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LABOR SHARE AND FACTORS AFFECTING IT IN THREE BALTIC COUNTRIES

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Contents

Lists of figures and tables:

Introduction

Income distribution is a widely discussed topic among politicians, scientists and society. In the last few decades there has been a great deal of research carried out analyzing the gap between rich and poor, skilled and unskilled workers. Inequality of income among individuals and households has captured attention of scientists from all over the world.

Nevertheless, scientists had forgotten another important aspect of income distribution until late 1990's. Functional income distribution, which explores dissemination of value created among main factors of production – labor and capital, has been comparatively under-researched in the scientific literature. This fact is rather surprising, since functional income distribution reveals the relationship between employers and employees, and shows how they split the national income.

Relationship between labor and capital income has a great effect on many aspects of economic and social life. According to Rodriguez and Jayadev (2010) understanding income distribution between labor and capital is essential for grasping the dynamics of the entire economy. Changes accruing to functional income distribution have significant macroeconomic implications, since they affect national growth rates, aggregate demand and other factors.

At the same time, functional income distribution can have implications on separate individuals through changes in wages and employment. For instance, if increasing foreign investment and productivity gains are absorbed by foreign capital owners, standard of living among the local population can develop much slower than expected, i.e. wage moderation would take place (Decreuse and Maarek, 2007).

Furthermore, according to Dauley and Garcia-Penalosa (2007), changes in labor share can also significantly affect GINI coefficients, which point to increasing income inequality between households. Factor distribution of income is regarded as a key component of income inequality by Dauley and

Garcia-Penalosa (2007), Guscina (2006), Checchi and Garcia-Penalosa (2009), etc.

Despite the obvious importance, this macroeconomic aspect of income distribution for a long time was explained by the theoretical conception that income shares are stable over a long-run and until lately, there was insufficient empirical data to prove otherwise.

Recently the discussion on changes in income distribution between capital and labor has been revived. Several authors have presented conclusive empirical evidence showing a worldwide decline in labor share, especially manifested in continental Europe (Blanchard, 1997; Berthold, Fehn and Thode, 1999; Rodriguez and Jayadev, 2010; EC, 2007; Giovannoni, 2010, etc.). One of the most recent contributions in this respect was made by Piketty (2014), his book focusing on capital and inequality attracted immense interest from the economists worldwide. Piketty (2014) argued that the returns from capital are growing faster than the economy itself, thus capital owners are able retain more wealth than others. This stressed the importance of changes in income distribution between labor and capital.

Once empirical evidence was available economists started to study not only the dynamics of factor shares, but also factors responsible for the changes in income shares of labor and capital (Bertolila and Saint-Paul, 2003; Bertoli and Farina, 2007; Diwan, 2001; Giovannoni, 2010; Guscina, 2006; Harrison, 2005; Rodic, 1998; Slaughter and Swagel 1997; Stockhammer, 2009; etc.). There have also been attempts to explain the effect of changing income shares on aggregate demand, its different components and tax base, which in turn have significant political implications (Stockhammer, Hein and Grafl, 2007; Hein and Vogel, 2007; Stockhammer, Onaran and Ederer, 2009; Lavoie and Stockhammer, 2012).

Despite these efforts a lack of systematic analysis to explain the situation remains. There is no generally accepted single theory of functional income distribution or unified measurement of factor shares, and there are number of forces discussed in publications, such as biased technological change,

intensifying globalization processes, weakening bargaining power of workers, changing industry structure, financialization and other country specific factors, which could have contributed to the long-term shifts in factor shares around the world.

Most of the attempts to analyze dynamics and factors affecting changes in income shares look at panel data of groups of countries, for instance OECD (Stockhammer, 2009; Guscina, 2006; Bertolila and Saint-Paul, 2003; Blanchard, 1997). There have also been several attempts to analyze the changes in functional income distribution in single countries, such as US, Germany, France, Italy (Poterba, 1997; Stockhammer, Hein and Grafl, 2007; Hein and Vogel, 2007; Torrini, 2005; Piketty 2014). Nevertheless, research has been mostly limited to large countries, despite the fact that small open economies[1] might feature different effects than large countries. According to Stockhammer, Onaran and Eder (2009), small economies might have essential differences from large economies, which might cause economy to shift from wage-led to profit-led due to larger import and export shares.

Research problem

Lithuania, Latvia and Estonia, as the Baltic countries, have undergone a rapid economic restructuration by moving from fully socialist to rather open market economies, opening their borders and leaving their citizens' incomes vulnerable to international competition, at the same time pressuring them into the informal sector.

Majority of scientific articles acknowledge the fact that labor share in national income is declining around the world, which points to large social implications, since labor might not be benefiting from technological improvements, openness of trade and mobility opportunities as much as capital. Rising income inequality is closely related to ownership of assets and bargaining power over them and therefore is adversely influenced by

[1] The author defines small open economies as active participants in the international trade and price takers in the world market (Wynne, 2007).

decreasing labor share. This is pointing to the theoretical and practical research importance of the driving forces of changes in income distribution between capital and labor. Nevertheless, the stability of labor and capital shares in national income and factors affecting them are rarely analyzed for small open economies.

This raises an interesting **research question:** does labor share in Baltic countries sustain its stabile level over the long-term, what economic factors are affecting labor share in small open economies and how?

The identified research problem will be analyzed firstly by revealing labor share dynamics in three Baltic countries and then by analysis of economic factors that might exhibit an effect on labor share.

The answer to this problem will provide a better understanding of the macroeconomic implications associated with changes in labor share and will highlight economic factors that influence the dynamics of labor share in small open economies.

Research object: Labor share in national income of the three Baltic countries.

Research aim: to analyze changes in labor share in national income of the three Baltic countries, to determine the causes for these changes and disclose their macroeconomic implications.

Research objectives:

1. To perform a systematic scientific literature on the topic of functional income distribution.
2. To analyze labor share trend developments around the world.
3. To identify possible economic factors in the scientific literature affecting changes in labor share.
4. To ascertain the measurement issues of labor share.
5. To outline the dynamics of labor shares in the Baltic countries, contrast and compare them.

6. To analyze the effect of outlined factors on labor share in the Baltic countries.
7. To evaluate macroeconomic implications associated to changes in labor share.

Substantiation of selected research methodology

Multiple researchers rely on error correction models, while carrying out analysis in the field of labor economics and apply different types of error correction models (Kristal, 2010; Serres and Scarpetta, 2002; Hein and Vogel, 2007; Stockhammer, Hein and Grafl, 2007; Berthold, Fehn and Thode, 1999, etc.). Vector error correction model (VECM) is selected for the research of this thesis. Error correction models (ECM) enable the distinction between long and short-term relationships of variables in the model, which provides a dynamic aspect to this research, as well as it allows to find the causal factors that affect the dependent variable – labor share.

Several sources were used to construct the database for this thesis. Mainly macroeconomic statistical data was retrieved from EUROSTAT database. Some data is taken from AMECO database and shadow economy data is retrieved and compiled from two sources: Schneider at al. (2010) and Schneider (2015). For the purpose of this research quarterly time series data was used for three Baltic countries: Estonia, Latvia and Lithuania and a sample for the period of 1995Q1-2015Q2. Data for some variables is more limited, thus this further shrunk the sample.

For data processing Eviews statistical package was employed. Model liability tests were performed to check for model stability, normality, autocorrelation and homoscedasticity. Analysis also includes long and short-term causality analysis and variance decomposition for VECM model of three Baltic countries.

Econometric analysis is complimented with labor share trend exploration, confirming decreasing labor share trend in all three Baltic

countries for the period of past 20 years. Furthermore, labor share measurement methodology was also addressed in this thesis.

Results of the analysis were explained for each of the three Baltic countries individually with their specific VECM model and similarities/differences were highlighted.

Scientific significance of the dissertation

The topic of functional income distribution only in recent years has gained renewed attention from the scientific community. The topic still lacks systematic analysis, faces measurement issues, there is no generally accepted single theory of functional income distribution and there are number of forces discussed in publications, among them country specific factors, which could have contributed to long-term shifts in functional income distribution around the world. The performed research firstly allows us to better understand the measurement issues related to labor shares. Secondly it highlights the dynamics of labor share in national income in the three Baltic countries, reveals if movements can be explained by technological change or wage gaps persists, signaling at the effect of other economics factors.

The performed research has not only revealed the economic factors effecting changes in labor share in the Baltic countries, but also points to the difference between factors affecting the movements in labor share in large economies and contrast them to the effect on small open economies, such as the Baltic countries.

Another imminent issue is the diminishing labor bargaining power and protectionist measures undertaken or ignored by governments. Either of the two political decisions: liberalization or protectionist policies, without economic research to base them could lead to reduced economic efficiency because of the discrepancies between wages and productivity. In the internationally open market higher wages could mean the loss of international competitiveness and further reduction in employment and labor share.

Nevertheless, lower wages could demotivate workers and further reduce productivity. Thus, this research will help better uncover the factors behind movements in income shares in small open economies.

Constrains of the study

Researching labor shares at macro level poses several measurement dilemmas, which can be taken into account, however only up to a certain point and certain assumptions need to be made.

The greatest limitation of this work is related to data availability. Empirical analysis of a single small country is challenging, since most data for the Baltic countries is only available starting 1995, which gives up to 20 years of data. To name a few issues faced due to short analysis period:

- Some data might be sensitive to selected start and end dates,
- Relatively small samples can eliminate variables, due to non-normal distribution of data.
- Research implications are only stated for medium-term and will include interpretations of single countries.

These data limitations are overcome by performing graphical data analysis and eliminating independent variables, which do not meet criteria, from econometric research, this way ensuring the stability and reliability of econometric models. Nevertheless, this constrains the author from interpreting the effect of removed factors, this way limiting the scope of analysis.

Approbation and dissemination of research results

Dissertation results were published in the scientific publications and results were presented in international conferences:

1. Razgune, A. and Lazutka, R. (2015). "Labor Share Trends in Three Baltic Countries: Literature Review and Empirical Evidence", Ekonomika, Vol. 94 (1), ISSN 1392-1258 – Vilnius, Vilnius University, p.p. 97-116
2. Primukhamedova, M. and Razgune, A. (2014). "Business Cycle Dynamics of the CEE Euro Candidates in the Face of Economic Crisis", 2014 Global Business Conference, Conference proceedings, ISSN 1848-2252
3. Pacebutaite, A. (2014). "Effect of Globalization on Labor Shares in the Baltic Countries", 6th International conference "Economic Challenges in Enlarged Europe", Conference proceedings, ISSN 2382-6797 - Tallinn, Estonia.

The topic of dissertation was further extended in the national research project "Factors of Income Distribution: Labour, Capital and Welfare State", by the analysis of the gap between functional distribution of income and household income at the micro level, its dynamics and unequal distribution.

Dissertation structure and scope

Dissertation is composed of introduction, three chapters, conclusions and recommendations, references and appendixes. Dissertation scope is 111 pages (without appendixes), 3 tables, 20 figures, 100 literature sources and 7 appendixes.

The first chapter of the research – theoretical analysis – presents the definitions of income distribution as well as overview of the contribution by the scientific community to the topic of functional income distribution and labor share trend. Second part of the theoretical analysis chapter discusses in detail the economic factors influencing changes in labor shares. And the last

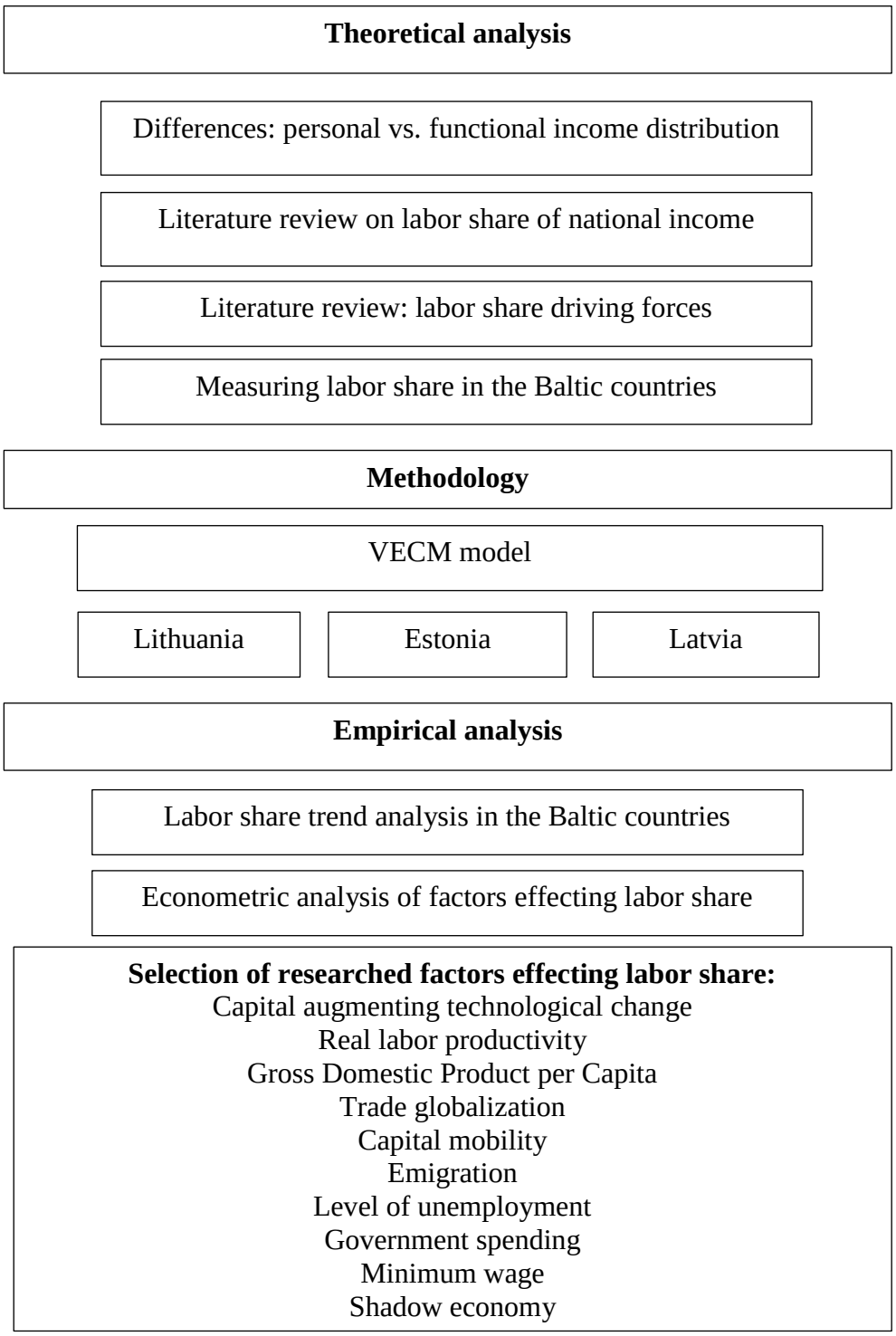
part of the theoretical analysis chapter is dedicated to discuss the issues faced in measuring labor share in national income, which is essential for further research to avoid discrepancy of the results.

Theoretical analysis is followed by the second chapter of the dissertation – methodology, which clarifies the methods, used for the analysis of the identified issues and describes the selected econometric model.

Third chapter of the research includes labor share trend analysis in the Baltic countries, economic calculations based on the selected econometric model, which measure long and short-term relationships between labor share in the Baltic countries and independent variables selected on the basis of theoretical analysis and data availability. Third chapter is concluded by the overview of the obtained results and their implications.

The dissertation is concluded with an overall overview of results and direction for further research. The detailed structure of the thesis is presented in figure 1.

Figure 1. Structure of the thesis



Source: Compilation by the author

1. Labor share as a research object in scientific literature

1.1 Definition of income distribution: personal versus functional

Before starting the analysis, it is important to clearly outline the main terminology and concepts used in this research.

