of the Ranis-Fei model of economic development: comment, *American Economic Review* 61 (4): 695–703.

Ciegis, R.; Ramanauskiene, J. 2009. Sustainable development and its assessment, *Applied Economics: Systematic Research* 3(2): 143–153.

Cornwall, J.; Cornwall, W. 1994. Growth theory and economic structure, *Economica* 61: 237–251.

Corrado, C.; Haskel, J.; Jona-Lasinio, C. 2015. Private and public intangible capital: productivity growth and new policy challenges [online], ASSA Conference. Available from: http: //www.spintan.net [Accessed 22 December 2014].

Corrado, C.; Haskel, J., Jona-Lasinio, C.; Iommi, M. 2014. ICT, R&D and non R&D intangible capital: complementary relations and industry productivity growth, Third WORLD KLEMS conference on growth and stagnation in the world economy, Tokyo, Japan.

Cristiaensen, L.; Jesper, K. 2011. The evolving role of agriculture in poverty reduction-– An empirical perspective, *Journal of Development Economics* 96(2): 239–254.

Dietz, J. 1983. Theories of development, *Journal of Economic Issues* 17(4): 1160–1162.

Domingo, C.; Tonella, G. 2000. Towards a theory of structural change, *Structural Change and Economic Dynamics* 11: 209–225.

Dumenil, G.; Levy, D. 1995. Structural change and prices of production, *Structural Change and Economic Dynamics* 6(4): 397–434.

Du Pisani; Jacobus, A. 2006. Sustainable development-historical roots of the concept, *Environmental Sciences* 3(2): 83–96.

Eltis, W. 2000. The classical theory of economic growth. Macmillan, Basingstoke.

Erumban, A. A. 2009. Rental prices, rates of return, capital aggregation and productivity: evidence from EU and US, *CESifo Economic Studies* 54(3): 499–533.

Erumban, A. A.; Gouma, R.; de Vries, G.; de Vries, K.; Timmer, M. 2012. WIOD Socio-Economic Accounts (SEA): Sources and Methods, *the European Commission, Research Directorate General as part of the 7th Framework Programme*, Theme 8: Socio-Economic Sciences and Humanities.

Eurostat database [online]. Available from: http://ec.europa.eu [Accessed 18 March 2014].

EU KLEMS database [online]. Available from: http: //www.euklems.net/ [Accessed 18 March 2014].

Fagerberg, J. 2000. Technological progress, structural change and productivity growth: a comparative study, *Structural Change and Economic Dynamics* 11(4): 393–412.

Fabricant, S. 1942. Employment in manufacturing. NBER: New York.

Fisher, A. G. B. 1939. Production: primary, secondary, and tertiary, *Economic Record* 1: 24–38.

Franke, R.; Kalmbach, P. 2005. Structural change in the manufacturing sector and its impact on business-related services: an input–output study for Germany, *Structural Change and Economic Dynamics* 16: 467–488.

Freeman, C.; Soete, L. 1997. The economics of industrial innovation. Cambridge, Mass: The MIT Press.

Galor, O. 2010. The 2008 Lawrence R. Klein lecture-comparative economic development: insights from unified growth theory, *International Economic Review* 51(1): 1–41.

Ginevicius, R.; Podvezko, V.; Gineviciene, V. B. 2004. A complex evaluation of the work productivity of university teaching staff, 8th Baltic Region Seminar on Engineering Education: 4 Kaunas University of Technology, Kaunas, Lithuania, pp. 44–46.

Ginevicius, R.; Podvezko, V. 2006. Comprehensive evaluation of economic and social development of Lithuanian regions based on a structured set of criteria, The 4th International Conference Citizens and Governance for Sustainable Development, pp. 194–199.

Grybaite, V. 2011. Towards measurement of sustainable development: systems of indicators, *Journal of Security and Sustainability Issues* 1(1): 17–24.

Gouma, R.; Timmer, M. P.; de Vries, G. 2014. Employment and Compensation in the WIOD Socio–Economic Accounts (SEA): Revisions for 2008/2009 and new data for 2010/2011, the European Commission Research Directorate General as part of the 7th Framework Programme, Theme 8: Socio–Economic Sciences and Humanities.

Guerrieri, P.; Meliciani, V.2005. Technology and international competitiveness: The interdependence between manufacturing and producer services, *Structural Change and Economic Dynamics* 16: 489–502.

Gualerzi, D. 1996. Natural dynamics, endogenous structural change and the theory of demand: a comment on Pasinetti, *Structural Change and Economic Dynamics* 7(2): 147–162.

Halkos, G.; Tzeremes, N. 2008. Trade efficiency and economic development: evidence from a cross country comparison, *Applied Economics* 40: 2749–2764.

Hartwig, J. 2010. Testing the growth effects of structural uhange, KOF Working Papers No. 264, Zurich.

Havlik, P. 2005. Structural change, productivity and employment in the new EU member states, The Vienna institute for international economic studies wiiw research reports 313.

Herman, E. 2011. The impact of the industrial sector on Romanian employment1(6)21.

Hishiyama, I. 1996. Appraising Pasinetti's structural dynamics, *Structural Change and Economic Dynamics* 7(2): 127–134.

Huber, P.; Mayerhofer, P. 2006. Structural change in the CENTROPE Region, workshops proceedings of workshops, No. 9.

IADB. 2010. The age of productivity: transforming economies from the bottom up. Palgrave Macmillan: New York.

Inklaar, R.; Timmer, M.P.; van Ark, B. 2007. Mind the gap! International comparisons of productivity in services and goods production, *German Economic Review* 8(2): 281–307.

Inklaar, R.; Timmer, M.; van Ark, B. 2008. Market services productivity across Europe and the US, *Economic Policy* 23: 94–141.

Inklaar, R.; Timmer, M. P. 2007. Of yeast and mushrooms: patterns of industry-level productivity growth, *German Economic Review* 8(2): 174–187.

Inklaar, R.; Timmer, M. P. 2008. Accounting for growth in retail trade: an international productivity comparison, *Journal of Productivity Analysis* 29(1): 23–31.

Inklaar, R.; Timmer, M. 2008. GGDC productivity level database: international comparison of output, inputs and productivity at the industry level, EU KLEMS project productivity in the European Union: a comparative industry approach, Working paper No. 40.

Jalava, J. 2006. Production, primary, secondary and tertiary: Finnish growth and structural change, 1860–2004, *Pellervo Economic Research Institute Working Papers* 80: 27. ISSN 1455–4623.

Jaimovich, E. 2011. Sectorial differentiation, allocation of talent, and financial development, *Journal of Development Economics* 96: 47–60.

Jorgenson, D. W.; Gollop, F. M.; Fraumeni, B. M.1987. Productivity and US economic growth, Cambridge MA: Harvard University Press.

Jorgenson, D. W.; Timmer, M. P. 2009. Structural change in advanced nations: a new set of stylised facts, *Scandinavian Journal of Economics* [online]. Available from http://www.rug.nl [Accessed 22 December 2014].

Karnitis, E. 2011. Strategy and efficient mechanisms to improve security and sustainability of the natural gas supply in Baltic States, *Journal of Security and Sustainability Issues* 1(1): 3–15.

Kaźmierczyk, J. 2012. Information technology systems and their impact on the employment level in the polish banking sector, *Journal of Security and Sustainability Issues* 1(3): 187–195.

Keynes, J. M.1936. The general theory of employment, interest and money. United Kingdom: Palgrave Macmillan.

King, R. G.; Rebelo, S.T.1993. Transitional dynamics and economic growth in the neoclassical model, *American Economic Review* 83(4).

Korsakiene, R.; Breivyte, I.; Wamboye, E. 2011. Sustainable development and Human Development Index, *Journal of Security and Sustainability Issues* 1(2): 103–112.

Kosempel, S. 2004. A theory of development and long run growth, *Journal of Development Economics* 75: 201–220.

Kuznets, S. 1966. Modern economic growth: rate, structure and spread. Yale university press: London.

Kuznets, S. 1979. Growth, population, and income distribution: Selected essays. Norton: New York.

Kratena, K. 2007. Technical change, investment and energy intensity, *Economic Systems Research* 19(3): 295–314.

Kummel, R.; Henn, J.; Lindenberger, D. 2002. Capital, labour, energy and creativity: modeling innovation diffusion, *Structural Change and Economic Dynamics* 13: 43–415.

Landes, D. 1969. The Unbound Prometheus. Cambridge University Press: Cambridge.

Larrain, J. 1989. Theories of development: capitalism, colonialism, and dependency. Cambridge Polity press: Cambridge.

Lewis, W. A. 1955. The theory of economic growth. Homewood, Ill.:Richard D. Irwin.

Lewis, W. A. 1954. Economic development with unlimited supplies of labour, *Manchester School Economic Social Studies* 22: 139–191.

Lithuanian National statistics database [online]. Available from: http://www.stat.gov.lt [Accessed 18 March 2014].

Lucas, R. B. 1988. On the mechanics of economic development, *Journal of Monetary Economics* 22: 3–42.

Mackevicius, J.; Jarmalaite. 2011. Intangibles as the object of accounting: Concept, recognition and classification, *Actualities of Business and Law* 6(2): 302–318.

Mas, M.; Javier, Q. 2005. ICT and economic growth in Spain 1985–2002, EU KLEMS Working Papers, No. 1.

Mas, M.; Milana, C.; Serrano, L. 2008. Spain and Italy: Catching up and falling behind, two different tales of productivity slowdown, EU KLEMS project productivity in the European Union: a comparative industry approach, Working paper nr. 37.

Mas, M.; Quesada, J. 2005. ICT and economic growth: a quantification of productivity growth in Spain 1985–2002, *OECD Statistics Working Papers*, OECD Publishing.

Mas , M.; Stehrer, R. 2012. Industrial productivity in Europe growth and crisis, Edward Elgar publishing limited. UK: Cheltengam.

Maroto-Sanchez, A.; Cuadrado-Roura, J. R. 2009. Is growth of services an obstacle to productivity growth? A comparative analysis, *Structural Change and Economic Dynamics* 20: 254–265.

Matuzeviciute, K.; Skuncikiene, S.; Tamasaityte, E. 2010. GDP structural chages analysis of Baltic countries, *Economics and Management: Actualities and Perspectives* 2(18): 78–88. 39.

Maudos, J., Pastor, J. M.; Serrano, L. 2008. Explaining the US-EU productivity growth gap: structural change vs. intra sectorial effect, *Economic Letters* 100(2): 311–313.

Melnikas, B. 2010. Sustainable development and creation of the knowledge economy: the new theoretical approach, *Baltic Journal of Sustainability* 16: 516–540.

Melnikas, B. 2012. Intellectual economics and creation of a knowledge based society and knowledge economy: new challenges in the context of global transformations*, Intellectual Economics* 1(7): 7–28.

Misiunas, P.; Kaminskiene, B. 1999. Main change tendencies of industry sector*, Lithuanian Economy: Journal of Economic Thoughts* 1: 21–23.

Montobbio, F. 2002. An evolutionary model of industrial growth and structural change, *Structural Change and Economic Dynamics* 13: 387–414.

Mursheda, M. S.; Serinoc, L.A. 2011. The pattern of specialization and economic growth: the resource curse hypothesis revisited, *Structural Change and Economic Dynamics* 22: 151–161.

Murshed, S. M.; Serino, L. A. 2011. The pattern of specialization and economic growth: the resource curse hypothesis revisited, *Structural Change and Economic Dynamics* 22(2): 151–161.

Nakatani, T. 2007. Japanese growth and stagnation: A Keynesian perspective, *Structural Change and Economic Dynamics* 18 (3): 306–332.

Ninomiya, Y.; Yoshimoto, A. 2008. Statistical method for detecting structural change in the growth process, *Biometrics* 64 (1): 46–53.

Notarangelo, M. 1999.Unbalanced growth: a case of structural dynamics, *Structural Change and Economic Dynamics* 10 (2): 209–223.

O'Mahony, M.; Vecchi; Michela. 2009. R&D, knowledge spillovers and company productivity performance, *Research Policy* 38(1): 35–44.

O'Mahony, M.; Timmer, M. P. 2009. Output, input and productivity measures at the industry level: the EU KLEMS database, *The Economic Journal* 119: F374–F403.

Oulton, N. 2007. Ex post versus ex ante measures of the user cost of capital, *Review of Income and Wealth* 53(2): 295–317.

OECD statistics database [online]. Available from: http://data.oecd.org [Accessed 22 December 2014].

OECD. 2001. Measuring Productivity, OECD Manual. Rosewood Drive, Danvers, MA 01923 USA.

OECD. 2009. Measuring Productivity, OECD Manual, the second edition. Rosewood Drive, Danvers, MA 01923 USA.

Raa, T., Wolff, E.N. 2000. Engines of growth in the US economy, *Structural Change and Economic Dynamics* 11: 473–489.

Padoan, P. C. 1998. Trade, knowledge accumulation and diffusion: a sectorial perspective, *Structural Change and Economic Dynamics* 9(3): 349–372.

Palana, N., Schmiedebergb, C. 2010. Structural convergence of European countries, *Structural Change and Economic Dynamics* 21: 85–100.

Pan, H. 2006. Dynamic and endogenous change of input-output structure with specific layers of technology, *Structural Change and Economic Dynamics* 17: 200–223.

Peneder, M. 2009. Sectorial growth drivers and competitiveness in the European Union. European Commission, Enterprise and Industry, European Communities, pp. 1–542.

Peneder, M. 2003. Industrial structure and aggregate growth, *Structural Change and Economic Dynamics* 14: 427–448.

Peneder, M.; Kaniovski, S.; Dachs, D. 2003. What follows tertiarisation? Structural change and the role of knowledge based services, *The Service Industry Journal* 23(2): 47–66.

Perez, C. 1983. Structural change and assimilation of new technologies in the economic and social systems, *Futures* 15 (5): 357–375.

Perez, C. 1985. Microelectronics, long waves and world structural change: new perspectives for developing countries, *World Development* 13(3): 441–463.

Prescott, E. C.1988. Robert M. Solow's neoclassical growth model: an influential contribution to economics, *Scandinavian Journal of Economics* 90(1): 7–12.

Pritchett, L. 2000. Understanding patterns of economic growth: searching for hills among plateaus, mountains and plains, *World bank Econ Rev* 14: 221–250.

Pugno, M. 2006. The service paradox and endogenous economic growth, *Structural Change and Economic Dynamics* 17: 99–115.

Qin., D. 2006. Is China's growing service sector leading to cost disease? *Structural Change and Economic Dynamics* 17: 267–287.

Regulation (EU) No. 549/2013 of the European Parliament and of the council of 21 May 2013 on the European System of the national and regional accounts in the European Union [online]. Available from: http://euroalert.net
[Accessed 22 December 2014].

Regulation (EC) No. 2223/96 of 25 June 1996 on the European system of national and regional accounts in the Community [online]. Available from: http://eur-lex.europa.eu [Accessed 22 December 2014].

Ricardo, D. 1817. On the principles of political economy and taxation. John Murray: London.

Romer, M. P. 1986. Increasing returns and long-run growth, *Journal of Political Economy* 94: 1002–1037.

Rostow, W. 1960. The stages of economic growth: a non communist manifesto. London: Cambridge University Press.

Rutkauskas, A. V.; Racinskaja, I.; Stasytyte, V. 2014. The universal sustainability of development as a tool of constructive interaction of interests and possibilities of development and the balance of goals and resources, 4th International Scientific conference „Whiter economics", Vilnius.

Sanchez, C. J.; Duarte, R. 2006. The effect of structural change on the self-reliance and interdependence of aggregate sectors: the case of Spain, 1980–1994, *Structural Change and Economic Dynamics* 17(1): 27–45.

Sarkar, D. 2007. The role of human capital in economic growth revisited, *Applied Economics Letters* 14: 419–423.

Sauramo, P.; Maliranta, M. 2011. Structural change in Finnish manufacturing: the theory of the aggregation of production functions and an empirical analysis with a plant-level panel, *Structural Change and Economic Dynamics* 22(2): 116–134.

Smith, A. 1776. An inquiry to the wealth of nations, Scotland: W. Strahan and T. Cadell, London.

Solow, R. M.1988. Growth theory and after, *American Economic Review* 78(3): 307–17.

Solow, R. M. 1956. A contribution to the theory of economic growth*, Quarterly Journal of Economics* 7.

Sonobe, T.; Hu, D.; Otsuka, K. 2004. From inferior to superior products: an inquiry into the Wenzhou model of industrial development in China, *Journal of Comparative Economics* 32: 542–563.

Spintan database [online]. Available from: http://www.spintan.net [Accessed 22 December 2014].

Stankeviciene, J.; Sviderske, T.; Miecinskiene, A. 2014. Dependence of sustainability on country risk indicators in EU Baltic Sea region countries, *Journal of Business Economics and Management* 4(15): 646–663.

Stankeviciene, J.; Cepulyte, J. 2014. Sustainable value creation: coherence of corporate social responsibility and performance of socially responsible investment funds, *Economic Research* 1 (27): 882–898.

Stankevicius, P. 2006. Lithuania's economy changes in the XXth century, *History: Science Works*, Vilnius Pedagogical University, pp.66–76.

Stańczyk, J. 2011. European security and sustainability issues in the context of current international environment, *Journal of Security and Sustainability Issues* 1(2): 81–90.0: 65–94.

Syrquin, M. 2010. Kuznets and Pasinetti on the study of structural transformation: Never the Twain shall meet? *Structural Change and Economic Dynamics* 21: 248–257.

Szirmai, A. 2012. Industrialisation as an engine of growth in developing countries, 1950–2005, *Structural Change and Economic Dynamics* 23: 406–420.

Tanuwidjaja, E.; Thangavelu, S. 2007. Structural change and productivity growth in the Japanese manufacturing industry, *Global Economic Review* 36(4): 385–405.

Thakur, S. K.; Alvayay, J. R. 2012. Identification of regional fundamental economic structure (FES) of Chilean economy: a field of influence approach, *Structural Change and Economic Dynamics* 23: 92–107.

Theobald, R.1961. Reviews. Toward a practical theory of economic growth, *American Journal of Economics & Sociology* 20(3): 327–331.

Timmer, M. P.; Szirmai, A. 2000. Productivity growth in Asian manufacturing: the structural bonus hypothesis examined, *Structural Change and Economic Dynamics* 11: 371–392.