Income distribution has always been a fundamental concern of economic theory and policy. Classical economists were mainly concerned with income distribution between main factors of production (labor, capital and land), however later this focus has shifted towards income at a microeconomic level, among households and individuals. Therefore, income distribution in scientific literature is generally separated into *personal income distribution* and *functional income distribution*.

Personal income distribution is mainly oriented towards equal distribution of income among representatives of different employee classes, skilled and unskilled workers, who possess different levels of education, experience, etc. (Giovannoni, 2010). Personal income distribution concentrates on household income distributions and for analysis often employs micro level data obtained from surveys and other similar sources, and measure of inequality, such as GINI coefficient.

Most literature tend to focus on changes in wage inequality, much less attention is devoted to labor share, the movements of which can adjust income inequality. On the other hand, functional income distribution is often associated with macroeconomic analysis, which refers to income distribution among main production factors – capital and labor, i.e. relative income received by the owners of factors of production (Giovannoni, 2010). Changes accruing to functional income distribution have significant macroeconomic implications, since they affect national growth rates, aggregate demand and other factors.

Nevertheless, functional income distribution can also aid in exploring a link between incomes at macroeconomic and household levels. It is important

to analyze this issue to bring awareness to people regarding the relation between macroeconomic indicators and their incomes. Often improvements in national macroeconomic indicators are assumed to be proportionally translated into incomes of individual households without actual research (Atkinson, 2009). For instance, the effect of globalization to economic growth was rather immense. However, the capital is concentrated in the hands of a few percent of the population and now constitutes a larger share of national income[2] than before in the majority of countries (Dew-Becker and Gordon, 2005). This argument is also supported by Piketty (2014), who was able to present extensive data in this respect. Piketty also points out that this process has cumulative effects, thus capital owners might even further extend their wealth when compared to those who retain only labor income.

Furthermore, it is important to note, that for instance an increase in contribution of employees often is not fully reflected by direct increase in the wage of employees, part of the increase is usually paid by employer to social security and pension funds. In societies where welfare benefits and pensions are low, employees might not appreciate the increase in social security or pension funds paid by employers, which they do not actually feel it in their pockets. Thus, this research will move in the direction of most recent renewed interest in functional income distribution.

Thus, it is essential to define not only functional income distribution, but also *factor shares: Labor and Capital*, which are the central object in the functional income distribution analysis and are typically measured using aggregate data. Simplified mathematical expression would show that the sum of factor shares divided by total output is assumed to be equal to 1, and could be expressed as: total compensation of employees and capital income divided by total output after subtraction of indirect taxes. A slightly more precise expression of capital share would also take into account income and wages of

[2] National income in this thesis is used as an interchangeable term to national output and is measured as gross value added in the selected country.

unincorporated enterprises. Thus, according to Ellis and Smith (2007), capital share (CS) can be expressed using the following mathematical expression:

$$CS = \frac{GOS + In_u - w_u}{Y} \quad (1)$$

where GOS is gross operating surplus, In_u and w_u are income and wages of unincorporated enterprises, Y is total output minus depreciation and indirect taxes, plus subsidies).

As seen from the equation, unincorporated income is adjusted to exclude wages earned by business owners and self-employed from the capital share, since this income is perceived as labor income. Nevertheless, labor share is often computed first and capital is treated as a residual (Gurriero, 2012). Thus, for the purpose of this dissertation the author will mainly focus on the labor share (LS) in national income, which could be decomposed into:

$$LS = \frac{EC}{Y} = \frac{w * n}{p * q} \quad (2)$$

where EC is employee compensation, Y is total output (minus depreciation and indirect taxes, plus subsidies), w – nominal average wage, n – number of employees, p and q represent price and output per worker. Labor share composition in more detail can be rewritten as:

$$LS = \frac{w}{p} * \frac{1}{\frac{q}{n}} = \frac{w_r}{A_L} \quad (3)$$

From this equation we can summarize that labor share can be decomposed into real wages (w_r) and labor productivity (A_L). Then increase in wages is often transferred into the increase in labor share, whereas increase in labor productivity has a tendency to decrease labor share. The later can also be regarded as labor-augmenting technological change (EC, 2007). Therefore, if real wages and productivity grow at the same pace, labor share should remain stable, but if real wages outpace labor productivity, the share of labor in national income should go up, and vice versa.

Nevertheless, this relationship is not as simple as it looks, since other factors might come into play and have effects on real wages or productivity (Giovannoni, 2010). On the other hand, we should not forget the role of profits as well, since the changes in functional income distribution might be due to changes occurring to capital share, rather than labor.

Another issue, related to measurement of factor shares is, that it is difficult to draw a fine line between labor and capital income, since it is common for individuals to receive income from few different sources. Therefore, it is a matter of interpretation, rather than two mutually exclusive groups (Krueger, 1999).

To sum up, the factor shares are often measured using aggregated macroeconomic data, since they are employed to reflect a "macroeconomic functioning of the economy" (Guerriero, 2012). Nevertheless, there are attempts to estimate factor shares using microeconomic data, such as business sector surveys (Young, 1995; Wolff and Zacharias, 2007), however all studies express concerns over various limitations. In this dissertation the main focus will be concentrated on labor share in national income and the challenges measuring it will be discussed in more detail in later chapter on measurement issues.

1.2 Overview of theoretical research on the topic of Functional income distribution

Income distribution roots can be traced to the works of **classical economists** such as Adam Smith, Thomas Malthus and David Ricardo. Later on, their followers have developed different theoretical and conceptual points of view and divided themselves into different schools of thought. However, all of them tend to focus on basic economic concepts including factors of production and remuneration (profits and wages) for their inputs.

One of the approaches to distribution of income is **neoclassical**, which sees resource allocation and factor prices as central issues of income distribution. It postulates that each factor of production is paid its marginal product and factor prices are determined by relative factor supply and demand interactions in a perfectly competitive market. This school of thought has provided us with marginal productivity theory of distribution, which assumes competitive market in both: product and labor markets, ensuring fair distribution of income. Therefore, profits and wages depend on the scarcity/abundance of factors, preferences and their productivity (technology).

Furthermore, assuming factor endowments do not change, labor demand curve will be determined by technology and labor supply curve will depend on preferences (Stockhammer, 2009). This relationship can be easily expressed by an aggregate production function with two factors of production (capital and labor), such as the standard neoclassical Cobb-Douglas aggregate production function, where capital and labor are determined by production technology, which equally increases marginal products of capital and labor, thus employees and employers benefit equally from technological progress (Kristal, 2010).

In neoclassical economics factor substitution plays a significant role in ensuring balance between savings and investment. To generalize, if elasticity of substitution between capital and labor is equal to 1 and there are constant returns to scale, as assumed by Cobb-Douglas production function, then the relative factor shares should remain stable.

Up until the end of the 20th century, scientists observed the phenomena of stable factor shares over a long period of time; therefore, constancy of factor shares was more implied than explained by neoclassical marginal productivity theory. On the other hand, Solow (1957) offered an explanation of constancy by relaxing assumptions of Cobb-Douglas production function, which was in line with marginal productivity theory of neoclassical economists. He tried to explain the observed constancy in terms of labor intensive technological progress, which compensated the observed increase in capital-labor ratio, as the capital and technologically augmented labor ratio remained constant, i.e. technological substitution of capital and labor.

Another view, coming from a rather different theoretical perspective, is expressed by so called Post-Keynesian economists, such as Kaldor (1957) and Pasinetti (1962). Some call these theories "heterodox" rather than Keynesian, since Keynes himself did not explicitly concentrate on income distribution in his *General Theory* (Giovannoni, 2010). His focus was more laid on short term determinants of output and employment (Stockhammer, 2009).

Nevertheless, Keynes provided valuable suggestions in respect to the effects of income distribution on employment, level and composition of aggregate demand. He assumed diminishing marginal returns, thus with fixed amount of capital, prices would be higher when output increased, leading to an inverse relation between employment and purchasing power of money wages. This also suggested an inverse relation between labor share and effective demand, output and employment (Kregel, 1978).

According to Kregel (1978), distribution of income in post-Keynesian theory extended Keynes ideas, by stressing the role of investment in determining not only the output and employment, but also relative shares of labor and capital in the economy. As opposed to neoclassical view, they stipulated that propensities to save from wages and profit differ, thus a critical role in determining division of income between profits and wages should be attributed to aggregate savings and investment.

Post-Keynesians did not recognize the role of technology or bargaining power in their models (Stockhammer, 2009) and assumed that since the propensity to save from profits is higher, the level of investment divided by national output should determine the share of profits in national income (Kaldor, 1957), i.e. post-Keynesian theories see factor shares as endogenously provided by investment behavior of firms.

Nevertheless, such view has also received its fair share of criticism. The main fault related to Kaldor's work is often associated with over restrictive assumptions. He made assumptions that productivity of capital and labor, as well as capital-labor ratio and distribution of income are constant over a long term. Thus Kaldor is often associated with stability of factor shares, this phenomenon is also often called a "stylized fact of economic growth". Solow (1957) was one of those who questioned this fact and criticized Kaldor's assumptions.

Nevertheless, Pasinetti (1962) further corrected Kaldor's model, to assume that the share of profits also occurs to workers, i.e. they also receive profits. Thus, their overall propensity to save does not match the propensity to save from wages and even though workers' saving behavior affects distribution of profits between the two classes, their decisions do not have influence on the overall functional income distribution[3].

The main conclusion of Kaldor's calculations is that income distribution is associated with the investment rate, which in turn is a variable of demand. For example, increasing demand for investment (assuming full employment) would increase total aggregate demand, prices and profit rates. From this we can see that capital share depends on investment-output ratio. Therefore, often calculations based on Kaldor's model are associated with demand-based explanations (Giovannoni, 2010).

The theories of both schools of thought generally assumed full employment and perfect competition, which makes them still rather distant from reality. For

[3] For more detailed mathematical calculations of this relationship you can refer to Bertoli and Farina (2007).

instance, the notion of full employment in neoclassical economics is essential and if this assumption is relaxed the relationship between wages and marginal product of labor is no longer clear (Stockhammer, 2009).

On the other hand, contribution of Marxian and post-Marxian economists to the topic of income distribution was a bit different, but also significant. Followers of Marxian theories, such as Goodwin (1967), stress the importance of class struggle on income distribution and perceive labor share as an inverse function of unemployment. At the same time it stresses the relationship between labor share and capital accumulation.

Kalecki's (1938) work was one of the first to relax some of the assumptions. He looked at an economy as if without driving forces to the state of full employment, i.e. not self-clearing as in neoclassical theories. He allowed for imperfect competition, assumed that firms have power to set prices (which are not very responsive to changes in demand) by producing under full capacity and policies of the State has the power to restore full employment and change income distribution. Furthermore, he postulated that the degree of monopoly would have an effect on income distribution. Nevertheless, he did not elaborate much on factors which might have an influence on the degree of the monopoly itself. He mentioned that bargaining power of workers would have an effect on monopoly, but it is unclear how this power would be exerted. Kalecki assumed that marginal propensity to save is higher for capital, thus consumption is expected to increase when wages rise (Stockhammer, Onaran and Ederer, 2009).

Thus, increase in nominal wages will be translated into increase in prices at the expense of competitiveness loss and would not affect functional income distribution, since prices are not responsive to demand (Stockhammer, 2009). Nevertheless, this cost transferring might be limited in open economies due to international competition and therefore might reduce profits instead (Dunhaupt, 2013). Therefore, from the theoretical perspective we can conclude that, different paradigms offer different approaches to the issue, but only

Kalecki's (1971) model was the one at the time that did not rule out possible changes in functional income distribution.

More recent theoretical contribution on the role of functional income distribution in macroeconomic models was presented by Bertola, Feollmi and Zweimuller (2005). They offer an extensive overview of growth models from the perspective of income distribution. Their overview includes explanations of Harrod-Domar growth model, which identified the conditions of steady growth, and is often followed when discussing the interactions between factor shares, saving propensities and steady growth rates. They discuss the implications of neoclassical growth model, where factor ownership is a determinant of saving behavior of an individual. Another important contribution was from Bertola, et. al. (2005), who also overview the topics of exogenous productivity growth, bounded marginal product of accumulated factor and the relationship between optimal savings and sustained growth. Nevertheless, much attention in this work is given to policy implications on factor shares, i.e. distortionary taxation.

Bertoli and Farina (2007) have also analyzed the interplay between factor shares and economic growth. They focus on possible impact of significant change in functional income distribution on interpersonal income inequality. The article also presents an extensive overview of the literature on functional income distribution by different schools of thought and other researchers. The authors try to explain labor share movements by sectorial composition of production, country specific factors, impact of technological progress and institutional changes. Bertoli and Farina (2007) suggest that according to their literature analysis there should be a positive association between the size of capital share and economic growth. However, in recent decade growth of OECD countries and European countries was sluggish and did not reflect this statement. The authors suggest that there might be methodological issues to produce a consistent measurement of factor shares, accounting for self-employment or changes in sectorial composition of production. Due to these reasons it is difficult to compare findings and find them consistent.

Another recent and extensive theoretical contribution comes from Hein (2012), where the redistribution of national income between capital and labor is stressed. Author argues that financialization has affected long-term developments. Primary focus is laid on the channels through which financialization impacts changes in distribution, investment in capital stock and consumption. Hein further extended his research the following year (Hein, 2013), where he integrated financialization factor into Kaleckian approach and summarized the channels through which financialization and liberalization has contributed to labor share decline since early 1980 in fifteen advanced capitalist economies.

One of the most recent theoretical overview of theories about labor share and its current developments is presented by Dunhaupt (2013), who focuses on the evolution of labor share in selected OECD countries. This work summarizes different theoretical perspectives and available empirical literature on potential explanations of labor share declines. Dunhaupt also provides recommendations on how to stabilize the falling labor share depending on the theoretical perspective. She recommends strengthening labor bargaining power through higher involvement of trade unions and strengthening of redistributive power of the public sector.

To sum up, there are clear differences between different schools of thought. Nevertheless, most of economic models provided by Neoclassical, Keynesian and Marxian economists use over restrictive assumptions of closed economy and full employment (Stockhammer, 2009) and relaxation of these assumptions might be problematic in overviewed models. Stockhammer (2009) further adds that such restrictive assumptions are far from the analyzed situation which is very dynamic and medium-term should be preferred in the analysis to long-term. This is especially relevant to small open economies which experience rapid liberalization process, structural unemployment, declining labor unions, structural changes, etc.

1.3 Overview of empirical studies on the trend of labor share

Besides Kalecki's remark about the possibly changing factor shares in an open economy, until recently it was assumed that relative shares of production factors – labor and capital – are stable over a long term. According to Bertoli and Farine (2007) this phenomenon was even called Bawley's Law in honor of Arthur Bowley who demonstrated that labor share has remained constant over time, therefore scientific interest diminished.

Most theoretical growth and capital accumulation models base factor share stability on one of the following factors: elasticity of substitution between factors of production is always one, or technological change, which is only labor augmenting (Acemoglu, 2003). Nevertheless, Acemoglu (2003) raises an interesting question, why would firms, oriented at profit-maximization, choose to invest into innovations that only improve labor intensive technologies?

Recently, after the empirical findings contradicting the status quo started to emerge in the scientific literature, the interest towards functional income distribution has returned.

Numerous authors have presented conclusive empirical evidence showing a worldwide decline in labor share, which is especially manifested in continental Europe. First scientific attempts to empirically analyze functional income distribution in the last two decades tended to focus on the trend of labor share itself. Blanchard (1997) was one of the first to question theoretical assumptions on the stability of factor shares over time. He tried to explain the medium-term movements in factor shares in OECD countries using the developed model for employment and capital accumulation in monopolistically competitive market, where there are costs associated with labor-capital ratio adjustments.