Timmer, M. P.; Vries, G. J. 2007. A cross-country database for sectorial employment and productivity in Asia and Latin America, 1950–2005.

Timmer, M.; Moergastel, T.; Stuivenwold, E.; Ypma, G. 2007. EU KLEMS growth and productivity accounts, Version 1.0 PART I Methodology March, Groningen Growth and Development Centre.

Timmer, M.; Moergastel, T.; Stuivenwold, E.; Ypma, G. 2007. EU KLEMS growth and productivity accounts, Version 1.0 PART II Methodology March, Groningen Growth and Development Centre.

Timmer, M. P. 2012. The World Input-Output database (WIOD): contents, sources and methods, European Commission, Research Directorate General as part of the 7th Framework

Programme, Theme 8: Socio-Economic Sciences and Humanities.

Timmer, M. P.; Inklaar, R.; O'Mahony, M.; van Ark, B. 2013. Economic growth in Europe: a comparative industry perspective**.** Cambridge University Press: Cambridge.

Todaro, M. P.; Smith, S.C. 2011. Economic development, eleventh edition. Pearson Education limited: England.

Van Ark, B.; Hann, J. 1997. The Delta-Model revisited: recent trends in the structural performance of the Dutch economy, Research memorandum GD-38, Groginen growth and development centre.

Vaona, A. 2011. Profit rate dynamics, income distribution, structural and technical change in Denmark, Finland and Italy, *Structural Change and Economic dynamics* 22(3): 247–268.

Vernon, W.; Ruttan. 1988. The new growth theory and development economics: a survey, *Journal of Development Studies* 35(2): 1–26.

Vitas, A. 2012. The economy structural changes analysis and evaluation in Baltic states: doctoral dissertation, social sciences. Vilnius University: Vilnius.

Vilkas, E.; Vasiliauskas, A.; Kuodis, R. Economic growth and its structural development strategy [online]. Available from: http://www.ukmin.lt [Accessed 22 December 2014].

Vries, G. J., Erumban, A. A., Timmer, M. P., Voskoboynikov, I., Wu, H.X. 2011. Deconstructing the BRICs: structural transformation and aggregate productivity growth, research memorandum GD–121, Groginen growth and development centre, University of Groginen.

Vries, G. J.; Erumban, A. A.; Timmer, M. P.; Voskoboynikov, L.; Wua, H. X. 2012. Deconstructing the BRICs: structural transformation and aggregate productivity growth, *Journal of comparative economics* 40 (2): 211–227.

Willis, K. 2005. Theories and practices of development. Routledge, Taylor & Francis group: London and New York.

WIOD database [online]. Available from: http://www.wiod.org [Accessed 22 December 2014].

World Bank [online]. Available from: http://search.worldbank.org [Accessed 22 December 2014].

WORLD KLEMS database. Available from: http://www.worldklems.net [Accessed 22 December 2014].

Yi, K.; Zhang, J. 2010. Structural change in an open economy, University of Michigan.

Young, A. 1928. Increasing returns and economic progress, *The Economic Journal* 38:527–542.

Yudha, P.; Masaru, N. 2012. Integrated simulation model for energy security evaluation, *Energies* 5(12): 5086–5110.

Zhang, W. 1996. Preference, structure and economic growth, *Structural Change and Economic Dynamics* 7: 207–221.

List of Publications by the Author on the Topic of the Dissertation

Papers in scientific journals

Lankauskiene, T.; Tvaronaviciene, M. 2011. Interrelation of countries' developmental level and foreign direct investments performance, *Journal of Business Economics and Management* 12(3): 546–565. ISSN 1611-1699 (ISI Web of Science database).

Tvaronaviciene, M.; Lankauskiene, T. 2011. Peculiarities of FDI performance in developed, developing and underdeveloped countries, *Business: Theory and Practice* 12(1): 50–62. ISSN 1648-0627 (Other international databases).

Tvaronaviciene, M.; Lankauskiene, T. 2011. Plausible foreign direct investment' impact on sustainable development indicators of differently developed countries, *Journal of Security and Sustainability Issues* 1(1): 27–38. ISSN 2029-7017 (Other international databases).

Tvaronaviciene, M; Lankauskiene, T. 2012. Should consistent patterns be traced: impact of globalization on certain sustainable development facets, *Social Science Studies* 4(2): 443–468. ISSN 2029-2236 (Other international databases).

Lankauskiene, T.; Tvaronaviciene, M. 2012. Security and sustainable development: approaches and dimensions in the globalization context, *Journal of Security and Sustainability Issues* 1(4): 285–295. ISSN 2029-7017 (Other international databases).

Tvaronaviciene, M.; Lankauskiene, T. 2013. The impact of production factors and economic structures on economic development, *Business: Theory and Practice* 14(1): 5–16. ISSN 1648-0627 (Other international databases).

Lankauskiene, T.; Tvaronaviciene, M. 2013. Economic sector performance and growth: contemporary approaches in the sustainable development context, *Intellectual Economics* 3(17): 355–374. ISSN 1822-8011 (Other international databases).

Lankauskiene, T. 2014. Accounting productivity in the sectors of economy: methodological aspects, *Entrepreneurship and Sustainability Issues* 2(2): 98–106. ISSN 2345-0282 (Other international databases).

Papers in other editions

Lankauskiene, T.; Tvaronaviciene, M. 2012. Production factors and structural changes in economy sectors: genesis of theoretical approaches, in *Proceedings of Contemporary Issues in Business, Management and Education'2012, Vilnius, Lithuania*, pp. 245–259. ISSN 2029-7963 (Other international databases).

Lankauskiene, T.; Tvaronaviciene, M. 2014. Economy structure, productivity and economic growth: towards methodological perspective, in *Proceedings of 8th International Scientific Conference Business and Management'2014, Vilnius, Lithuania*, pp. 528–535. ISSN 2029-4441 (Other international databases).

Summary in Lithuanian

Įvadas
Problemos formulavimas

Disertacijoje ūkio struktūrą sudaro kiekvienos ūkio šakos pridėtinės vertės augimą lemiančių veiksnių sudėtis ir jų agregavimas į bendros pridėtinės vertės augimą. Augimą lemiančių veiksnių sudėties kitimas įtakoja atskirų ūkio šakų ir viso ūkio ekonominio augimo tempą. Augimą lemiančius veiksnius atspindi darbo valandos ir darbo produktyvumo komponentai. Darbo produktyvumo komponentus sudaro skirtingi darbuotojų tipai ir kapitalo rūšys (pvz. kompiuterių įranga, komunikacijos priemonės, transporto priemonės, kitos mašinos ir įrenginiai, negyvenamieji pastatai, gyvenamieji pastatai, nematerialusis turtas). Taip pat labai svarbus ir daugiaveiksnis produktyvumas, kuris įvertina visų veiksnių produktyvumą.

Tačiau klasikinis ūkio šakos darbo produktyvumas vis dar išreiškiamas sukurta pridėtine verte per darbo valandą. Taip matuojama duomenų bazėse, tokiose kaip Lietuvos statistikos departamentas (LSD), Eurostatas. Remiantis naujausiu požiūriu į ūkio šakos darbo produktyvumo matavimą, anksčiau pateikti darbo produktyvumo komponentai yra svarbūs aspektai lyginamajai ekonominei analizei ir turėtų būti apskaityti.

Mokslinė darbo problema – klasikinis ūkio šakos darbo produktyvumo matavimas neatskleidžia darbo produktyvumo komponentų ir trūkumas metodikų, leidžiančių įvertinti ūkio augimą lemiančių veiksnių sudėtį ir jų poveikį ekonominiam augimui.

Darbo aktualumas

Pirma, problematika aktuali, nes Europos Sąjungos (ES) šalių nacionalinės statistikos departamentams rekomenduojama įvertinti augimą ir produktyvumą lemiančius veiksnius bei rengti „Augimo ir produktyvumo apskaičiavimo sąskaitas“ (Europos Parlamento ir Tarybos reglamentas (ES) Nr. 549/2013, p. 525). Lietuvos statistikos departamentas tokių sąskaitų nerengia.

Antra, ES kapitalo, darbo, energijos, medžiagų, paslaugų (EU KLEMS) ir pasaulio kapitalo, darbo, energijos, medžiagų, paslaugų (WORLD KLEMS) projektuose trūksta kitų mažiau išsivysčiusių šalių (įskaitant ir Lietuvos) augimo apskaičiavimo metodo pritaikymo tyrimų rezultatų, kurie papildytų tarptautinius akademinius standartus.

Galiausiai, šalių ūkių augimą lemiantys veiksniai yra itin aktualūs tiek tyrimų, tiek politiniuose lygmenyse. Be to, darbo produktyvumo svarba akcentuojama tiek ekonominio augimo ir vystymosi teorijose, kurių ištakos siekia XVIII a., tiek šiuolaikiniuose darnaus vystymosi požiūriuose.

Tyrimo objektas

Ūkio šakų augimą lemiantys veiksniai ir jų poveikis ekonominiam augimui.

Darbo tikslas

Pagrindinis disertacinio darbo tikslas – nustatyti ūkio šakų augimą lemiančių veiksnių sudėtį ir jų poveikį ūkio ekonominiam augimui.

Darbo uždaviniai

Tikslui pasiekti iškelti tokie uždaviniai:

1. Ištirti ūkio šakų veiklos ir ekonominio augimo sąryšį.
2. Išanalizuoti ūkio šakų darbo produktyvumo apskaičiavimo metodus. Pagrįsti naujo darbo produktyvumo apskaičiavimo metodo pritaikymo priežastis ir tobulinimo galimybes.
3. Sudaryti metodiką, leidžiančią įvertinti ūkio šakų augimą lemiančių veiksnių ir darbo produktyvumo komponentų sudėtį, bei jų poveikį ūkio ekonominiam augimui.
4. Patikrinti metodiką tyrimui pasirinktoms šalims.
5. Atlikti Lietuvos atvejo analizę labiau išsivysčiusių šalių kontekste.

Tyrimų metodika

Nagrinėjant darbo objektą, taikytini šie metodai:

– pirmoje darbo dalyje – mokslinės literatūros kritinė analizė, kontekstinė analizė, grupavimo analizė, lyginamoji ir apibendrinamoji analizė, indukcijos, dedukcijos metodai.
– antroje darbo dalyje – grupavimo, lyginamoji ir apibendrinamoji analizės.
– empirinėje darbo dalyje – augimo apskaičiavimo metodas. Gautų rezultatų vertinimui naudota lyginamoji analizė. Skaičiavimams naudotas *Ms Office EXCEL 2013* programos paketas.

Darbo mokslinis naujumas

1. Disertaciniame darbe motyvuota nauja metodika yra tinkama, siekiant įvertinti šalių bendrosios pridėtinės augimą lemiančius veiksnius (darbo valandas ir darbo produktyvumo komponentus), ir ūkio struktūros šablonas, apjungiantis įvairių ekonomikos rūšių klasifikatorius (ISIC 3, ISIC 4, NACE rev. 1, NACE rev. 2).
2. Disertaciniu darbu pagrįsti nauji darbo produktyvumo rodikliai, darbo produktyvumo kompentai (kompiuterių įranga, komunikacijos priemonės, transporto priemonės, kitos mašinos ir įrenginiai, negyvenamieji pastatai, gyvenamieji pastatai, nematerialusis turtas), papildantys LSD ir Eurostato duomenų bazių teikiamus duomenis.
3. Motyvuotas kapitalo paslaugų įvertinimas nacionaliniu lygmeniu.
4. Išvesti detalūs augimą lemiantys kapitalo veiksniai nei vien informacinė ar neinformacinė veiksnių grupės.
5. Praplėsta žinių pagrindo augimą lemiančių veiksnių grupė. Prie kompiuterių įrangos, komunikacijos priemonių, darbuotojų sudėties (kvalifikacinio pobūdžio), daugiaveiksnio produktyvumo gali būti pridedama visa nematerialiojo turto grupė.

Darbo rezultatų praktinė reikšmė

Metodika gali būti praktiškai naudinga LSD ir Eurostatui atliekant išsamesnius darbo produktyvumo matavimus bei įvertinant kapitalo paslaugas.

Rezultatai naudingi suinteresuotoms grupėms, formuojant viso šalies ūkio, atskirų ūkio šakų ir industrinę politiką. Taip pat prognozuojant ir skatinant tam tikrus tikslingus Lietuvos ūkio struktūros pokyčius.

Ginamieji teiginiai

1. Darbe pagrįstas naujas požiūris įvertina ūkio struktūros augimą lemiančių veiksnių sudėtį ir jų poveikį ūkio ekonominiam augimui.
2. Augimą lemiančių veiksnių sudėties kitimas įtakoja atskirų ūkio šakų ir viso ūkio ekonominio augimo tempą.
3. Darbe motyvuoti nauji rodikliai, darbo produktyvumo komponentai, leidžia išsamiau įvertinti darbo produktyvumą ir papildo LSD bei Eurostato teikiamus duomenis.
4. Darbe pagrįstas naujas požiūris įvertina skirtingų šalių ekonominio augimo šaltinius. Jo pritaikymas mažiau išsivysčiusių šalių grupei sumažino iki šiol gyvavusį tokio pobūdžio tyrimų heterogeniškumą.

Darbo rezultatų aprobavimas

Disertaciniu darbu sudaryta metodika, leidžianti įvertinti ūkio augimą lemiančių veiksnių sudėtį ir jų poveikį ekonominiam augimui, yra aprobuota Lietuvos pavyzdžiu. Disertacijos tema paskelbta 10 mokslinių straipsnių. Aštuoni – tarptautiniuose mokslo žurnaluose, du – kituose mokslo leidiniuose. Viešinant disertacijos rezultatus buvo skaityti keturi pranešimai Vilniaus Gedimino technikos universitete Verslo vadybos fakultete doktorantų seminarų metu, dvi prezentacijos tarptautinėse konferencijose. Skaičiavimų klausimais buvo diskutuojama mokslinės stažuotės metu (2014/09/16–2014/11/16) tyrimų centre IVIE (Valensija, Ispanija) bei Valensijos universitete (Valensija, Ispanija).

Disertacijos struktūra

Darbą sudaro įvadas, trys pagrindiniai skyriai, bendrosios išvados, literatūros sąrašas, autorės mokslinių publikacijų disertacijos tema sąrašas ir priedai. Disertacijos apimtis (be priedų) – 110 puslapių, 42 formulės, 4 paveikslai ir 7 lentelės.

1. Ūkio šakų veiklos ekonominio augimo procese teorinių požiūrių analizė

Ūkio struktūros ir ekonominio augimo tyrimų atitinkamoje užsienio mokslinėje literatūroje gausu: konstatuojama, kad šalies ūkio struktūros kilmė ir greitis yra itin svarbus reiškinys darniam šalies vystymuisi bei diskutuojama įvairiais aspektais, pradedant veiksniais, lemiančiais ūkio šakų veiklą, ir baigiant įžvalgomis apie ūkio struktūros sandarą darniam šalies augimui ir produktyvumui skatinti (pvz. Andersen 2001; Bah, Brada 2009; Baumol 1967; Botta 2009; Bogliacino, Pianta 2011; Broadberry 1995; Broadberry, Ghosal 2005; Castellacci 2010; Christiaensen, Jesper 2011; Cornwall 1994; Domingo, Tonella 2000; Dumenil, Levy1995; Fagerberg 2000; Franke, Kalmbach 2005; Freeman, Soete 1997; Gualerzi 1996; Guerrieri, Meliciani 2005; Hartwig 2010; Hishiyama 1996; Huber, Mayerhofer 2006; Jorgenson, Timmer 2009; Kuznets 1966; Kuznets 1979; Kummel *et al.* 2002;

Lewis 1954; Maroto-Sanchez ,Cuadrado-Roura 2009; Murshed , Serino 2011; Nakatani 2007; Ninomiya, Yoshimoto 2008; Palana, Schmiedebergb 2010; Padoan 1998; Pan 2006; Peneder *et al.* 2001; Peneder *et al.* 2003; Perez 1983; Perez 1985; Pugno 2006; Qin 2006; Raa, Wolff 2000; Sánchez, Duarte 2006; Sauramo, Maliranta 2011; Syrquin 2010; Timmer, Szirmai 2000; Vaona 2011; Yudha, Masaru 2012; Yi, Zhang 2010; Zhang 1996).

Lietuvoje detaliau šią temą nagrinėjo Artūras Vitas, kuris 2012 metais Vilniaus universitete apgynė daktaro disertaciją „Lietuvos ūkio struktūrinių pokyčių Baltijos šalyse analizė ir vertinimas“. Jis pasiūlė makroekonominį modelį struktūriniams pokyčiams vertinti.

Pirmajame disertacinio darbo skyriuje atlikus mokslinių šaltinių disertacijos tematika kritinę analizę, pastebimas nepakankamas Lietuvos mokslininkų dėmesys šios tematikos tyrimams.

2. Ūkio šakų darbo produktyvumo apskaičiavimo metodų analizė

Antrajame disertacinio darbo skyriuje kritiškai išanalizuoti darbo produktyvumo apskaičiavimo metodai ir išskirtos šios jų grupės:

1. Bendro produktyvumo apskaičiavimo metodas.

Šis metodas naudoja standartinę poslinkio analizę. Ją sudaro trys dalys – hipotezės: struktūrų bonuso, struktūrų naštos ir vidinio augimo. Struktūrų bonuso hipotezė įvertina, ar šalies ekonomika pereina iš mažesnio į didesnio darbo produktyvumo ūkio šakas. Struktūrų naštos hipotezė tiria, ar ūkio šakos, palaikančios aukštą darbo produktyvumo augimą, taip pat plečia ir darbuotojų bei darbo valandų skaičių. Paskutinė dalis – vidinio augimo efektas – įvertina vidinį ūkio šakos darbo produktyvumo augimą, prisiimant hipotezę, kad ūkio šaka išlaikė tokį pat darbuotojų skaičių, kaip ir pradiniais metais. Kadangi darbo produktyvumas turi tendenciją augti, šis įvertinimas dažniausiai būna teigiamas.

Atitinkamoje mokslinėje literatūroje yra daug šio metodo versijų, pagrindinis skirtumas tarp jų yra bazinių metų ar svorių pasirinkimas.