Blanchard tested this model and tried to explain factor share movements for a particular country – France. He found that relative factor prices did not reflect factor share movements in continental European countries during the period of 1980-1995. This divergence from a stable level, according to the

author, can be due to long time span needed for adjustment of factor proportions to factor prices.

On the other hand, he did not rule out the possibility that the relations between factor prices and quantities have shifted due to division of rents between workers and employees or capital biased technological change. Blanchard also tried to prove the effect of bias technological change but his empirical evidence was week.

Giammarioli, Messina, Steinberger and Strozzi (2002) studied the evolution of labor share in selected EU countries and US with the help of the dynamic labor demand model, over the period of 1960-1998. They found that labor share in continental Europe fell starting the 1980s and onwards, whereas in Anglo-Saxon countries it remained rather constant. They also confirm the importance of employment protection legislation and union power to movements in labor share, i.e. tighter the legislation, higher the fluctuations in labor share for similar fluctuations in economic conditions. Whereas de-unionization process in most EU countries is assumed to translate into reduced wage demands and the downwards shift of the equilibrium schedule.

Later the general decline in labor share was confirmed by the results of Rodriguez and Jayadev (2010), their research showed statistically significant downwards time trend of labor share across two large samples (UNIDO and UN datasets). Authors highlighted this trend as a general phenomenon, which is not limited to the developed countries. They also found a decline in labor share across sectors which could not be solely explained by shifts in production to sectors with a lower average labor share.

Another research confirming this trend was performed by Guerriero (2012), who looked at a sample of 89 countries over the period of 1970-2009 and once again confirmed that labor shares are not constant over time and across countries. She found a general decrease in labor share and extended her research by using per capita GDP measure to relate economic development to labor share. Nevertheless, the author concludes that relationship between these

factors, once labor share is properly adjusted for self-employment, is not straightforward.

An important contribution related to labor shares' trend developments was also made by EC (2007, ch5), who decomposed labor share into real wage, capital-output ratio, and capital-labor ratio (inverted) in order to show the negative trend of labor share in EU countries. They found a decline in labor share trend when comparing two periods (1960-1980 and 1981-2006) in all EU15 countries.

Furthermore, they have stressed that the changes in labor share caused by its components - real wages and productivity - do not fully explain its movements, because short-term developments, such as business cycle fluctuations, which effect real wages and productivity - make up only one part of the equation. Long-term trend developments, conditioned by structural changes in underlying economic factors, also play an important role. These results further confirmed the lack of stability of factor shares as previously assumed by the early models. The reason for this might be that in a certain economic setting (i.e. intensifying globalization) real wages could be rising due to improvements in labor productivity, whereas labor share might be declining due to intensifying competition and converging factor prices due to the mobility of capital (EC, 2007).

On the other hand, Young (2010) looked at labor share along the lines of Sollow (1957) research studying US economy in separate sectors and found that relative stability of aggregate labor share in US is due to offsetting shifts in different industries.

Despite the abundant research on the stability of labor share, the trend analysis of labor share for small open economies, including the Baltic countries is very limited in the scientific literature. This is often due to the lack of time series data, which for the Baltic countries is available at most from 1993 and allows analysis only over a medium-term. However, according to Stockhammer (2009), medium-term analysis is more realistic than long-term from the perspective of theoretical economic models, since economies not

always perform at full capacity and are open to external markets. Also medium-term analysis is more relevant to policy makers (Arpaia, Perez and Pichelmann, 2009).

Nevertheless, there is some research related to labor share trends, which includes the Baltic countries. One of them is ILO (2011) report, which looked at European countries (including Lithuania, Latvia and Estonia) as a group and found significant fluctuations in their aggregate labor share in the past several years.

However, this research did not reflect country specific fluctuations, or fluctuation in the labor share of small open economies, since it focused solely on aggregate measure of labor share, despite the possible differences between large and small, industrial and developing economies.

Sileika, Tamasauskiene and Barteliene (2010), on the other hand, did a comparative analysis of wages and labor productivity in Lithuania and as part of their research they looked at a labor share change in Lithuania over the period of 2001-2008. Their findings suggest that labor share in Lithuania increased by 6% over their analyzed period. However, this research shows labor share fluctuations only over a short period of time and can provide biased results on the medium-term interpretation due to timing of the economic cycle reflected in the selected start and end dates of the indicator (Meager and Speckesser, 2011). Also authors did adjust labor share for changes in self-employment, nor take into account changes in tax rates. However, they recognize the importance of labor share studies.

Similar results were obtained by Meager and Speckesser (2011), who also found labor share increase in Lithuania and Latvia over the period of 1990-2008. Nevertheless, this study also does not adjust for self-employed and use GDP as an output measure, which might also distort calculations due to differences in tax rates over the analyzed period. Authors recognize problems with this indicator by stressing its measurement issues.

EC (2007), on the other hand, incorporated new EU member states (among them the Baltic countries) in its research and found that adjusted labor share

declined in all three Baltic countries, as well as, in other new EU members and EU15 countries. Furthermore, they stressed that components of labor share (labor productivity and wages) are not able to fully explain the behavior of labor share.

Thus, as seen from the overview of labor share trend research, majority of authors find a declining trend of labor share when analyzing large economies or their groups, but they are not able to fully justify this decline. Furthermore, there is a lack of research and substantial differences between results obtained in respect to small open economies, such as Baltic Countries, where the trend of labor share is even less explained. Therefore, next chapter of this thesis will overview factors mentioned in scientific literature, which might be exerting influence on labor share.

1.4 Overview of labor share and its driving factors

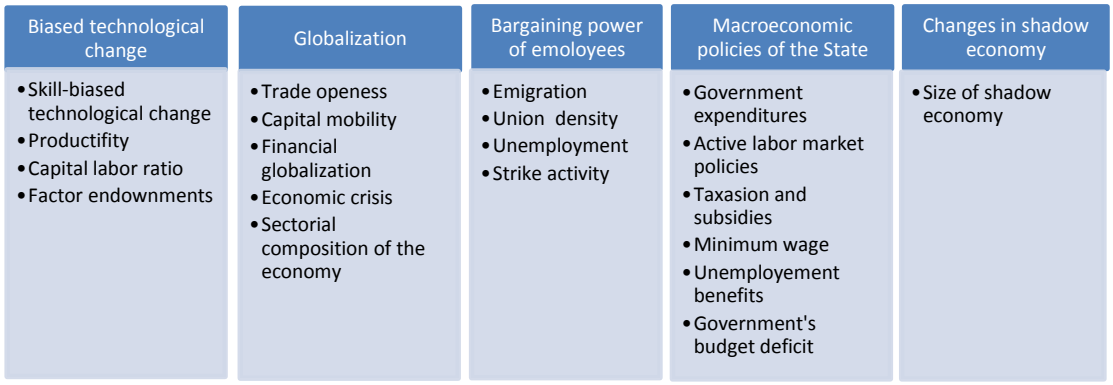
Once empirical data became available scientists started to focus their analysis on the labor share trends. However, some recent studies adopt the assumption of a negative trend in labor share from previous research and continue on a notion that labor share components are not able to fully explain the downward trend, thus they focus on exogenous factors affecting functional income distribution.

Different scientific contributions outline different combinations of economic and institutional factors responsible for the changes in factor shares. The summary of the overviewed studies related to labor share movements, and factors affecting them, is presented in the Appendix 1.

There are various factors mentioned by different authors, from often researched, such as trade openness, liberalization, financial globalization, biased technological progress, active labor policies, bargaining power changes, etc.; to less popular connections to factor shares, such as level of privatization (Torrini, 2005; Azmat, Manning and Reenen, 2007), level of development (Maarek, 2012), democracy (Rodric, 1998), financial crisis (Diwan, 2001) and even feminization of labor force (Finnoff and Jayadev, 2006), which might also affect labor share.

Thus, due to the abundance of these factors and differences in their measurements the author tried to group them, by distinguishing the main and most extensively discussed groups of factors affecting labor share: *biased technological change*, *globalization, bargaining power of employees, macroeconomic policies of the state and changes in size of shadow economy*. Main sub-factors of these groups are listed in figure 2 and factor groups are further overviewed in detail and adapted to the case of the Baltic countries.

Figure 2. List of sub-factors researched in scientific literature as effecting labor share



Source: Compilation by the author

Biased technological change

Technological developments in the past few decades have reduced transaction costs within and between countries. Recently economists stared to doubt the effects of technology on capital and labor as identified by Cobb-Douglass function. Some tend to relate worldwide decline in labor share to the biased effect of technology towards labor and capital, as well as towards skilled and unskilled labor.

After regaining independence Lithuania, Latvia and Estonia joined the ranks of other developing countries that proceeded with extensive market and capital account liberalization in their economies. Since Baltic countries were capital receivers rather than donors, capital accumulation increased. Furthermore, along the processes of liberalization, trade with developed countries increased technology transfer through technology embodied in imported capital goods, this way it might have increased the growth rate of total factor productivity and promoted capital-augmenting technological change (Maarek, 2012).

According to the study of Bentolila and Saint-Paul (2003), essentially labor share is related to capital-output ratio and this relationship is shifted firstly by

capital-augmenting technological progress, then by price of imported materials. Authors also found a significant relationship, that shows there are mismatches between marginal product of labor and real wage due to labor adjustment costs and to lesser extent union wage bargaining. In support of this argument, studies performed by IMF (2007) and EC (2007) have found that technological change was one of the main causes for the decline in labor share and the effect of globalization could be interpreted as less important.

European Commission contribution was later extended by Arpaia, Perez and Pichelmann (2009), who also analyzed EU15 over the medium-term as in a previous EC study and used a model similar to Bentolila and Saint-Paul (2003). They split changes in labor share into three components: sectorial composition, employment structure and employees' remuneration. Authors quantified contributions of shifts in composition of economic sectors and employment to labor share dynamics. They stressed the importance of complex interaction of factors such as demand and supply conditions for capital, high and low skilled labor categories, nature of technological progress and imperfect market structures. Their research showed that main factors influencing a declining trend of labor share in EU15 are: increasing amount of capital per worker in the economy, biased technological process and substitution of different labor skill categories. They find that skilled labor and capital complement each other and capital and unskilled labor act as substitutes.

However, it is stressed, that the importance of institutional changes (due to globalization) should also be considered as relevant in this process. Ellis and Smith (2007) took a slightly different perspective putting more weight on institutional differences between countries. They analyzed industrialized countries and recognized the importance of technological progress and institutional factors. Their analysis shows that labor bargaining power is declining, thus firms are able to reap larger share from national income. This effect is particularly articulated in countries with more rigid labor market institution and could be decreased by increasing competition and innovation.

Furthermore, *Skill-biased technological change* is one of the widely used explanations for rising wage distribution between skilled and unskilled workers (Atkinson, 2009; IMF, 2015). Atkinson and others (Krusell, Ohanian, Ríos-Rull, and Violante, 2000; Jaumotte and Tytell, 2007; Monfort, Vandenbussche, and Forlani, 2008) argue that skill-biased technological change has affected skilled and unskilled labor differently, since elasticity of substitution between capital and unskilled labor is higher than between capital and skilled labor. Similar estimations where made by IMF (2007) and EC (2007), who used Information and Communication Technology (ITC) proxy and capital-labor ratios to measure the effect of skill-biased technological change on labor share in OECD countries. Although Krusell et al. (2000) state, that unskilled labor has not only suffered from cheaper labor from abroad and mobility of firms, but also from better and cheaper capital equipment. Thus, technological advances have favored skilled workers, making skilled work more of a compliment to capital, and unskilled labor became a substitute for capital.

Slaughter and Swagel (1997) have found the widening gap between wages of skilled and unskilled labor. According to them, globalization had only a modest effect on wages, whereas changes in technology were a main factor contributing to shifts of demand for labor which favored skilled workers. Furthermore, Hutchinson and Persyn (2011) suggest that lower trade costs and international low-wage competition together with industry concentration have negatively impacted labor share. However, even more pressure on labor share was exerted from skill-based technological change and cyclical price changes of intermediary goods. They build on Bentolila and Saint-Paul (2003) model and use the following set of factors to explain the changes in labor share: market structure developments that occurred together with EU integration process, increased mobility of firms (increased competition) and changes in technology and factor markets.

Nevertheless, there has also been skepticism regarding the effect of biased technological change on labor share. For instance, Torrini (2005) has recognized the importance of different economic sectors and possible

calculation errors if an aggregate measure of labor share is selected. He analyzed Italian profit share in manufacturing, which is more exposed to external competition and less to privatizations. Torrini (2005) found that profit share in the manufacturing sector declined together with returns on capital stock, whereas non-manufacturing sector was affected by privatizations, which led to growth in total factor productivity. The author suggests that profit share growth in the 90's in Italy was mainly led by redistribution of rents rather than biased technological change.

Furthermore, Stockhammer (2009) replicated the calculation process of IMF (2007) and EC (2007) and found that their results related to technological change are not robust and suffer from econometric problems. According to Stochammer (2009), the effect of globalization together with financial globalization and union density measures were statistically significant determinants of labor share at least in non-Gent countries.

The effect of biased technological changes on the labor share, to our knowledge, is not studied in the Baltic countries, but its effect on labor share in other countries is widely discussed in the literature, thus it will be included in this research.

Globalization

Globalization is often seen as a major factor affecting labor shares especially over the past 20 years in majority of countries. A well-known classical Heckscher-Ohlin model (H-O) assumption is that the effects of trade will differ across countries depending on factor endowments. It predicts that increasing trade between countries and increasing mobility of firms will diminish the returns to workers in the capital abundant countries, since fixed costs of relocation are often larger for workers than firms in the medium-term.

Nevertheless, according to EC (2007) it is unclear if EU countries, in a worldwide sense, are capital-abundant and to what extent. In order to

determine this, it is important to assess the elasticity of substitution, not only between capital and labor but also among skilled and unskilled workers[4]. However, most researchers assume EU countries as capital abundant countries (Hutchinson and Persyn, 2011). The results of studies performed by Guscina (2006) and EC (2007), confirm H-O assumptions.

Nevertheless, empirical study by Ortega and Rodriguesz (2002) finds contradicting effects to Heckscher-Ohlin model assumptions. They find that national (aggregated) and sectorial (manufacturing sector) capital income shares increase with increasing **trade openness**, independently of the fact if the country is capital or labor abundant.

These results are also supported by Harrison (2005) who suggested that H-O assumption does not hold and this deviation can be explained with decreasing bargaining power of labor. She performed one of the most explicit researches on the effect of globalization on labor share, which looked not only at factors affecting factor shares, but also at labor shares in poor and rich countries. Harrison (2005) used a panel data of more than a 100 countries around the world to look at the relationship between factor shares and globalization and found that over the period of 1960-1997 the labor shares in poor countries fell, while in rich countries rose. The author points to factor endowments and government spending, as well as to more conventional globalization measures (trade shares, exchange rate crisis, movements in foreign investment and capital controls) as factors which had an influence on labor share trends.

Harrison (2005) also stresses that capital controls and government spending increase labor share, whereas trade shares and exchange rate crisis have a negative effect on labor share. These factors showed the strongest effects on labor share in her research. Changing bargaining powers should also be mentioned while analyzing increasing international trade.

[4] As previously referred, skill-biased technological change might have favored the skilled workers, who can be perceived as complimentary to capital, whereas unskilled labor is more a substitute for capital.

According to Hutchinson and Persyn (2011) increasing openness to trade has not only affected labor share depending on factor endowments, but also could have altered the sizes of firms, since larger multinational firms can gain bargaining power over employees by threatening to relocate and pay out a smaller share of their value added as salaries. These two factors are found to be important and often considered as significantly contributing to changes in labor share (see Guscina, 2006; Ortega and Rodriguez, 2002).