2. Bendro darbo produktyvumo spartinimo įvertinimo metodas.

Šio metodo autoriai teigia, kad standartinė poslinkio analizė tinkamai neįvertina besiplečiančių ir besitraukiančių ūkio sektorių ir jų šakų įtakos bendram darbo produktyvumo augimui. Jie siūlo modifikuotą poslinkio analizę, kuri panaikina šį standartinės poslinkio analizės trūkumą.

Pirmuose dviejuose metoduose darbo produktyvumas išreikštas sukurta pridėtine verte, tenkančia vienai dirbtai valandai. Metodai įvertina struktūrinių pokyčių įtaką ekonominiam augimui.

3. Augimo apskaičiavimo metodas.

Šis metodas leidžia įvertinti ūkio šakos pridėtinės vertės augimą lemiančių veiksnių sudėtį ir darbo produktyvumo komponentus.

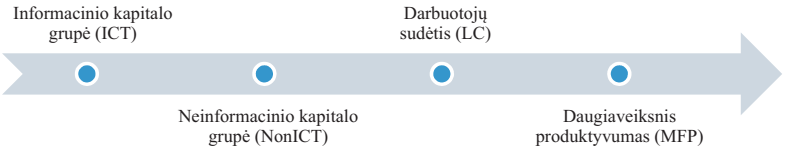
Metodas pateikia naujausią požiūrį į ūkio šakos darbo produktyvumo matavimą.

Metodas yra galingas įrankis siekiant gauti svarbius lyginamajai ekonominei analizei rezultatus bei užčiuopti skirtingų šalių pagrindines ekonomikos varomąsias jėgas.

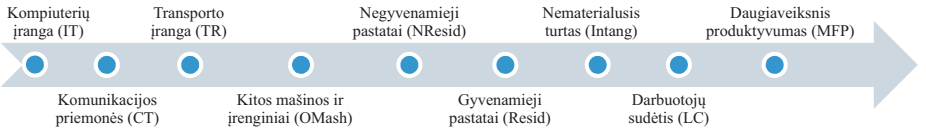
Kadangi augimo apskaičiavimo metodas leidžia įvertinti naujausią, daug išsamesnį nei iki šiol paplitęs, požiūrį į darbo produktyvumo matavimą, ir yra pastebimas šio metodo pritaikymo trūkumas mažiau išsivysčiusioms šalims (įskaitant Lietuvą), jis bus naudojamas trečiojoje disertacinio darbo dalyje.

3. Šalių ūkių augimą lemiančių veiksnių ir jų poveikio ekonominiam augimui įvertinimas

Šioje disertacinio darbo dalyje, naudojant augimo apskaičiavimo metodą, sudaryta nauja metodika, leidžianti įvertinti šalių pridėtinės vertės augimo veiksnių sudėtį. Veiksnių sudėtį sudaro darbo valandos ir darbo produktyvumo komponentai (kompiuterių įranga (IT), komunikacijos priemonės (CT), transporto priemonės (TR), kitos mašinos ir įrenginiai (OMash), negyvenamieji pastatai (NResid), gyvenamieji pastatai (Resid), nematerialusis turtas (Intang), daugiaveiksnis našumas (MFP), darbuotojų sudėtis (LC)). S.1 ir S.2 paveiksluose pateikti pirminio augimo apskaičiavimo metodo ir naujos disertaciniame darbe sudarytos metodikos pagrindiniai skirtumai.



S.1 pav. Pirminio augimo apskaičiavimo metodo darbo produktyvumo komponentai. Žinių pagrindo augimą lemiančių veiksnių grupė: informacinio kapitalo grupė, darbuotojų sudėtis, daugiaveiksnis produktyvumas (Timmer *et al*. 2007)



S.2 pav. Naujos disertacinio darbo metodikos darbo produktyvumo komponentai. Žinių pagrindo augimą lemiančių veiksnių grupė: kompiuterių įranga, komunikacijos priemonės, nematerialusis turtas, darbuotojų sudėtis, daugiaveiksnis produktyvumas (sudaryta autorės remiantis Timmer *et al.* 2007)

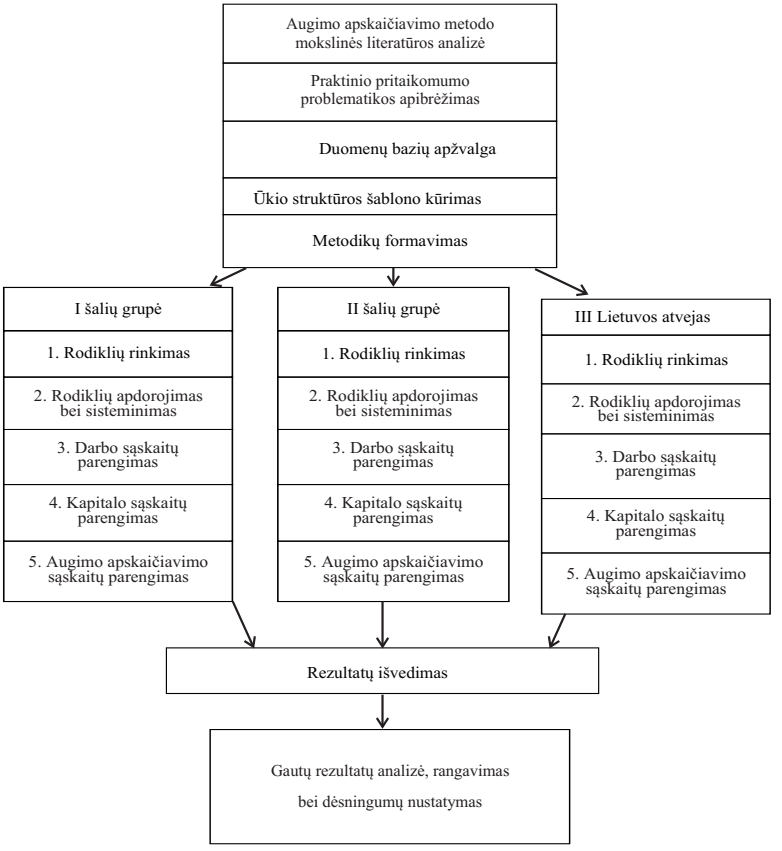
Viso ūkio ekonominis augimas matuojamas bendrosios pridėtinės vertės procentiniu padidėjimu per laiko matą.

Ūkio struktūra – kiekvienos ūkio šakos pridėtinės vertės augimo veiksnių sudėtis ir jų agregavimas į bendros pridėtinės vertės augimą.

Ūkio struktūros šablonas – tyrime naudotų duomenų bazių įvairių rūšių ekonominės veiklos klasifikatorių (pvz. ISIC rev. 3, ISIC rev. 4, NACE rev. 1, NACE rev. 2) ir jose pateiktų skirtingų ūkio šakų agregavimas į vieną šabloną, norint gauti lyginamuosius rezultatus (S.1 lentelė).

S.1 lentelė. Ūkio struktūros šablonas (sudaryta autorės remiantis ISIC Rev. 3, ISIC Rev. 4, NACE rev. 2 ekonominės veiklos klasifikatoriais)

1.	TOTAL. Iš viso pagal ekonominės veiklos rūšis.
2.	Žemės ūkis, miškininkystė ir žuvininkystė.
3.	Kasyba ir karjerų eksploatavimas.
5.	Maisto produktų, gėrimų ir tabako gamyba.
6.	Tekstilės gaminių gamyba; drabužių siuvimas (gamyba); odos ir odos dirbinių gamyba.
7.	Medienos, popieriaus ir popieriaus gaminių gamyba; leidyba ir spausdinimas.
8.	Kokso ir rafinuotų naftos produktų gamyba.
9.	Chemikalų ir chemijos produktų gamyba. Pagrindinių vaistų pramonės gaminių ir farmacinių preparatų gamyba.
10.	Guminių ir plastikinių gaminių bei kitų nemetalinių mineralinių produktų gamyba.
11.	Pagrindinių metalų ir metalo gaminių, išskyrus mašinas ir įrenginius, gamyba.
12.	Kompiuterių, elektroninių ir optinių gaminių gamyba. Elektros įrangos gamyba.
13.	Niekur kitur nepriskirtų mašinų ir įranginių gamyba.
14.	Transporto įrangos gamyba.
15.	Baldų gamyba; papuošalų, juvelyrinių dirbinių , muzikos instrumentų, žaislų gamyba; mašinų bei įrangos remontas ir įrengimas.
16.	Elektros, dujų, garo tiekimas ir oro kondicionavimas. Vandens tiekimas, nuotekų valymas, atliekų tvarkymas ir regeneravimas.
17.	Statyba.
18.	Didmeninė ir mažmeninė prekyba; variklių transporto priemonių ir motociklų remontas.
19.	Transportas bei saugojimas.
20.	Apgyvendinimo ir maitinimo paslaugų veikla.
21.	Informacija ir ryšiai. Leidybinė veikla; kino filmų, vaizdo filmų ir televizijos programų gamyba, garso įrašymo ir muzikos įrašų leidybos veikla; programų rengimas bei transliavimas. Telekomunikacijos. Kompiuterių programavimo, konsultacinė ir susijusi veikla; duomenų apdorojimo, interneto serverių paslaugų ir susijusi veikla; interneto vartų paslaugų veikla.
22.	Finansinė ir draudimo veikla.
23.	Nekilnojamo turto operacijos.
24.	Profesinė, mokslinė ir techninė veikla. Administracinė bei aptarnavimo veikla.
25.	Viešasis valdymas ir gynyba; privalomasis socialinis draudimas.
26.	Švietimas.
27.	Žmonių sveikatos priežiūra ir socialinis darbas.
28.	Meninė, pramoginė ir poilsio organizavimo veikla. Kita aptarnavimo veikla.