Furthermore, Diwan (2001) concentrated on the behavior of labor share during economic crises, which are often transmitted to broad scope of countries, due to globalization process. The author found that labor share has a tendency to fall sharply during financial crisis and does not fully recover. This decline can be partially explained by the extent of leverage labor has, the nature of financial crisis and openness of trade; labor share fall is wide spread, especially evident in countries experiencing financial crisis. The author concludes that labor tends to bail out capital during financial crisis, since it has a worse bargaining power due to the greater mobility of capital.

Therefore, it is an important tool in resolving financial crisis. The author also stresses that the effect of globalization on labor share is mostly expressed during the crisis, rather than spread through time, when capital starts to move to better locations. This leads us to the conclusion that trade openness factor is often found to be a significant contributor to changes in labor share (see Diwan, 2001; Harrison, 2005; Ortega and Rodriguesz, 2002; ILO, 2011, etc.).

Regarding the case of the Baltic countries, Eurostat data shows that the share of imports and exports in 2014 has reached 98% in Latvia, 134% in Estonia and 141% of GDP in Lithuania. These numbers show immense openness to trade in all three countries at hand. Thus, the effect of trade openness on labor share in the Baltic countries is expected to be highly significant. Also based on the assumption that the Baltic countries are more capital than labor abundant, this relationship is expected to be negative.

Nevertheless, trade openness does not fully reflect the process of globalization and is not the only studied measure of globalization. Another

factor which needs to be taken into account is that globalization has opened borders of previously closed countries. The opening of China, India and the collapse of Soviet Union has significantly increased labor supply in the global market, and led scientists to stipulations how this could have affected labor share around the globe. According to Freeman (2006), global integration of these countries has doubled the number of workers in the global context. Nevertheless, there is no conclusive empirical evidence on how this increase in labor supply has affected labor share, due to the fact that it is difficult to find a proper measure for this change.

Another important factor contributing to labor share changes was increasing **capital mobility** together with increasing mobility of firms and intensifying competition. Most research studying the effect of capital mobility on factor shares is usually presented as part of a more complex research covering the broader spectrum of globalization indicators. However, there are scientific contributions that primarily focus on capital mobility factor. One of them is Jayadev (2007), who analyzed the effects of capital account openness on labor share using a new and more explicit capital account openness index. In his research he studied a broad scope of countries and stressed the fact of the increased mobility of capital relative to labor. He found a negative robust relationship between degree of capital account openness and labor shares.

Nevertheless, the author stresses that this relationship does not hold for low income countries. He explains this relationship through changing bargaining strengths of labor and capital due to increasing capital account mobility. Another important contribution to the effect of capital mobility was made by Decreuse and Maarek (2007), who studied the relationship between labor share in manufacturing sector and FDI in developing countries. They found two contradicting effects of FDI flows on labor share. One arises from foreign firms' technological advances and another arises from competition over labor[5]. According to their study, there is a U-shaped relationship between labor share

[5] Where in a simple job search model worker receives two job offers, one from local and one from foreign firm his bargaining power is higher than receiving job offer only from local firm (for broader explanation see Decreuse and Maarek, 2007).

and FDI. Short-term effect is negative due to technological advances of foreign firms and long-term effect is positive, since it is dominated by wage competition.

As mentioned previously, Baltic countries are more FDI receivers than donors. Thus, the effect of capital account openness on labor share is expected to be positive, since increasing FDI flows would create additional jobs in Baltic countries, which have often faced high unemployment rates, also creating wage competition, which in turn should push comparatively low wages up.

Financial globalization is another rather new factor discussed in the scientific literature, which reflects to the power of financial institutions on non-financial activities (Stockhammer, 2009), i.e. increased mobility of capital enabled capital owners to disregard geographical boundaries as well as broadened their scope of investment, this way putting labor, as a less mobile factor, to a disadvantage and reducing its bargaining powers.

Another important contribution in this respect was made by Hein (2013), who studied financialization in 15 advanced capitalist economies, where he integrated financialization factor into Kaleckian approach and summarized the channels through which financialization and liberalization of markets has contributed to labor share decline since early 1980 in studied economies. The author found that the decline was conditioned by shifts in sectorial composition of economies, weakened bargaining power of labor unions and increase in top management salaries.

Lin and Tomaskovic-Devey (2011), who analyzed US economy, have confirmed this finding. They argue that due to intensifying financial globalization firms started to rely more on earnings from financial channels in the long term and less on income from actual production, this way weakening bargaining power of workers. This trend is also visible for non-financial sector, such as manufacturing. According to their study, salaries of top management have increased over the period of 1970-2008, further increasing dispersion between workers and reducing labor share.

In the case of the Baltic countries the gap between high and low earners has also increased, this can be partially explained by further strengthening power of financial institutions[6]. According to IMF (2015) report, financial deregulation can also lead to an increase in financial wealth and wages in the rapidly growing financial sector, in other words could foster skill-specific wage bargaining.

Another important consequence of globalization might be the changes in **sectorial composition of the economy**. Overtime the changing structure of the economy might have had important implications to changes in functional income distribution through the changing importance of economic sectors. Bertoli and Farina (2007) stress the importance of changes in country's sectorial composition of production and institutional changes. Authors suggest that there might be methodological issues to produce a consistent measurement of factor shares, accounting for self-employment, or changes in sectorial composition of production. Due to these reasons it is difficult to compare findings and find them consistent. In other words, authors suggest that changes in sectorial composition might have contributed to changes in factor share.

Arpaia, Perez and Pichelmann (2009) support this statement and use sectorial adjustments in their calculations. Hutchkinson and Persyn (2011) and Serres and Scarpetta (2002) also take in to account changes in market structure in their calculations, whereas Hutchkinson and Persyn (2011) stress the importance of European integration process on structural changes.

Furthermore, the relative growth of sectors with lower salaries might cause labor share to decline, whereas growth of sectors with high value added and high salaries would improve relative share of labor in national income. Nevertheless, a shift from labor intensive to capital intensive sectors would put pressure on labor share (Arpaia, Perez and Pichelmann, 2009). Empirical evidence shows that wage differences persist between employees in different industries, but with comparable skills and working conditions (Lucifora, 1993;

[6] Assumption formulated based on World Bank data on GINI index. For further information please refer here: https://www.quandl.com/c/demography/gini-index-by-country

Hartog, Pereira and Vieira, 2000; Serres and Scarpetta, 2002). However, it should not be disregarded, that there might be a third factor, as unobserved quality of labor force or inter-sectorial profit variations, which are driving these inter-industry differences (EC, 2007).

Changes in bargaining power of employees

Another important factor affecting labor share in national income are the changes in bargaining power of employees. Many above mentioned studies include bargaining power measure as one of the determinants of labor share.

Nevertheless, others stress this factor as the main indicator. For instance, Kristal (2010) argues that bargaining power of employees is the main determinant of labor share variations. She tested this relationship for 16 OECD countries with the help of a single-equation – a Panel error correlation model based on Beck and Katz (1995). Her findings suggest that labor share decreased due to weaker bargaining power of workers, which in her research was conditioned by decreasing role of unions, lower strike activity, reduced government spending and bargaining decentralization.

Furthermore, Ortega and Rodriguez (2002) used a bargaining model on a broad spectrum of countries and found that the greater openness of a country corresponds to the larger capital share due to reduced bargaining powers of workers. This effect is even more expressed if the work force is more unionized in the country. One explanation for this relationship, according to the authors, might be industry mix of the economy, i.e. trade creates conditions for relocation of resources towards capital intensive sectors in the economy, which increases capital share and reduces bargaining power of workers. Furthermore, authors tested this relationship with capital share in manufacturing, to show that results are not due to changes in industry mix. Nevertheless, they do not account for the possibility of capital intensive technological improvements.

As we know from neoclassical theory, in the perfectly competitive market real wages should correspond to marginal productivity of labor. However, if

bargaining power of employees is week, the imperfect competition conditions in labor market reduce output level and enable profit maximizing firms to make larger profits. This way the wedge opens between wages and marginal productivity of labor, putting pressure on labor share.

According to EC (2007), two factors affecting this wedge are trade liberalization, which increases the level of competition in the market, and changes in employee bargaining powers. Another factor, which might affect bargaining power of skilled employees, is the fact that skilled employees are protected by large turnover costs (they are more difficult to replace), thus are able to bargain for higher than market-clearing wages (Lucifora, 1993).

Furthermore, as mentioned by Kristal (2010), the strength of collective bargaining power of employees might also influence labor share. Nevertheless, this effect has not been systematically researched. Theoretically, higher wages of unionized workers might result in lower wages of nonunionized employees. On the other hand, wages exceeding productivity growth in the long-term might result in substitution of labor with capital and higher unemployment rates (EC, 2007). Besides, wage increases bargained by unions might be offset by price increases. Nevertheless, this is unlikely in a globalized world where producers face international competition for their goods. A more likely outcome would be outsourcing their production to lower labor cost countries.

Another important factor for Baltic countries, which might affect bargaining power of employees, is emigration. Emigration indicators have extensively increased since 1998 and remain high and on average amount to 1% per year of total population in Latvia and Lithuania, whereas in Estonia this indicator is less significant and on average amounts to 0.28% per year[7]. Emigration in general signals to a higher ability for labor to relocate, thus should positively affect labor share by increasing bargaining power of employees.

On the other hand, large scale emigration might cause a so called "Brain-drain" in a country, which in turn will effect firms' investment decisions, since

[7] Author's calculations based on Eurostat data.

if there are no high skilled employees needed for the company, it might choose a different location for its business. Therefore, it is imperative to understand the relationship not only between emigration and labor share, but also between employment and labor share over different time periods. For instance, in short-term capital is often assumed as fixed or at least "quasi-fixed", it is difficult for a firm to make adjustments after various shocks, thus employees of a certain sector might enjoy greater bargaining power and receive higher wages (Serres and Scarpetta, 2002).

Nevertheless, over the long-term firms tend to be more mobile and try to minimize costs by shifting resources towards more profitable sectors (Slaughter and Swagel, 1997). Thus, assuming high elasticity of capital and a tendency to minimize costs in a competitive setting, the bargaining power of less mobile factor – labor – decreases until the balance within a particular sector between real wages and productivity is reached. Shrinking wage gap in turn increases the demand for labor and unemployment should fall. These observations encourage further investigation of the relationship between determinants of bargaining power and labor share.

Macroeconomic policies of the State

Labor market developments are also largely influenced by national policies which determine the size of unemployment benefits, minimum wage and tax wedge, which, in turn, affect the opportunity costs of official work (Bertola, Feollmi and Zweimuller, 2005).

Active labor market policies related to vocational training of unemployed, public employment services and hiring incentives associated with employment of sensitive groups have an impact on the total employment in the economy through improvement of the efficiency of the job matching process (Bassanini and Duval, 2006), and thus on labor share of income. Influence of these policies on labor share is often dampened by the lack of their effectiveness and

is highly conditioned by substitutability of low-skilled workers with capital (EC, 2007).

On the other hand, some political actions, such as taxation and subsidies, in economic theory, are often regarded as a distortionary process, which results in distributional issues by changing the rewards rather than ownership of production factors (Bertola, Feollmi and Zweimuller, 2005). Furthermore, they might work as demotivating factors and increase the attractiveness of work in the shadow economy (EC, 2007).

Another structural policy factor, which might affect labor share dynamics, is minimum wage, which tends to raise real wages above the level of marginal productivity of labor, this way pushing the labor share upwards (Rodic, 1998; Stockhammer, 2009). Dunhaupt (2013) confirms that minimum wages are a viable instrument available for governments or trade unions to aid workers in obtaining a larger share of total output, this way also stabilizing income share of low-skilled workers. Nevertheless, according to Serres and Scarpetta (2002), the level of minimum wage might have a direct effect on structural unemployment, especially if the employment protection legislation is weak (Bertoli and Farina, 2007).

Relatedly high unemployment benefits might also contribute to structural unemployment, through reduced job-search incentive. On the other hand, unemployment benefits might provide security for job seekers and give them more time to find the best job option for their qualifications (Bassanini and Duval, 2006).

Strive towards market economies through liberalization and privatization of the State owned enterprises has been a distinct feature of the former Soviet Union states, such as the Baltic countries. Therefore, it is important to look at liberalization effects as well. For instance, government spending (GOV) has diminished in all Baltic countries since 1995. In Estonia it has decreased by 6%, in Latvia by close to 9% and in Lithuania the decrease reached 8% of GDP

during the period of 1995 to 2013[8]. These changes can be partially attributed to market liberalization and increasing foreign competition, which pushes for reduction in corporate taxes.

This process took place in other countries as well; however it was not as pronounced and rapid as in the Baltic countries. Reduced government spending can also be interpreted as liberal policies pursued by national governments. Furthermore, budgetary constraints do not decrease inequality, they spread the burden among a wide range of populations, thus the amount of increased burden per capita is small, but affects everyone.

On the other hand, structural reforms are much more effective, but difficult to implement. The resistance for them is greater due to the fact that the burden per capita for certain classes of population (often rich and powerful) is much greater than for the rest. Furthermore, affected groups tend to have greater lobbying power. Nevertheless, from the point of competitiveness of the country, structural reforms are more effective than budgetary constraints. Therefore, reductions in government spending should be negatively reflected in labor share, in other words, government spending and labor share are expected to show direct a relationship.

Changes in size of shadow economy

Another important factor influencing factor shares could be the changes in the size and structure of shadow economy through time. This indicator is little discussed in the context of income distribution and often ignored in explaining functional income distribution, mostly due to the difficulties in measuring it. However, it can have an influence on labor share through changes in workers' bargaining power, which partially depends on the size and productivity of "outside" work opportunities. This sector is often excluded from national

[8] Calculations are based on EUROSTAT data (Final consumption expenditure of general government). "General government" describes the institutional sector that consists of central, regional, state and local government units.

accounts, but the informal sector[9] does play an important role in the performance of the formal sector (Rodric, 1998; Dessy and Pallage, 2003; Banerjee and Dufo, 2007; La Porta and Shleifer, 2008; Maarek, 2012).

Therefore, the employment numbers and earnings could be affected by changes in the size of this sector through time and especially during the periods of economic instabilities. Maarek (2012) relates the shadow sector to the development stage of the economy. According to his research, the size and other features of the informal sector determine workers' "outside" opportunities, which in turn modify workers' bargaining power in wage setting process and affect factor shares. Furthermore, the importance of informal sector can be explained by the fact that productivity growth in the informal sector is generally lower than in the formal sector. Therefore, productivity gains do not necessarily trigger wage increases, especially in developing countries where informal sector is larger, as informal employment opportunities depend on the informal sector productivity, which increases slower than the formal sector or remains stable (Maarek, 2012).

The easiest way to understand the possible effect of the informal sector is through a mathematical expression of employers and employees bargaining over surplus, proposed by Rodrik (1998). We will denote output generated by both factors of production as *s*, then the sum of profits, surplus attained by employers (p) and wages, share of output attained by employees (w) will equal to: $s = p + w$. In this case other options for workers would be to seek employment in the informal sector of the economy, which pays w^i and for employers to outsource their production and receive p^i available through opportunities in other countries or illegal production. Then, assuming the sum of other options is less than output ($p^i + w^i < s$), bargaining powers of both, employers and employees could be described as α for employees and $1 - \alpha$ for employers, where α is $1 < \alpha < 0$. Then the solution for the outcome could be found in Rodrik (1998):

[9] For the purpose of this dissertation terms "shadow economy", "informal economy" and "informal sector" are used interchangeably.

$$\max_{p,w}(p - p^i)^{1-\alpha} * (w - w^i)^{\alpha} \quad (4)$$

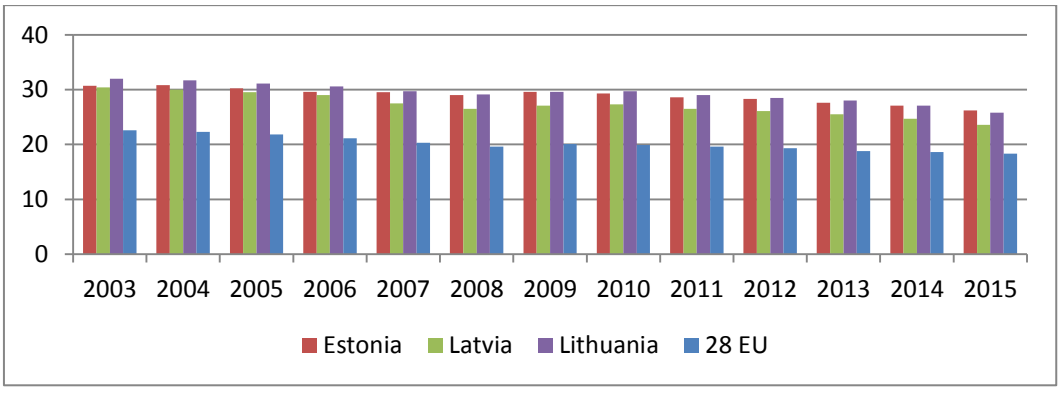
This results into the following:

$$w = \alpha(s - p^i) + (1 - \alpha)w^i \quad (5)$$

From this expression we can see that the bargaining power of labor, together with the value of options provided by exporting production or switching activities to the informal sector has an effect on wages and therefore on the level of labor share in the country. As mentioned before, macroeconomic policies of the State, such as setting unemployment benefits, employment protection legislations and taxes are elements triggering changes in the size of the country's informal sector and highly impact the decisions of employees in the bargaining process (EC, 2007).

As noted by Satchi and Temple (2008), informal sector activities provide an unofficial safety net in the absence or low state-provided unemployment benefits. This indicator is little discussed in explaining functional income distribution. However, it could have a mixed effect on changes in labor share through reduction in formal employment (often caused by the tax wedge), decrease in the income share of unskilled workers and increase of income share of the skilled workers, assuming different elasticity of substitution for these two groups (EC 2007).

Figure 3. Size of the Shadow Economy of the Baltic countries (% of GDP)



Source: Author's compilation of data retrieved from Schneider at al. (2010) and Schneider (2015).

The estimated size of the shadow economy in the Baltic countries is rather high (Figure 3), when compared to other EU countries and it fluctuates with the cycles of the economy. Nevertheless, the declining cycle is visible, which brings the size of shadow economies in the Baltic countries closer to the EU average. The fluctuations in the shadow economy are not as expressed as in other macroeconomic variables and labor share, but visible and due to its size might be an important factor effecting labor shares in the Baltic countries. Furthermore, the larger the shadow economy, the smaller the portion of economy is directly affected by national policy and government decisions. Therefore, neglecting shadow economy, might disclose only partial macroeconomic impacts, thus in this thesis it will be selected as one of the independent variables.

To sum up, scientific literature review has revealed that from all mentioned factors some have shown more significant effects on labor share than others. Most often mentioned factor group is globalization, nevertheless others, such as technological change, bargaining power of employees and macroeconomic policy of the State also showed significance in several researches. Based on the observation, we can conclude, that some factors, such as intensifying trade are relevant in the majority of countries, but others such as shadow economy or emigration can be case specific and can exhibit effect only in particular countries. As previously mentioned, there is a substantial lack of research on labor share in the small open economies. This might be partially due to data availability issues, which will also be an issue of this thesis. Thus, in the econometric analysis of this thesis, only factors with sufficient available data will be analyzed, leaving other factors for future research.

1.5 Measuring labor share

Labor share measurement issues are widely discussed in the literature. They can also create significant discrepancies between results if adjustments are not made. Thus, it is important to define the precise measure of labor share used in this thesis.

The most commonly used measure in determining labor share of income is obtained by dividing wages by output. Nevertheless, according to Feldstein (2008), it is important to consider the changes in overall compensation of employees, rather than narrower measure of wages, since the later measure includes not all benefits provided by the employer, which might differ between countries and time. Therefore, selecting compensation of employees' measure instead of wages makes national and international comparisons more precise. This argument is also supported by Bosworth and Perry (1994). Thus, compensation of employees is a preferred measure of income to wages and salaries, since it reflects total remuneration payable by the employer to the employee (wages, salaries and employers' social contributions, bonuses, etc.). The most often used measure of output is GDP. The main reason identified in scientific literature behind the use of GDP as an output measure in labor share calculations is the availability of data for a broad scope of countries.

Another possible measure of output could be the National income, which adjusts for income of non-residents of the analyzed country. Nevertheless, this indicator can also create problems and overstate labor share, since it adds incomes of residents working in other countries, which might have much higher average earnings due to higher standards of living in the country of their employment. This is especially relevant in the Baltic countries which have high emigration levels.

When output is computed using GDP as a measure, indirect taxes are subtracted and subsidies added. However, if the measure of gross value added (GVA) is available for researched countries it makes calculations easier and is a preferred measure (see: Bertoli, Farina, 2007; Arpaia, Perez, Pichelmann,

2009; Rodriguez and Jayadev, 2012; Guerriero, 2012). GVA measure is equal to GDP minus taxes[10] and plus subsidies on goods and services produced. Therefore, for the purpose of our research we will use GVA as an output indicator. A mathematical expression of this would be the following:

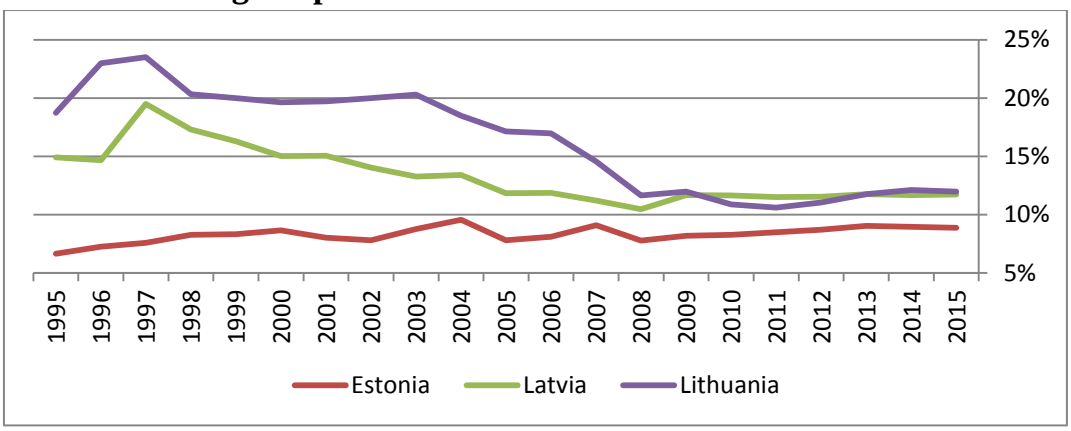
$$LS_t = \frac{EC_t}{GVA_t} \tag{6}$$

where LS_t is labor share, EC_t is employees' compensation and GVA_t stands for Gross value added (selected measure of output).

This calculation reflects labor share of income over time calculated using aggregate data and disregards the income of self-employed, by attributing it to the share of capital. The scientific community considers it as a significant drawback, especially when analyzing the change in labor share over a longer period of time or using this measure for international comparisons.

As seen from figure 4, Baltic States are not an exception; the share of self-employed has changed overtime in the Baltic countries as well.

Figure 4. Share of self-employed in total employment in the Baltic countries during the period of 1995 – 2015.



Source: Compilation by the author based on AMECO database data

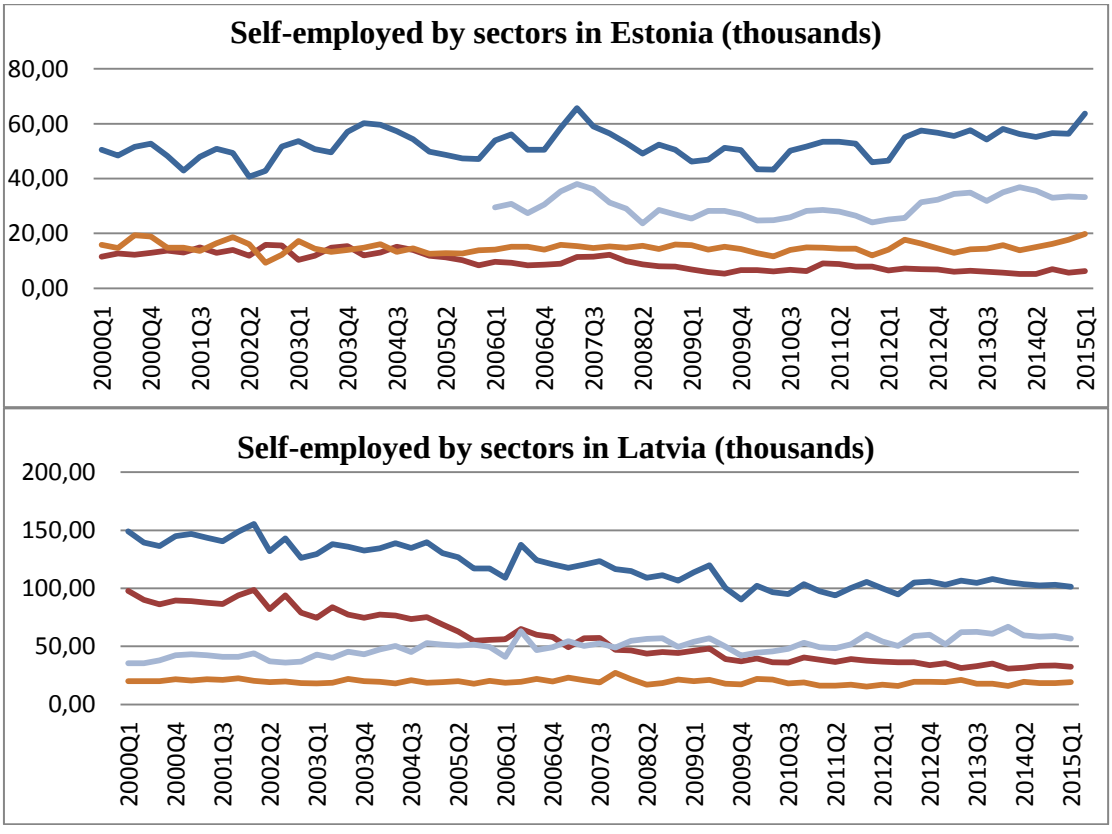
Note: **Self-employed persons** are persons working in their own business, farm or professional practice. A self-employed person is considered to be working if she/he meets one of the following criteria: works for the purpose of earning profit, spends time on the operation of a business or is in the process of setting up his/her business (EUROSTAT database).

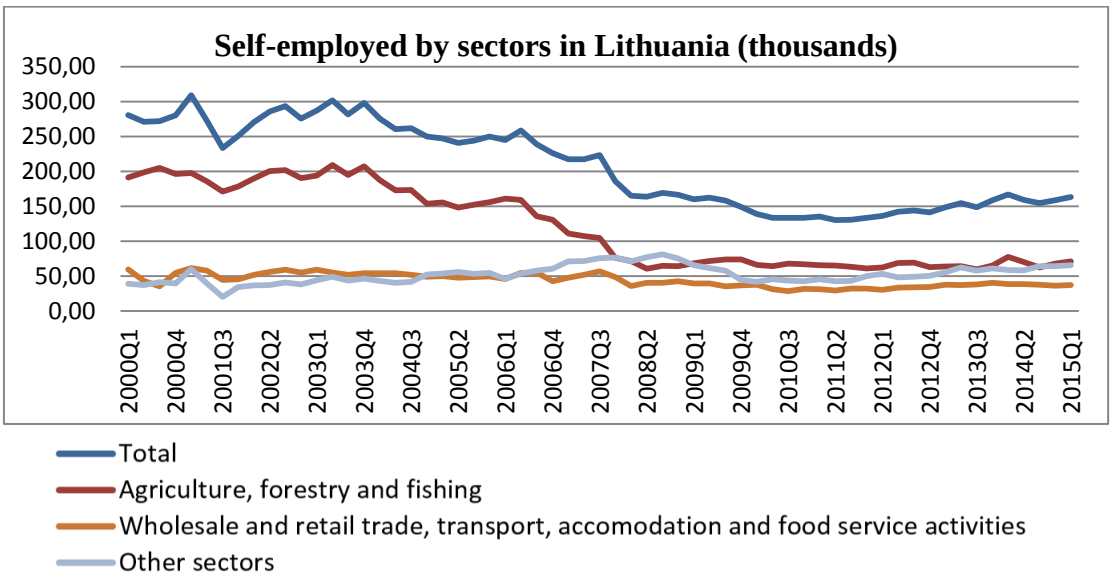
[10] Taxes include: value added taxes, taxes and duties on imports and taxes such as stamp taxes on sale of alcohol and tobacco (Eurostat database).

As seen from figure 4, the numbers of self-employed as a share of total employment varied greatly especially in Latvia and Lithuania during the first decade of independence. The numbers of self-employed have substantially declined in Lithuania (from 18.7% in 1995 to 12% in 2015), suffered moderate decline in Latvia (from 14.9% in 1995 to 12% in 2015), and increased in Estonia (from 6.8% in 1995 to 8.9% in 2015).

Thus, the differences in employment structure over time and among countries might create serious measurement problems while measuring labor share trend and comparing it among different countries. Furthermore, if self-employed possess substantial amounts of capital then labor share will be overstated, thus it is important for our research to look at changes of self-employed numbers across sectors in all three Baltic countries (see graphs below).

Figure 5. Self-employed by economic sectors (measured in thousands of persons)



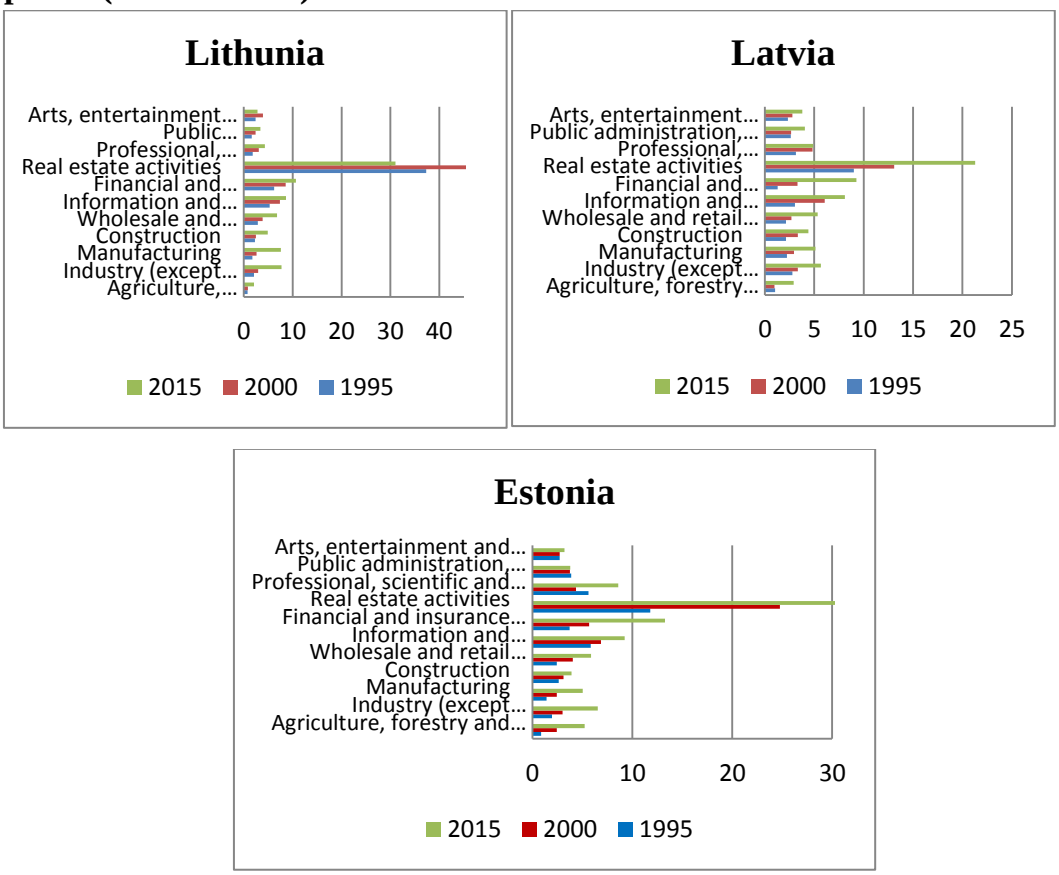


Source: Author's compilation based on Eurostat data.