S.3 pav. Empirinės darbo dalies tyrimo schema (sudaryta autorės)

Tyrimui pasirinktos šalys: Australija, Čekija, Danija, Švedija, JAV, Austrija, Suomija, Vokietija, Italija, Japonija, Olandija, Ispanija, Jungtinė Karalystė, Lietuva.

Šalių pasirinkimo kriterijus:

– Lietuvos tikslas ilgalaikėje perspektyvoje yra pasiekti labiau išsivysčiusių šalių darbo produktyvumo lygį.

Tyrimo eigos etapai (S.3 pav.)

3. Darbo indėlio sąskaitų rengimas

$$\Delta \ln L_t = \sum_l v_{l,t} \Delta \ln H_{l,t}\,, \qquad \text{(S.1)}$$

čia $\Delta\ lnL_t$ – darbo paslaugos; $H_{l,t}$ – darbuotojų pagal išsilavinimo tipą (skaidymas: aukštos, vidutinės, žemos kvalifikacijos) dirbtų valandų dalis bendroje dirbtų valandų dalyje

(visų dalių suma turi būti lygi 1); $v_{l,t}$ – darbuotojų pagal išsilavinimo tipą vidutinė svorio dalis bendroje darbuotojų kompensacijos dalyje (visų dalių suma turi būti lygi 1).

$$v_{l,t} = 0{,}5(v_{l,t} + v_{l,t-1}); \tag{S.2}$$

$$v_{lt} = (\sum_{l} p^{L}{}_{lt} H_{lt})^{-1} p^{L}{}_{lt} H_{lt} . \tag{S.3}$$

Darbo paslaugos įvertintos naudojant kiekvieno darbuotojų tipo darbo valandų logaritminius augimo tempus, pasveriant juos iš to tipo vidutinės darbuotojų kompensacijos dalies bendroje darbuotojų kompensacijos dalyje ir viską susiejant Tornqvist apimties indeksu.

4. Kapitalo indėlio sąskaitų rengimas

$$\Delta \ln K_t = \sum_{k} v_{k,t} \Delta \ln A_{k,t} , \tag{S.4}$$

čia Δ lnK_t – kapitalo paslaugos; $A_{k,t}$ – kapitalo rūšies (IT, CT, Tr, OMash, NResid, Resid, Intang) reali atsargų vertė; $v_{k,t}$ – kapitalo rūšies vidutinė svorio dalis bendroje nominaliojoje kapitalo kompensacijos dalyje (visų dalių suma turi būti lygi 1).

$$v_{k,t} = 0{,}5(v_{k,t} + v_{k,t-1}); \tag{S.5}$$

$$v_{k,t} = (\sum_{k} p^{K}{}_{kt} A_{kt})^{-1} p^{K}{}_{kt} A_{kt} , \tag{S.6}$$

čia $\sum p^{K}{}_{kt} A_{kt}$ – bendroji nominalioji kapitalo kompensacija (bendrasis likutinis perteklius atėmus save įdarbinusių žmonių pajamas).

Kapitalo paslaugos įvertintos naudojant kiekvienos kapitalo rūšies realios atsargų vertės logaritminius augimo tempus, pasveriant juos iš tos kapitalo rūšies vidutinės svorio dalies bendroje nominaliojoje kapitalo kompensacijos dalyje ir viską susiejant Tornqvist apimties indeksu.
Kapitalo rūšies kompensacijos apskaičiavimas – vartotojo (nuomos) kainos požiūris*:*

$$p^{K}{}_{k,t} = p^{I}{}_{k,t-1} i_t + \partial_k p^{I}{}_{k,t} - (p^{I}{}_{k,t} - p^{I}{}_{k,t-1}) , \tag{S.7}$$

čia $p^{K}{}_{k,t} A_{k,t}$ priklauso nuo kapitalo rūšies atsargos nominaliosios vertės ir ūkio šakos nominaliojo grąžos tempo (S.8 formulė); kapitalo rūšies nusidėvėjimo tempo (S.2 lentelė); turto kainos pokyčių.

S.2 lentelė. Kapitalo rūšių nusidėvėjimo tempai pagal ūkio šakas (sudaryta autorės jos sudarytam ūkio struktūros šablonui remiantis Timmer *et al.* 2007)

Kapitalo rūšys	Kompiuterių įranga (IT)	Komunikacijos priemonės (CT)	Transpoto įranga (TR)	Kitos mašinos ir įrenginiai (OMash)	Negyvenamieji pastatai (NResid)	Gyvenamieji pastatai (Resid)	Nematerialusis turtas (Intang)
1 TOTAL							
2	0,315	0,115	0,170	0,129	0,024	0,011	0,315
3	0,315	0,115	0,170	0,129	0,024	0,011	0,315
5	0,315	0,115	0,168	0,109	0,033	0,011	0,315
6	0,315	0,115	0,184	0,109	0,033	0,011	0,315
7	0,315	0,115	0,173	0,106	0,033	0,011	0,315
8	0,315	0,115	0,154	0,110	0,032	0,011	0,315
9	0,315	0,115	0,181	0,104	0,033	0,011	0,315
10	0,315	0,115	0,191	0,112	0,033	0,011	0,315
11	0,315	0,115	0,169	0,106	0,033	0,011	0,315
12	0,315	0,115	0,166	0,108	0,033	0,011	0,315
13	0,315	0,115	0,170	0,107	0,033	0,011	0,315
14	0,315	0,115	0,167	0,109	0,033	0,011	0,315
15	0,315	0,115	0,193	0,113	0,033	0,011	0,315
16	0,315	0,115	0,191	0,094	0,023	0,011	0,315
17	0,315	0,115	0,195	0,139	0,034	0,011	0,315
18	0,315	0,115	0,216	0,133	0,030	0,011	0,315
19	0,315	0,115	0,146	0,107	0,027	0,011	0,315
20	0,315	0,115	0,203	0,140	0,028	0,011	0,315
21	0,315	0,115	0,176	0,115	0,035	0,011	0,315
22	0,315	0,115	0,187	0,149	0,044	0,011	0,315
23	0,315	0,115	0,227	0,147	0,027	0,011	0,315
24	0,315	0,115	0,155	0,144	0,044	0,011	0,315
25	0,315	0,115	0,173	0,138	0,025	0,011	0,315
26	0,315	0,115	0,173	0,138	0,025	0,011	0,315
27	0,315	0,115	0,225	0,149	0,027	0,011	0,315
28	0,315	0,115	0,223	0,136	0,051	0,011	0,315

Ūkio šakos nominaliojo grąžos tempo (i) apskaičiavimas:

$$i_{j,t} = \frac{p^K{}_{j,t} K_{j,t} + \sum_k (p^I{}_{k,j,t} - p^I{}_{k,j,t-1}) A_{k,j,t} - \sum_k p^I{}_{k,j,t} \partial_k A_{k,j,t}}{\sum_k p^I{}_{k,j,t-1} \; A_{k,j,t}}, \qquad \text{(S.8)}$$

čia $p^K{}_{j,t} K_{j,t}$ – bendroji kapitalo kompensacija (bendrasis likutinis perteklius atėmus save įdarbinusių žmonių pajamas); $A_{k,j,t}$ – kapitalo rūšies reali atsargų vertė; $p^I{}_{k,j,t}$ – kapitalo kategorijos rūšies kainų lygis; ∂_k – nusidėvėjimo tempas.

5. Augimo apskaičiavimo sąskaitų rengimas

Ūkio šakos kuriama pridėtinė vertė *(V)* susideda iš kapitalo *(K)* ir darbo *(L)* indėlių ir jos nominalioji vertė yra:

$$P^V{}_j V_j = P^K{}_j K_j + P^L{}_j L_j, \tag{S.9}$$

čia P^V – pridėtinės vertės nominali kaina.

Pridėtinės vertės augimas susideda iš kapitalo, darbo ir daugiaveiksnio produktyvumo (MFP) (A^V) indėlių:

$$\Delta \ln V_{jt} = w^K{}_{jt} \Delta \ln K_{jt} + w^L{}_{jt} \Delta \ln L_{jt} + \Delta \ln A^V{}_{jt}, \tag{S.10}$$

čia Δ *ln* – natūrinis logaritminis augimo tempas; w – indėlio svoris; indėlio dviejų periodų vidurkio dalis nominaliojoje pridėtinės vertės dalyje. Indėlio svorių dalys augimo apskaičiavimo sąskaitose:

$$w^L{}_{jt} = (P^V{}_{jt} V_{jt})^{-1} P^L{}_{jt} L_{jt}; w^K{}_{jt} = (P^V{}_{jt} V_{jt})^{-1} P^K{}_{jt} K_{jt}; \tag{S.11}$$

$$w^L{}_{jt} + w^K{}_{jt} = 1. \tag{S.12}$$

Svoriai išvedami iš BVP apskaitos pajamų metodu komponenčių: darbuotojų kompensacijos (COMP) ir bendrojo likutinio pertekliaus (GOS). Bendrojo likutinio pertekliaus (GOS) rodiklis yra pakoreguojamas atėmus save įdarbinusių žmonių pajamas (jos pridedamos prie darbuotojų kompensacijos). Tokiu būdu gaunami bendrosios darbuotojų kompensacijos $w^L{}_{jt}$ (LAB) ir kapitalo kompensacijos $w^K{}_{jt}$ (CAP) dalys nominaliojoje ūkio šakos pridėtinės vertės dalyje.

$$VA\_Q = \ln \Delta V_{jt}, \tag{S.13}$$

VA_Q – realios pridėtinės vertės logaritminis augimo tempas.

$$VAconH = w^L{}_{jt} \Delta \ln H_{jt}; \tag{S.14}$$

$$VAconLC = w^L{}_{jt} (\Delta L_{jt} - \Delta \ln H_{jt}); \tag{S.15}$$

$$VAconK = w^K{}_{jt} \Delta \ln K_{jt}; \tag{S.16}$$

$$VAconL = w^L{}_{j,t} \Delta \ln L_{jt}; \tag{S.17}$$

$$VAconMFP = \Delta \ln A^V{}_{jt}, \tag{S.18}$$

w – veiksnių svoriai bendrojoje nominaliojoje ūkio šakos pridėtinės vertės dalyje.

S.3 lentelėje pateikti tyrimui pasirinktų šalių darbo produktyvumo rodikliai, išreikšti bendrąja pridėtine verte per dirbtą valandą (eurais) 1995–2013 m. laikotarpiui. Matyti, kad Lietuvos darbo produktyvumas žemas. Tačiau jo komponentų sudėtis tradicinėse duomenų bazėse nėra atskleista. Taip pat pastebimas spartus Lietuvos darbo produktyvumo augimo tempas (jos darbo produktyvumas nuo 1995m. iki 2013m. išaugo daugiau

negu dvigubai), tačiau jis išlieka žemas palyginti su labiau išsivysčiusiomis šalimis. Iš tradicinėse duomenų bazėse pateiktų duomenų lieka neaišku, kokie yra šalių augimą lemiančių veiksnių ir darbo produktyvumo komponentų sudėtis bei jų poveikis ekonominiam augimui.

Naujos disertaciniame darbe sudarytos metodikos empirinio pritaikymo pagrindiniai rezultatai pateikti S.4 ir S.5 lentelėse.

S.3 lentelė. Darbo produktyvumas, bendroji pridėtinė vertė (BPV) per dirbtą valandą (eurais) (Eurostatas, OECD)

Šalis	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1. Lietuva	5	5	5	5	6	6	6	7	7	8	8	8	9	9	8	9	10	10	11
2. Švedija	32	33	34	35	36	37	37	39	40	42	43	44	44	43	42	44	44	45	46
3. Australija	20	21	22	23	24	25	27	28	29	30	31	32	34	34	36	37	38	39	40
4. Jungtinė Karalystė	30	31	32	33	33	35	35	36	37	38	39	40	41	40	39	40	40	39	39
5. Suomija	30	31	32	33	33	34	35	36	36	38	38	40	41	40	38	39	40	40	40
6. JAV	25	26	27	28	29	31	32	33	35	37	39	40	42	43	45	46	48	49	50
7. Olandija	38	38	39	40	41	41	42	42	42	44	45	46	46	46	45	46	46	46	46
8. Austrija	31	31	31	32	33	34	34	35	35	35	36	37	38	38	38	39	39	40	40
9. Vokietija	34	35	36	36	36	37	38	39	39	39	40	41	42	42	41	42	42	43	43
10. Ispanija	27	27	27	27	27	27	27	27	28	28	28	28	29	29	29	30	30	32	32
11. Danija	45	46	47	47	47	48	48	48	49	51	51	52	52	51	50	52	53	53	53
12. Japonija	17	18	18	19	20	21	21	22	23	24	25	26	27	28	28	29	30	30	31
13. Italija	31	31	31	31	31	32	32	32	32	32	32	33	33	32	32	33	33	32	32
14. Čekija	8	9	9	9	9	9	10	10	11	11	12	12	13	13	13	13	13	13	13

S.4 lentelė. Šalių vidutinis metinis bendrosios pridėtinės vertės (BPV) augimas (procentais) ir jį lemiančių veiksnių sudėtis: darbo valandos ir darbo produktyvumas 1995–2009 m; darbo produktyvumo komponentai (LP = LC + IT + CT + TR + OMash + NResid + Resid + Intang + +MFP = 100 proc.) ir žinių pagrindo veiksniai išreikšti procentais (sudaryta autorės)

Šalis	BPV augimas	Darbo val. indėlis	Darbo produktvumo indėlis (LP)	Darbuotojų sudėties indėlis (LC)	Kompiuterių įrangos indėlis (IT)	Komunikacijos priemonių indėlis (CT)	Transporto įrangos indėlis (TR)	Kitų mašinių ir įrenginių indėlis (OMash)	Negyvenamųjų pastatų indėlis (NResid)	Gyvenamųjų pastatų indėlis (Resid)	Nematerialiojo turto indėlis (Intang)	Daugiaveiksnio produktyvumo indėlis (MFP)	Žinių pagrindo veiksnių grupės indėlis
1. Lietuva	4,5	– 0,1	4,5	2	3	3	13	28	31	1	3	16	27
2. Švedija	3,2	0,5	2,7	9	8	3	4	25	5	1	7	39	65
3. Australija	3,5	1,2	2,3	7	26	3	6	12	14	1	11	19	67
4. Jungtinė Karalystė	2,3	0,3	2,1	17	22	2	2	5	15	1	4	32	77
5. Suomija	2,5	0,5	2	5	5	4	1	5	6	– 1	9	67	89
6. JAV	2,4	0,7	1,7	9	25	8	8	11	13	2	18	5	66
7. Olandija	2,3	0,6	1,7	14	20	2	6	4	9	3	14	29	79
8. Austrija	2	0,5	1,5	12	15	2	6	– 4	13	2	5	48	83
9. Vokietija	1,2	– 0,3	1,5	11	17	2	8	9	7	1	14	33	76
10. Ispanija	2,9	1,4	1,5	20	13	8	15	24	38	28	5	– 52	– 5
11. Danija	1,9	0,7	1,2	3	44	1	5	14	3	9	33	– 12	69
12. Japonija	0,4	– 0,7	1,1	13	13	3	3	10	5	1	10	41	81
13. Italija	0,8	0,3	0,5	42	34	7	21	44	47	1	9	– 105	– 13
14. Čekija	2,8	0	2,8	4	15	3	13	23	15	6	– 4	25	42

S.5 lentelė. Pagal svarbą išdėstyti šalių darbo produktyvumo komponentai 1995–2009 m.; didžiausia reikšmė – 1, atitinkamai mažiausia – 9 (sudaryta autorės)

Šalis	BPV augimas	Darbo val. indėlis	Darbo produktyvumo indėlis (LP)	Darbuotojų sudėties indėlis (LC)	Kompiuterių įrangos indėlis (IT)	Komunikacijos priemonių indėlis (CT)	Transporto įrangos indėlis (TR)	Kitų mašinų ir įrenginių indėlis (OMash)	Negyvenamųjų pastatų indėlis (NResid)	Gyvenamųjų pastatų indėlis (Resid)	Nematerialiojo turto indėlis (Intang)	Daugiaveiksnio produktyvumo indėlis (MFP)
1. Lietuva	4,5	– 0,1	4,5	8	6	7	4	2	1	9	5	3
2. Švedija	3,2	0,5	2,7	3	4	8	7	2	6	9	5	1
3.Australija	3,5	1,2	2,3	6	1	8	7	4	3	9	5	2
4. Jungtinė Karalystė	2,3	0,3	2,1	3	2	8	7	5	4	9	6	1
5. Suomija	2,5	0,5	2,0	6	5	7	8	4	3	9	2	1
6. JAV	2,4	0,7	1,7	5	1	7	6	4	3	9	2	8
7. Olandija	2,3	0,6	1,7	4	2	9	6	7	5	8	3	1
8. Austrija	2,0	0,5	1,5	4	2	7	5	9	3	8	6	1
9. Vokietija	1,2	– 0,3	1,5	4	2	8	6	5	7	9	3	1
10. Ispanija	2,9	1,4	1,5	4	6	7	5	3	1	2	8	9
11. Danija	1,9	0,8	1,2	7	1	8	5	3	6	4	2	9
12.Japonija	0,4	– 0,7	1,1	2	3	7	8	5	6	9	4	1
13.Italija	0,8	0,3	0,5	3	4	7	5	2	1	8	6	9
14.Čekija	2,8	0,0	2,8	7	4	8	5	2	3	6	9	1

S.4 lentelėje pateikti atlikto tyrimo rezultatai, įvertinti augimo tempą lemiantys veiksniai ir jų sudėtis. Rezultatai rodo, kad Lietuvos tiek BPV, tiek darbo produktyvumo augimo tempas yra didžiausias kitų labiau ekonomiškai pažengusių šalių kontekste. Lietuvos vidutinis darbo produktyvumo augimo tempas tiriamu laikotarpiu buvo 4,5 proc., iš kitų labiau išsivysčiusių šalių aukščiausias – Švedijos 2,7 proc., žemiausias – Italijos 0,5 proc. Po Švedijos atitinkamai yra Australija, Jungtinė Karalystė, Suomija, JAV, Olandija, Austrija, Vokietija, Ispanija, Danija, Japonija, Italija. Tačiau Lietuvos žinių pagrindo veiksnių grupė į darbo produktyvumą įnešė tik 27 proc. Kitų labiau išsivysčiusių šalių šis rodiklis gerokai aukštesnis – Suomija (89 proc.), Austrija (83 proc.), Japonija (81 proc.), Olandija (79 proc.), Jungtinė Karalystė (77 proc.), Vokietija (76 proc.), Danija (69 proc.), Australija (67 proc.), JAV (66 proc.), Švedija (65 proc.), Čekijos (42 proc.) (išskyrus Ispanijos ir Italijos atvejus). Iš rezultatų matyti, kad Lietuvos ūkio struktūros ekonominio augimo šaltiniai – negyvenamieji pastatai ir kitos mašinos bei įrenginiai.