As seen from figure 5, the portion of self-employed persons has declined in Lithuania and Latvia mainly due to shrinking agriculture, forestry and fishing sector. In the case of Estonia, the number of self-employed has slightly risen from year 2000 to 2015. This was conditioned by a slight decline in agriculture, forestry and fishing sector and a moderate increase of self-employed numbers in majority of other industries, leading with wholesale and retail trade, transport, accommodation and food service sector. In all three countries, second largest sector by numbers of self-employed is wholesale and retail sector.

One could argue that these sectors have shifted from labor intensive to capital intensive throughout the years. Nevertheless, according to Swedbank Analysis (2011), labor productivity is expected to be relatively low in the labor-intensive sectors, when compared to other sectors.

Figure 6. Value added per employed person[11] in Lithuania at constant prices (index = 2010)



Source: Author's compilation based on Eurostat data.

From figures 5 and 6 we can state that in Lithuania and Latvia majority of self-employed persons are involved in the agriculture sector and service activities, such as food industry and accommodation, which have comparatively low labor productivity, thus could be perceived as labor rather than capital intensive. Thus, the majority of income earned by self-employed is labor rather than capital income. In case of Estonia the largest sector in respect to the number of self-employed is wholesale and retail activities, the productivity of which is also rather low, when compared to financial and insurance activities, information and communication, professional, scientific and technical activities; administrative and support service activities.

Even though, some authors do not use any corrections and perceive all income of self-employed as capital (see: Diwan, 2001; Daudey and Garcia-

[11] Including self-employed persons.

Penalosa, 2007), previous researches show that factor shares are sensitive to methods applied to correct for self-employment (Torrini, 2005). Therefore, the measure of employee compensation used without adjustment for self-employment can reflect a lower than actual labor share (Gollin, 2002).

Krueger (1999) argues that an increase in the ratio of employees' compensation over output could be explained by growing high wage sectors and shrinking low wage sectors, such as agriculture, where self-employment was dominant form of employment. From this we can assume that changes in composition of national income might lead to different level of labor share than estimated without adjustment for self-employment.

Therefore, different ways of adjusting for self-employment are proposed in the literature. For instance, Guscina (2006) perceives self-employed income as a mix of capital and labor. Therefore, in her calculations she attributes two thirds of self-employed income to labor share and one third to capital. This method was first proposed by Johnson (1954). It is logical to assume that self-employed income includes some capital and some labor income. The disadvantage of this approach is that it assumes the same mix of capital and labor in different countries and economics sectors. Besides most of proprietors as indicated in figure 5 work in generally labor-intensive industries, therefore it is logical to assume their income as wages. More accurate approaches involve micro level data, such as sex, age and education to estimate wage equations (Young, 1995), however it is difficult to control for abilities of self-employed and these calculations are highly data demanding.

Therefore, this complex approach is often avoided due to the lack of data for a longer and continues period. Five types of frequently used adjustments for self-employment are overviewed and an additional estimation method is proposed by Guerriero (2012).

Nevertheless, one of the most common (Bentolila, Saint-Paul, 2003; Harrison, 2005; Torrini, 2005; IMF, 2007) and straightforward adjustments is the one proposed by Gollin (2002). He suggested a pragmatic assumption that wage rates of employees and self-employed are the same, which makes it

rather simple, but often a sufficient correction. Based on Gollin's assumption adjusted labor share is scaled up by the proportion of self-employed in the labor force.

This approach is especially handy if the majority of self-employed are involved in labor-intensive sectors. Furthermore, the data of actual earnings of the self-employed is rare and often underreported; whereas data on composition of labor force is often present (Guerriero, 2012). Its mathematic expression would be the following:

$$ALS_t = \frac{\frac{EC_t}{E_t} * TE_t}{GVA_t} \tag{7}$$

where ALS_t is adjusted labor share for self-employment, TE_t is total employment[12] and E_t is the number of employed persons. This could be simplified to:

$$ALS_t = \frac{EC_t}{GVA_t} * \frac{TE_t}{E_t} \tag{8}$$

This estimation of labor share provides us with a better estimate of labor share. The advantage of this approach is that it eliminates guessing, but attempts to account for self-employed income. One should be careful with this estimation if there are substantial differences between the incomes of employees and self-employed. Nevertheless, according to Young (2000), such adjustments do not appear significant enough to distort calculations.

Another important aspect when calculating labor share is the difference between the economic sectors (industries). National data used for the equations of labor share above could be distorted (especially over longer periods of time) by changes in sectorial composition.

The moderating or decreasing overall labor share at first glance can signal to robust investment and reduction in structural unemployment. Nevertheless,

[12] Total employment in this thesis is an indicator covering employees and self-employed persons.

it may simply result from compositional bias in labor share caused by relative changes in growth of highly labor-intensive industries (Serres at all, 2002).

Similar explanation is provided by Young (2010). He shows that aggregate labor share tends to be less volatile that labor shares of separate industries, which can also move in opposite directions from an overall trend. For instance, Young (2010) finds that labor share in goods and services sectors have a high negative correlation, i.e. have been moving into different direction in the US. This shows that there might be substantial structural changes taking place in the economy, while aggregate data might show a stable trend. Therefore, to obtain a better measure, mathematical expression could be used (Arpaia, Perez and Pichelmann, 2009):

$$ALS_t^s = \sum_{i=1}^{k} \frac{EC_{i,t}}{GVA_{i,t}} * \frac{TE_{i,t}}{E_{i,t}} \quad (9)$$

where ALS_t^s is adjusted cumulative labor share calculated on sectorial basis and $GVA_{i,t}$ is output of a certain economic sector. Here the average wages of employees in the same industry, rather than average wages of the entire economy are attributed to self-employed (Torrini, 2005; Bertoli and Farina, 2007; Arpaia, Perez and Pichelmann, 2009).

In case of the Baltic countries, main changes, consistent in all three analyzed countries have happened in Agriculture, forestry and fishing sector. Its share of gross value added has substantially decreased with the largest drop in Lithuania (by 6%) during the period of 1995 to 2015. Wholesale and retail trade, transport, accommodation and food service activities' share in Lithuania has expanded (from 19% to 27%), whereas other sectors did not show much variation. Taking into account the fact that wholesale sector is a higher paid sector than for instance agriculture, but its productivity is still rather low, as discussed above, thus it could be perceived as a labor-intensive sector. Taking this into account, labor share should have increased in Lithuania, but we observe a negative trend, which points to other factors, rather than sectorial adjustments at play.

In case of Estonia, the decrease in agriculture sector's gross value added was the mildest among all three Baltic countries (by 2%) over the analyzed period. Other larger changes were reflected through the increase in real estate activities and professional, scientific and technical activities, the weight of both increased by 4% in gross value added. The later sector might be considered as more capital intensive, thus could put pressure on labor share. Furthermore, labor intensive wholesale and retail trade, transport, accommodation and food service has also increased as in other Baltic countries.

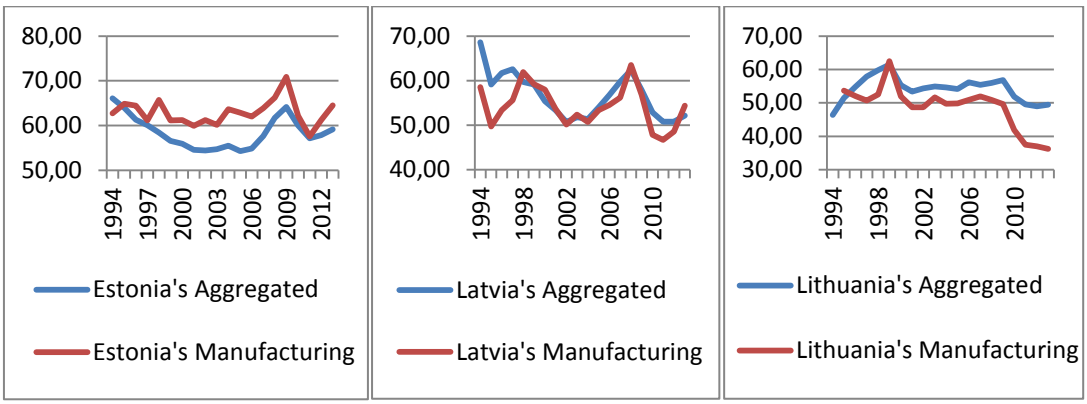
In Latvia the changes are similar to Lithuania, but more scattered through sectors. As mentioned before, agriculture sector exhibited a pronounced decrease during the analyzed period. Furthermore, industry and manufacturing sectors also decreased, whereas labor intensive wholesale and retail trade, transport, accommodation and food service activities' share has increased decreasing the pressure on labor share. Nevertheless, this increase in significance of labor intensive sectors is not reflected in the overall trend of labor share[13].

Conclusively, in case of Lithuania and Latvia shifts in sectorial composition should have given labor share stimulus to rise, rather than put pressure on. In case of Estonia, the situation is more complicated due to the increase in capital intensive sectors.

Furthermore, in case of the Baltic States there is a lack of data, which makes it difficult to compile labor share by adding all the sectors' shares, to further make sure there are no significant discrepancies between aggregated and sectorial data. To overcome this lack of data and discover whether the trend of labor share persists, aggregated labor share was compared to the labor share of manufacturing sector which in scientific literature (Rodrik, 1998; Gollin, 2002; Hutchkinson and Persyn, 2011; etc.) is often used for simplification as a reflection of labor share by sectors (Figure 7).

[13] All calculations are based on Eurostat data. Sectors' shares are calculated based on quarterly data of gross value added by sector by country.

Figure 7. Comparison of aggregated and manufacturing sector labor share in the Baltic countries.



Source: Author's compilation based on AMECO data.

The comparison of aggregated and manufacturing sector labor share in the Baltic countries shows similar trend over the analyzed period, but short-term deviations from overall labor share variations are visible, especially in Estonia.

Nevertheless, in all three analyzed countries the trend of labor share in manufacturing corresponds to the trend of aggregated labor share. Nevertheless, using aggregated labor share data rather than sector specific data can be perceived as one of the shortcomings of this thesis, which should be aggressed once more data is available.

To sum up, labor share is most often calculated using compensation of employees' data adjusted for income of self-employment and gross value added measure. Furthermore, data for Baltic countries has shown, that sectors with the highest self-employed numbers are agriculture and wholesale and retail, which are both labor intensive, thus for the purpose of this thesis income of self-employed will be attributed to labor share. Furthermore, aggregated labor share measure will be used due to the lack of statistical information in order to compile sector specific labor shares over the selected period of time.

2. Methodology for determining effects on labor shares in the Baltic countries

In order to achieve the aim of the dissertation - to analyze and explain changes in labor share in national income of the Baltic countries, determine the causes for these changes and disclose their macroeconomic implications - the empirical analysis was split in to two parts. First part focused on labor share trend analysis to check whether declining labor share trends discussed in the literature analysis correspond to the situation in the Baltic countries and second part of economic analysis focuses on relationship between labor share and explanatory variables.

Labor share trend analysis was carried out using graphical analysis, supported by linear regressions, variations and time trend average analysis. The purpose of trend analysis is to verify theoretical findings, that labor share is declining in majority of countries is also applicable for Baltic countries. Secondary yearly data is taken from AMECO database. Labor share is adjusted for income of self-employed, by attributing all income earned by self-employed to labor share rather than to capital on the basis of theoretical analysis.

The second part of economic analysis of this thesis – Econometric analysis is carried out on the basis of factors effecting labor share movements, which were identified in the first chapter of this thesis. Dynamic error correction model is applied and reveals the effects of the explanatory variables on labor share.

In the first chapter of the thesis, independent (predictor) variables were separated into the following groups: technological change, globalization, bargaining power of employees, national policies, shadow economies and control variables for simplification. Nevertheless, due to data quality and availability for a sufficiently long period of time needed to perform econometric analysis, the list of independent variables was shortened and additional control variables were added to account for external shocks (such as

economic crisis). It should be stressed that the list of predictor variables is not conclusive, but rather selected based on data availability and could be later extended or modified to enrich the analysis if new data becomes available.

The following variables were selected based on the theoretical research for econometric analysis[14]:

Table 1. Economic variables selected for econometric analysis

Dependent variable:	
Labor share	Adjusted labor income share – ALS
Independent variables:	
Technological change	Capital augmenting technological change – TFP Real labor productivity - PR_HW Gross Domestic Product per Capita – GDP_C
Globalization	Trade globalization (imports and exports) – IMEX Capital mobility (inwards FDI) – FDI_in
Bargaining power of employees	Emigration – EMI_POP Level of unemployment – UN
Redistributive national policies	Government spending Minimum wage – MIN
Shadow economy	Shadow economy – SHADOW

Source: Author's compilation.

The selection of explanatory variables was enriched by the measure of the shadow economy size (SHADOW). Due to lack of research related to functional income distribution including shadow economy as an explanatory variable, its informal and rather different nature, in comparison to other variables, this variable was analyzed in a separate model to provide more insights on its possible effect on labor share in Baltic countries.

[14] More information on variable definition, sources, abbreviations and precise time period is provided in Appendix 2.

Several sources were used to construct the database for this thesis. Mainly macroeconomic statistical data was retrieved from EUROSTAT database. Quarterly time series data was used for three Baltic countries: Estonia, Latvia and Lithuania and a sample for the period of 1995Q1-2015Q1 (n=81 per country).

Shadow economy, also called underground or informal economy is difficult to measure due to its informal nature and variations of its definition from nation to nation. There are various approaches to measuring it, starting from direct ones, which employ sample surveys or tax auditing statistics, to indirect macroeconomic ones. Direct approaches to measuring shadow economy are often more detailed and capture socio-economic aspect, but tend to underreport the extent of the shadow economy.

The most often used indirect ways of measuring shadow economy are based on the discrepancy between national expenditure and income, official and actual labor force statistics and, monetary mismatches (cash transactions). Indirect approaches tend to over-state the level of undeclared work and include the underreported income.

Nevertheless, for the purpose of detecting trend and relationship with other macroeconomic variables, the indirect measures often predominate, since they are less time and resource demanding ways of measuring. Furthermore, they can also be easily compared between countries if collected from the same source to exclude the bias of national perception of the "shadow economy".

For the purpose of this dissertation the shadow economy data is retrieved and compiled from two sources which use the same methodology: from Schneider at al. (2010) and Schneider (2015). This data is calculated using the methodology described in Schneider at al. (2010) and also used by Schneider and Buehn (2009) and Schneider and Enste (2000).

In order to measure the shadow economy, they employ an indirect approach to measuring it called Multiple Indicators Multiple Causes (MIMIC) estimation, which is a combination of structural equation model and factor model. MINIC takes into account both monetary (currency demand approach)

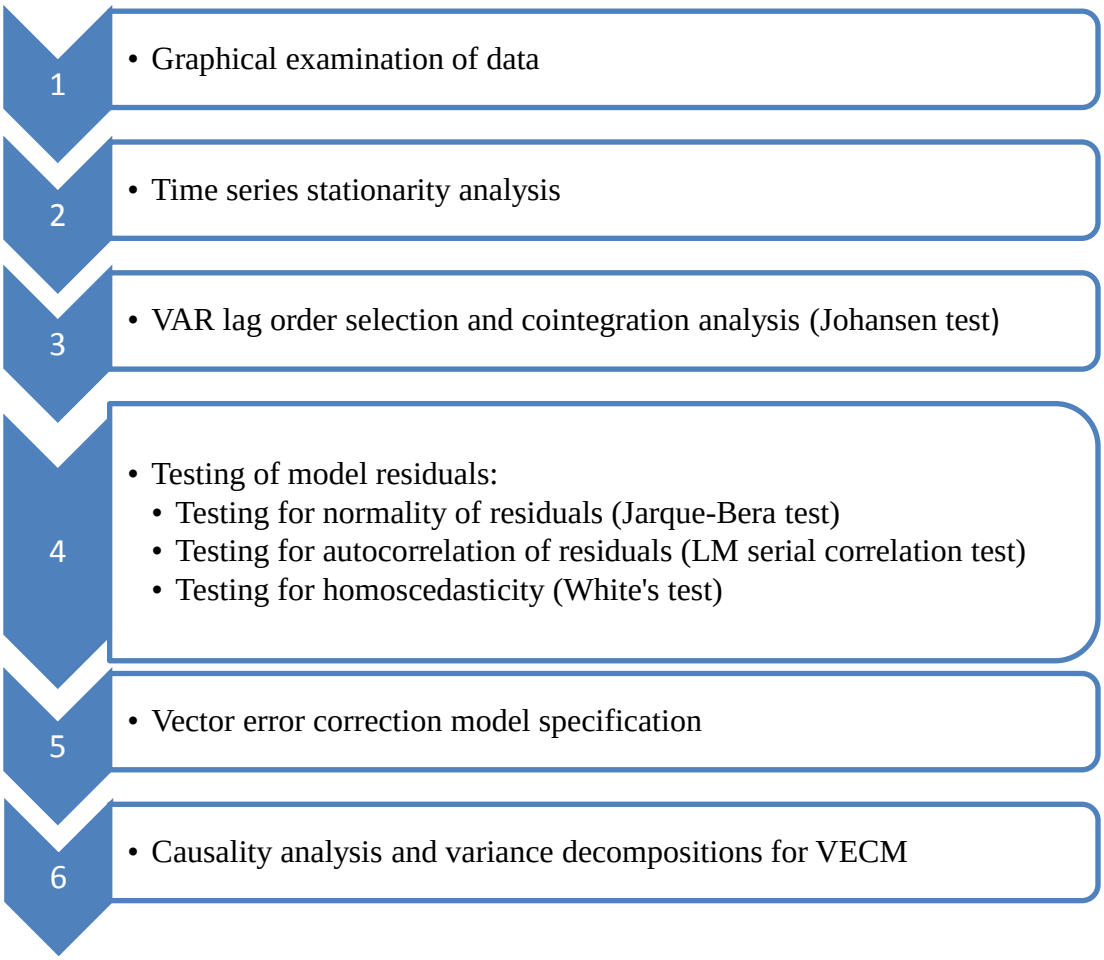
and labor market indicators (labor force participation rate, growth rate of total labor force), complimenting them with GDP per capita indicator, measured in purchasing parity power rates and expressed in percentage of GDP. Furthermore, this approach takes into account several control variables, such as size and effectiveness of government, share of direct taxes, fiscal and business freedom, unemployment rate (Schneider at al., 2010).

Data for some variables are more limited, thus this might further shrink the sample in some cases. Statistical information for used indicators from EUROSTAT are collected from national accounts, which in turn represent data obtained and aggregated from sources such as statistical research and administration (financial ministries, national banks, social insurance funds, national tax agencies, etc.). In some cases (shadow economy indicator and emigration), where quarterly data was not available, cubic spline interpolation was used to transform yearly or semi-annual data to quarterly data.

For data processing Eviews statistical package was employed. All data is seasonally adjusted. Some variables (inwards FDI, GDP per capita, minimum wage, productivity and total factor productivity) were transformed using natural logarithms due to different measurement units of variables; others were not transformed in order to provide simpler interpretation of the analysis results (variables expressed as percentage). Results of the analysis were firstly explained for each of the three Baltic countries individually with their specific model, then similarities and differenced were highlighted.

The relationships and its significance between variables were tested using VECM model. To test the significance, strength and direction of relationships between labor share and factors affecting them, empirical analysis was structured using the following steps to ensure validity of obtained results and stability of the model (Figure 8).

Figure 8. Steps to test VECM model stability and analyze the results.



Source: Author's compilation based on AMECO data.

1. Graphical examination of data

Time series graphs for all analyzed variables and different countries are presented to highlight data behavior (trend) and reveal possible problems (unit roots or structural breaks) if any. Furthermore, time series graphs reveal data spikes due to external shocks (i.e. crisis), which can be corrected with dummy variables. Time series graphs are provided for raw and differenced data. Scatterplots allow the visual analysis of the relationship between two variables (labor share and explanatory).

Furthermore, the graphical analysis was performed on differenced variables $(\{x_t - x_{t-1}\}, where\ x_t\ is\ raw\ data\ variable)$, which reveal the need for country specific time dummies to account for a data spikes, caused by

an external shock - economic crises. Mathematical expressions of dummy constructs are represented below:

$$Dummy_{crisis\_LT} = \begin{Bmatrix} 1\ if\ time\ periods\ 1998\text{Q}3 - 1999\text{Q}3 \text{ or } 2008Q2 - 2009Q2, \\ 0\ otherwise. \end{Bmatrix} \quad (10)$$

$$Dummy_{crisis_{EE}} = \begin{Bmatrix} 1\ if\ time\ period\ \ 2008Q1 - 2010Q2, \\ 0\ otherwise. \end{Bmatrix} \quad (11)$$

$$Dummy_{crisis\_LV} = \begin{Bmatrix} 1\ if\ time\ period\ 2007Q1 - 2009Q2, \\ 0\ otherwise. \end{Bmatrix} \quad (12)$$

For Lithuania a dummy with two crisis periods was applied, taking into account the Russian crisis (1998Q3-1999Q3) and current economic crisis (2008Q2-2009Q1). For cases of the other two countries, dummies covering the following periods showed most significance in the model: for Estonia – 2008Q1-2010Q2 and for Latvia – 2007Q1-2009Q2[15]. Other variations of dummies were also tested for each country, however, showed no significance to the model, thus they were removed.

2. Time series stationarity analysis

Before proceeding with deeper analysis, each variable (dependent and independent) was checked for stationarity, which signifies that each variable has a constant mean and variance structure. When using time series data, stationarity of variables is very important, since different models ought to be applied for non-stationary variables, otherwise the analysis can lead to unreliable results, wrongly specified model if vector autoregressive model is selected for non-stationary data.

Most macroeconomists agree that macroeconomic variables often exhibit non-stationarity (EC, 2007; Hein and Vogel, 2007; Stockhammer, 2009; ILO, 2011), thus it is important to check if this is true in the analyzed

[15] Even though Latvia has experienced two rather large economic downturns in the past 20 years, the dummy variable with two crisis periods did not show statistical significance in the econometric models.

case, using not only graphical analysis, but also statistical tests. If non-stationarity is found, the econometric analysis of this thesis we will proceed with Vector error correction model, which is a restricted form of vector autoregressive model, designed for non-stationary variables.

In order to test stationarity of variables the most common unit root test – ADF Fisher Chi-Square test was applied, which assumes individual autoregressive process, i.e. unit root under null hypothesis. The augmented Dickey-Fuller test can be calculated using three options: a simple unit root test, a unit root test with intercept and a unit root test with deterministic trend. These three options can be mathematically expressed in the following way:

$$\Delta y_t = \theta y_{t-1} + \sum_{i=t}^{n} \delta_i \Delta y_{t-1} + \varepsilon_t \quad (13)$$

$$\Delta y_t = \alpha + \theta y_{t-1} + \sum_{i=t}^{n} \delta_i \Delta y_{t-1} + \varepsilon_t \quad (14)$$

$$\Delta y_t = \alpha + \beta t + \theta y_{t-1} + \sum_{i=t}^{n} \delta_i \Delta y_{t-1} + \varepsilon_t \quad (15)$$

Where y_t denotes a tested variable, α is a constant, β- the coefficient on a time trend (t) and ε_t is a white noise error term.

If variables were determined to be non-stationary first differences ($\{x_t - x_{t-1}\}, where\ x_t\ is\ raw\ data\ variable$) of the variables were calculated and checked for stationarity again. Initially non-stationary variables, which become stationary at first differences, were tested for cointegration. If variables returned mixed stationarity results (e.g. due to trend or intercept), then second test – Dickey-fuller test with GLS detrending (DFGLS) was applied. This test uses transformation of variables with generalized least squares regression and it is more suitable for small sample sizes and has greater predictive power than the initial Dickey-fuller test (Elliott, Rothenberg and Stock, 1996).

3. VAR lag order selection and cointegration analysis

Before proceeding to cointegration analysis, the correct lag order for variables needs to be selected. According to Ozcicek and McMillin (1999) selecting correct number of lags is important, since incorrect lag length might cause inconsistent estimates, impulse responses and variance decompositions of the model. For instance, selection of lower number of lags might cause autocorrelation among model errors. VAR lag order selection criteria[16] will be applied in order to select the appropriate number of lags for the model. After the number of lags most suitable for the model is selected, data will be tested for cointegration relationships.

Testing data for stationarity is no longer sufficient in modern econometrics, as pointed out by Engle and Granger (1987), two or more non-stationary variables might be cointegrated, which would point to long-term relationships between variables. Thus, non-stationary variables, which showed stationarity at first differences, will be tested for cointegrated relationships, using one of the most popular VAR based Johansen cointegration test (Johansen, 1991 and 1995). If cointegration is found, VECM (Vector Error Correction) model will be applied instead of VAR (Vector Autoregressive) model. Null hypothesis of Johansen test is that there is no cointegration among variables. Furthermore, the author will check for robustness of the model, by removing repressors and observing the changes in the estimated regression coefficient.

4. Vector error correction model specification

Macroeconomic data involving time series is often found to be non-stationary and ECM are becoming a popular solution for analysis of non-stationary data, since they deal well with cointegrated data.

[16] Sequential modified LR test statistics (LR), Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ).

ECM fall into the category of multiple time series models, which can estimate the speed at which dependent variable returns to equilibrium[17] after the change in independent variable. In order to see the return of the dependent variable to equilibrium, cointegration condition needs to be met. Furthermore, error correction models provide a dynamic aspect, since they can grasp short-term (disequilibrium) and long-term (equilibrium) effects of one variable on anther.

ECM models also permit variation between variables selected for short-term and long-term analysis, since variables used for long-term analysis are tightly connected to equilibrium of the dependent variable, whereas variables used for short-term analysis can flexibly move within its dynamics. This is particularly interesting for macroeconomic variables, which are often cointegrated. Furthermore, according to Kristal (2010), error correction models assist in removing spurious relationships, which arise due to trend over time in analyzed variables.

Multiple researchers, in the field of labor economics have applied different types of error correction models (Kristal, 2010; Serres and Scarpetta, 2002; Hein and Vogel, 2007; Stockhammer, Hein and Grafl, 2007; Berthold, Fehn and Thode, 1999, etc.). For this research Vector error correction model was selected, due to individually non-stationary variables, which have a common stochastic trend.

With one cointegrated equation the bivariate VECM model can be specified using a dynamic single-equation error correction model, which consists of two equations[18]:

$$\Delta y_t = \alpha_0 + \gamma_1 * (y_{t-1} - \delta x_{t-1}) + \sum_{i=1}^{n} \alpha_{1i} * \Delta y_{t-1} + \sum_{i=1}^{n} a_{2i} \Delta x_{t-1} + \varepsilon_{1t} \quad (16)$$

$$\Delta x_t = \beta_0 + \gamma_2 * (y_{t-1} - \delta x_{t-1}) + \sum_{i=1}^{n} \beta_{1i} * \Delta y_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta x_{t-1} + \varepsilon_{2t} \quad (17)$$

[17] "Equilibrium is a stationary point characterized by forces which tend to push the economy back toward the equilibrium whenever it moves away" (Engle and Granger, 1987).
[18] Multivariate regression model can be build using the same logic.

Where α_0 and β_0 are constant drifts, γ shows the speed of adjustment to long-run equilibrium, $(y_{t-1} - \delta x_{t-1})$ denotes the error correction term and ε_t is a white noise error terms, which is assumed to be serially uncorrelated.

5. Testing of model residuals

- *Testing for autocorrelation of residuals (LM serial correlation test)*

The model residuals will be tested for autocorrelation using LM test, which checks for serial correlation among the residuals of the model. This test is superior to Durbin-Watson test, since it can test more than just the first order serial correlation. Null hypothesis of the LM test is no serial correlation at a selected lag order, thus if p value is above 5% we will assume model residuals do not exhibit autocorrelation. If p values are below 5%, selected lag order will be adjusted.

- *Testing for homoscedasticity (White's test)*

White's test for residual heteroskedasticity will be applied to VEVM model residuals. This test will provide Chi-square statistics. Null hypothesis of the test is residuals are homoscedastic, thus p value above 5% will signal homoscedasticity of model residuals and the model will be accepted.

- *Normality of residuals with Jarque-Bera test*

The specified model will be tested for normality to avoid biased data in the model. It is not always possible to achieve normality in macroeconomic variable distribution due to rapid change in the economic conditions, especially in small open economies, such as Baltic countries. Nevertheless, it is important to test for normality and if test results show non normal distribution, results will be interpreted with caution. The selected test for this thesis is multivariate Jarque-Bera test, which tests the normality of model's residuals using the value of skewness and kurtosis and provides an overall Jarque-Bera test statistics (Jarque and Bera, 1987).

Multivariate Skewness shows whether the distribution of residuals is symmetric and can be calculated using the following formula:

$$S = \frac{\hat{\mu}_3}{\hat{\sigma}_3} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^3}{\left(\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^3\right)^{3/2}} \quad (18)$$

For Skewness normal value, showing symmetrical distribution is 0 and for Kurtosis normal value showing shape of normal distribution is 3. Multivariate Kurtosis demonstrates the shape of data distribution and can be calculated using the following formula:

$$C = \frac{\hat{\mu}_4}{\hat{\sigma}_4} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^4}{\left(\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2\right)^2} \quad (19)$$

Where $\hat{\mu}_3$and $\hat{\mu}_4$ are the estimates of the third and fourth moment of a probability distribution of a random variable around the variable's mean. Respectively, $\bar{x}$ is the sample mean, and $\hat{\sigma}^2$ is variance (an estimate of the second central moment). After signifying skewness (S) and Kurtosis (C), we can determine the Jarque-Bera test by comparing how far these measures diverge from values of normal distribution and could be calculated using the following formula:

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}((C-3)^2)\right) \quad (20)$$

For the Jarque-Bera test, the null hypothesis is that residuals of the model are normally distributed, thus we will accept H_o if p>0.05, and reject if p<0.05. This test will inform us about the normality of the residuals and will suggest further modification of the model.

6. Causality analysis and variance decompositions for VECM model

Firstly, model's causality will be tested using error correction term coefficients, negative coefficient and a significant p value will point to a sustainable long-term relationship between independent and dependent variables. P-value of less than 5% will point to statistically significant relationship with 95% confidence level.