S.5 lentelėje bendrojo darbo produktyvumo komponentai išdėstyti pagal svarbą. Didžiausiam įvertinimui skirta vieneto reikšmė, mažiausiam – devyneto. Šioje lentelėje pateikti rezultatai parodo akivaizdų Lietuvos atvejo išskirtinumą. Didžiausią indėlį į vidutinį metinį darbo produktyvumą tiriamuoju laikotarpiu įnešė negyvenamieji pastatai ir kitos mašinos ir įrenginiai (nei vienas augimą lemiantis veiksnys žinių pagrindo grupei nepriklauso). Tačiau kitose labiau ekonomiškai pažengusiose šalyse pastebimas aiškus dėsningumas – didžiausią indėlį į darbo produktyvumo augimą įnešė veiksniai iš žinių pagrindo grupės. Labiau išsivysčiusių šalių rezultatai – abu pirminiai augimą lemiantys veiksniai iš žinių pagrindo grupės: Australija (IT ir MFP), Jungtinė Karalystė (MFP ir IT), Suomija (MFP ir Intang), JAV (IT ir Intang), Olandija (MFP ir Intang), Austrija (MFP ir IT), Vokietija (MFP ir IT), Danija (IT ir Intang), Japonija (MFP ir LC). Vienas veiksnys iš žinių grupės: Čekija (MFP ir OMash). Išskyrus Ispanijos bei Italijos atvejus, atitinkamai (NResid ir Resid) ir (NResid ir OMash), iš kurių nei vienas pirminis augimą lemiantis veiksnys žinių pagrindo grupei nepriklauso.

Bendrosios išvados

1. Disertacijoje ūkio struktūrą sudaro kiekvienos ūkio šakos pridėtinės vertės augimą lemiančių veiksnių sudėtis ir jų agregavimas į bendros pridėtinės vertės augimą.
2. Ūkio šakų veiklos tipai: augimas, vystymasis, transformacija, struktūriniai pokyčiai. Šiuolaikinėje mokslinėje literatūroje pastarasis yra dažniausiai naudojamas.
3. Klasikiniu būdu ūkio šakos darbo produktyvumas yra matuojamas sukurta pridėtine verte per darbo valandą. Taip matuojama ir Lietuvos statistikos departamente bei Eurostato duomenų bazėse.
4. Disertaciniame darbe susisteminti ūkio šakų darbo produktyvumo apskaičiavimo metodai, išskirtos tokios jų grupės:
   4.1. Bendro produktyvumo apskaičiavimo metodas.
   Jis įvertina ūkio šakų veiklą struktūroje remiantis trimis hipotezėmis ir jų poveikį bendro produktyvumo augimui.

4.2. Bendro produktyvumo spartinimo įvertinimo metodas.
Jis įvertina, kurios ūkio šakos labiausiai prisideda prie bendro produktyvumo augimo.
4.1 ir 4.2 metoduose, paminėtuose 4 punkte, ūkio šakos darbo produktyvumas išreikštas sukurta pridėtine verte per darbo valandą.

4.3. Augimo apskaičiavimo metodas.
Jis įvertina ūkio šakos pridėtinės vertės augimo veiksnių sudėtį ir darbo produktyvumo komponentus. Šis metodas leido įvertinti naujausią, daug išsamesnį nei iki šiol paplitęs, požiūrį į darbo produktyvumo matavimą. Jo pagalba išvesti rezultatai, leido atlikti skirtingų šalių pagrindinių ekonomikos varomųjų jėgų lyginamąją ekonominę analizę.

5. Mokslinė darbo problema – klasikinis ūkio šakos darbo produktyvumo matavimas neatskleidžia darbo produktyvumo komponentų ir pastebimas trūkumas metodikų, leidžiančių įvertinti ūkio augimą lemiančių veiksnių sudėtį ir jų poveikį ekonominiam augimui.
6. Mokslinei problemai išspręsti disertaciniame darbe sudaryta metodika, leidžianti įvertinti šalių pridėtinės vertės augimo veiksnių sudėtį (darbo valandas ir darbo produktyvumo komponentus (kompiuterių įranga (IT), komunikacijos priemonės (CT), transporto priemonės (TR), kitos mašinos ir įrenginiai (OMash), negyvenamieji pastatai (NResid), gyvenamieji pastatai (Resid), nematerialusis turtas (Intang), daugiaveiksnis našumas (MFP), darbuotojų sudėtis (LC)) bei jų poveikį ekonominiam augimui. Metodika yra apskaičiuojamoji bei atvaizduojamoji ir priežastinių ryšių nenustato. Remiantis ūkio struktūra, pateikiamas aiškus rodiklių apdorojimo principas, kuriame įeigos ir išeigos duomenys gali būti surenkami kartu ir tarp ūkio šakų, ir tarp rodiklių.
7. Empirinio tyrimo rezultatai:
   7.1. Ūkio augimą lemiančių veiksnių sudėties įvertinimas pateikė aktualius Lietuvai rezultatus. Jis atskleidė Lietuvos ūkio struktūros ekonominio augimo pirminius veiksnius. Pasirodė, kad nei vienas jų žinių pagrindo augimą lemiančių veiksnių grupei nepriklauso. Tačiau daugumai labiau išsivysčiusių šalių yra būdinga, kad pirminiai augimą lemiantys veiksniai yra iš žinių pagrindo grupės.
   7.2. Atskleistas ūkio struktūros augimą lemiančių veiksnių reikšmingumo kitimo dėsningumas: šalims vystantis vis labiau tampa svarbūs žinių pagrindo grupei priskiriami veiksniai. Tačiau jie įgauna savo varomąją jėgą tik sukūrus tinkamą infrastruktūrą ekonominei plėtrai.
   7.3. Lietuva šiuo metu yra dar infrastuktūros kūrimo stadijoje. Siekdami paspartinti šalies ekonominę plėtrą, turėtume tiek kurti infrastruktūrą, tiek skatinti kompiuterių įrangos, komunikacijos priemonių, nematerialiojo turto, daugiaveiksnio produktyvumo ir darbuotojų kvalifikacijos veiksnių indėlius į Lietuvos ekonominį augimą.
   7.4. Lietuvos ūkio struktūros pagrindiniai darbo produktyvumo komponentai ilgalaikėje ekonominėje perspektyvoje, siekiant labiau ekonomiškai pažengusių šalių gerovės, turėtų keistis, t.y. ženkliai didesnį indėlį į ūkio struktūros augimą turėtų įnešti žinių pagrindo grupei priskiriami veiksniai.

8. Disertaciniame darbe pagrįsti nauji darbo produktyvumo komponentai, leidžia išsamiau įvertinti darbo produktyvumą ir papildo LSD bei Eurostato teikiamus duomenis.
9. Disertaciniame darbe motyvuotas naujas požiūris įvertina ūkio struktūros augimą lemiančių veiksnių sudėtį ir jų poveikį ūkio ekonominiam augimui.
10. Darbe pagrįstas naujas požiūris įvertina skirtingų šalių ekonominio augimo šaltinius. Jo pritaikymas mažiau išsivysčiusių šalių grupei sumažino iki šiol gyvavusį tokio pobūdžio tyrimų heterogeniškumą.
11. Pažymėtina, kad ir kiti veiksniai gali daryti ir daro poveikį šalių ūkių ekonominiam augimui (pvz. makroekonominės sąlygos, paklausos veiksniai, rinkos struktūra, užsienio prekybos politika ir t. t.). Tačiau pagrįsta metodika galima įvertinti gamybos veiksnių poveikį ekonominiam augimui (žemė nėra įtraukta), metodika yra apskaičiuojamoji ir priežastinių ryšių nenustato.
12. Išskiriami šie pagrįstos metodikos trūkumai: būtini detalūs plataus mąsto duomenys ir griežta metodologinė skaičiavimų seka lyginamiesiems rezultatams gauti bei ilgai trunkantys skaičiavimai.

Annexes[1]

Annex A. Report on Toma Lankauskienė
Annex B. The co-authors agreements to present publications for the dissertation defence
Annex C. Copies of scientific publications by the author on the topic of the dissertation

[1]The annexes are available in the CD attached to the dissertation

Toma LANKAUSKIENĖ

ECONOMIC STRUCTURE AND ECONOMIC GROWTH EVALUATION

Doctoral Dissertation

Social Sciences,
Economics (04S)

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ŪKIO STRUKTŪROS IR EKONOMINIO AUGIMO VERTINIMAS

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