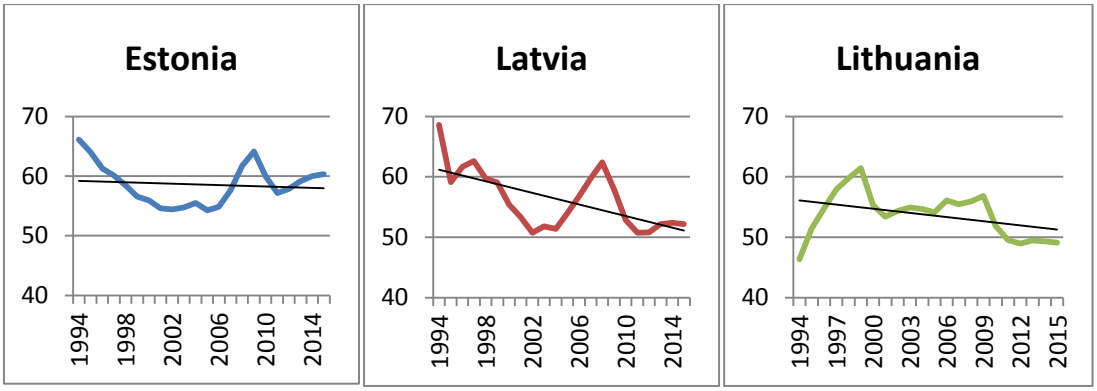
After causality and residual tests are performed, variance decomposition of independent variables exhibiting significant effect on dependent variable will be tested. This will provide us with additional information about dynamic properties of the model, such as the duration of the effect of the significant predictor variables on the dependent variable. Variance decomposition separates the variation into component shocks of the model for ten quarters time, which will give a sufficient measure of longer-term effects. The variance decomposition will measure the fraction of forecasted variance of dependent variable caused by an unexplained variance or independent variables. It is important to stress, that causality tests and variance decomposition might result in different outcomes due to difference in variable lags. Causality tests are performed on lagged variables, whereas variance decomposition focuses on raw data (Eviews 8 help guide, 2014).

3. Empirical analysis of labor shares in Baltic countries

3.1 Labor share trend analysis in The Baltic countries

As discussed in the first chapter of the thesis, labor share trend shows a declining tendency in the majority of countries in the last two decades. Baltic countries are not an exception, as seen from the Figure 9.

Figure 9. Adjusted labor share[19] in the Baltic countries 1994-2015 (in % of GDP at factor cost)



Source: Author's compilation based on AMECO database.

Note: Colored lines in the figures show the adjusted labor share measure taken from AMECO database, whereas black color lines show the underlying trend over the analyzed period.

Adjusted labor shares in all three Baltic countries follow the downward trend. This is consistent with the general development for labor share across Europe. Nevertheless, in Lithuania and Latvia labor share in national income has declined substantially, whereas in Estonia the declining trend was modest in the past twenty years.

Furthermore, as stressed by EC (2007), labor share in the Baltic countries is not only decreasing, but also shows a much higher variation and lower averages than in older EU member states. Latvia shows the strongest variation in labor share and it is closely followed by Lithuania (Table 2).

[19] Labor shares are adjusted to income of self-employed. More information about the labor share adjustment is provided in the methodology section. Those calculations also correspond to adjustment used by AMECO.

Table 2. Variation of Adjusted Labor share in the Baltic countries (in %)

	Coefficient of Variation	Average 1994-2015
Estonia	5,9	58,58
Latvia	8,8	56,15
Lithuania	7,1	53,69

Source: Author's compilation based on AMECO database.

Furthermore, the average of labor share in the income of all the Baltic countries is low. This is confirmed by the average of the past 20 years. The labor share in Estonia has the highest average in national income throughout the analyzed period, reaching above 58%. It is followed by Latvia's average and Lithuania's labor share in national income is the lowest, reaching only above 53%. Variation of the labor share in Latvia is the highest among all three Baltic countries, which points to a dynamic and changing situation.

Furthermore, variations in the labor shares are high in all three analyzed countries when compared to the variations in labor share of the old EU member states (EC, 2007). In recent years, the share of income attributed to labor in Latvia and Lithuania was around 50% of national income, which is much lower than the EU27 average of around 65% since 2010[20]. One could argue that low levels of labor shares in the Baltic countries could be related to lower levels of wages attributed to the comparatively low levels of productivity when compared to other countries. Nevertheless, for example, monthly earnings in Lithuania are much lower than in most European countries. Based on Eurostat data, we can see that average gross monthly wages in Lithuania reach only 24.5% of the EU27 average in 2010, whereas productivity in 2010 in Lithuania amounted to 62.6% of EU 27 average[21].

According to Gollin (2002), there might be several explanations why labor share is lower in some countries than others. He suggests that wages are not equal to marginal revenue products due to imperfect competition, thus labor

[20] Calculations based on AMECO data of adjusted wage share (as a percentage of GDP at factor costs) for EU 27.
[21] Author's calculations based on Eurostat database data.

share is lower. Low levels of labor share mean that in the Baltic countries the larger part of the "economic pie" is retained by profit owners than in other countries. This might be not only an inequality issue between workers and capital owners, but might also have deeper economic implications, such as an effect on economic growth. According to post-Keynesian theory marginal propensity to consume is higher from wages than profit, thus an increase in labor share should have a positive effect on the economy. This statement is also supported by Stockhammer, Onaran and Ederer (2009), according to their research, 1 percentage point increase in European labor share is translated to 0.17 - 0.19 percentage points increase in GDP.

After regaining independence, labor shares in three Baltic countries had rather different starting points (Figure 8). Lithuanian labor share is reported below 50% in 1994, whereas in Latvia and Estonia it is close to 70% of national income. Thus, we have to be cautious with these estimations, since the analyzed time period is too short to state a clear trend of labor shares in Baltic States over a long period of time, because time series can be sensitive to the starting points of the trends.

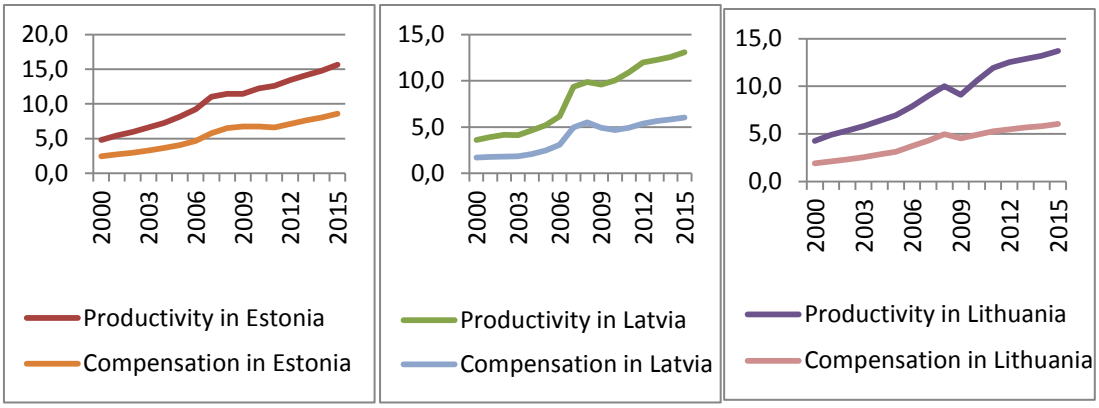
Furthermore, labor shares in Latvia seem to show high volatility, whereas Lithuanian and Estonian labor shares have weaker variations. Over the period of 1994-2015, coefficient of variation for Latvia's labor share amounted to around 8.8%, whereas in Lithuania and Estonia such variations were 7.1% and 5.9% respectively[22]. Some would say, that these countries have undergone large structural transformations, thus variation can be at least partially explained by the need of real wages to adjust to productivity levels (EC, 2007).

Productivity has been constantly increasing over the analyzed period, with short-term exemptions. At the same time, wages in the analyzed countries have also risen, but underperformed productivity growth. This is reflected in the growing distance between productivity and compensation of employees, which

[22] Calculations of variation coefficients are performed by the author, based on AMECO data (standard deviation of adjusted labor share divided by the mean). The same calculation methods are used by EC (2007) and Arpaia, Perez and Pichelmann (2009).

points to the increasing gains of capitalists (Figure 10). Thus, a wage gap has appeared and might be putting pressure on the labor share.

Figure 10. Labor productivity and compensation of employees in the Baltic countries in 2000-2015 (EUR/hour)



Source: Author's compilation based on AMECO database.
Note: Labor productivity is measured as output per hour of labor input (GDP at factor cost per hour worked) and wages are measured as employee compensation per hour worked.

Economists, in general, agree that productivity growth should be followed by wage growth and this raises livings standards (Cashell, 2004). According to Cashell (2004), this relationship is based on the assumption of diminishing marginal productivity under which additional hired worker will be less productive than the previous one, unless demand for goods produced increases or technology advances increase productivity. Thus, increasing productivity should increase the demand for labor, which in turn will push wages up.

However, as seen from the figure 10, productivity growth is not fully realized in compensation increases, i.e. the wage gaps over time have persisted in all three analyzed countries. Feldstein (2008) also stresses the importance of the relationship between wages and productivity, and perceives it as a key determinant of the standard of living in the country and income distribution between factor shares.

According to Meager and Speckesser (2011), since increases in wages do not fully realize the gains in productivity and wage gaps persist, relationship between wages and productivity cannot fully explain labor share developments. This finding is also supported by the results of EC (2007).

Furthermore, Baltic countries have undergone substantial economic and structural changes over the last twenty years, besides their labor shares are rather volatile, therefore it is important to investigate not only the trend, but also the driving forces behind these changes (Pacebutaite, 2014).

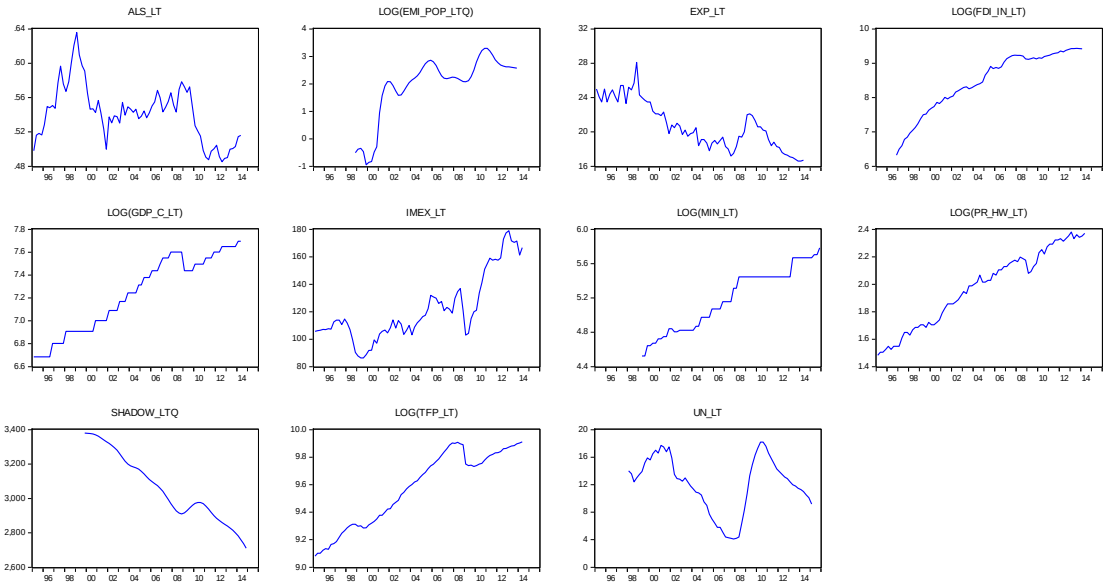
The volatility of labor shares in Baltic countries exceeds the volatilities of the developed countries presented in the analyzed literature. Furthermore, the productivity growth is not fully realized in employees' compensation increases in all three Baltic countries, which should push labor share upwards, but we observe a negative trend, thus there might be other factors at play as stipulated in the literature analysis. The declining trend of labor share in all three Baltic countries is well in line with the findings of literature analysis. Available scientific literature mostly focusses on large and well developed economies, whereas our research shows that trends of labor share in small economies are similar to the trend of large economies. Nevertheless, these conclusions are only valid for the medium-term (20 years). Once more data is available for the analyzed countries, the research could be repeated to confirm results over the long-term.

3.2 Econometric analysis of factors effecting labor share using VECM model

Graphical examination of data

The analysis of time series graphs (see all graphs in appendixes 3-5.) has revealed the non-stationarity trend in all three analyzed countries for majority of variables. This confirms a notion that macroeconomic data can be often characterized by non-stationarity feature (EC, 2007; Hein and Vogel, 2007; Stockhammer, 2009; ILO, 2011). Nevertheless, unemployment variable shows a rather stationary trend, which is in line with economic theory, that unemployment rates tend to linger around natural unemployment levels.

Figure 11. Analyzed variables – case of Lithuania.



Source: Author's compilation based on EUROSTAT database and Schneider at al. (2010), Schneider (2015) for shadow economy.

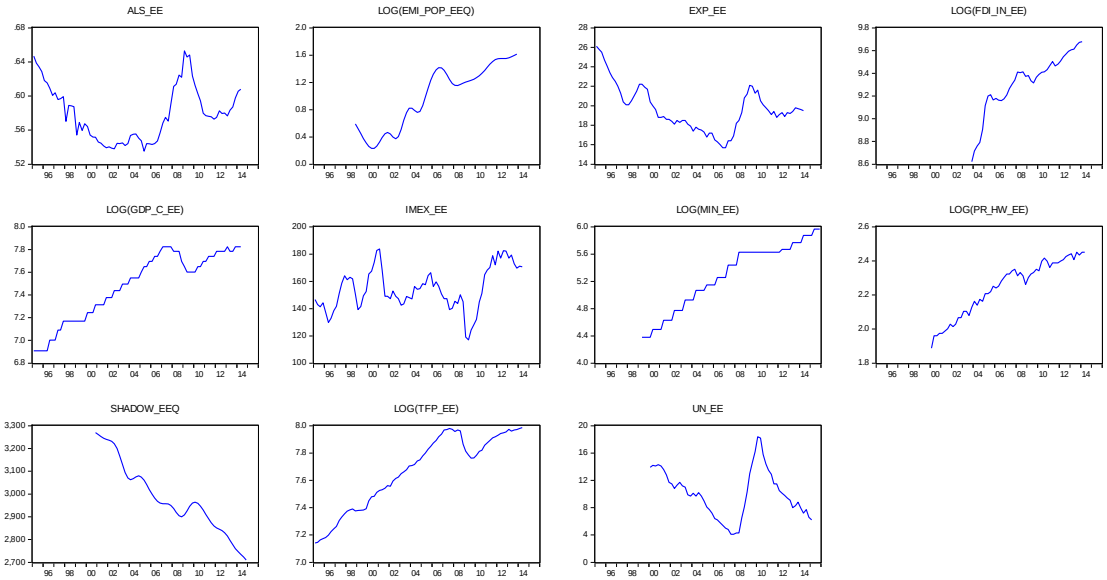
The graphical analysis shows rather clear down turn in labor share trend in Lithuania. This gives additional evidence, that the trend of labor shares in the Baltic countries is not stable.

Furthermore, we can observe two crisis periods, shocks are reflected in Lithuania's labor share, which are also visible in expenditure, unemployment

and trade globalization measures. Second shock, to some extent, is also visible in GDP per capita, productivity, shadow economy, total factor productivity and to some extent emigration measures. This confirms the need for crisis dummy variable to account for the effects of external shocks. If we look at scatterplots, the closest linear relationship of labor share in Lithuania seems to be with trade globalization and government expenditure.

In case of Estonia, labor share and majority of other variables exhibit only one clear shock, with the peak in year 2009.

Figure 12. Analyzed variables – case of Estonia.



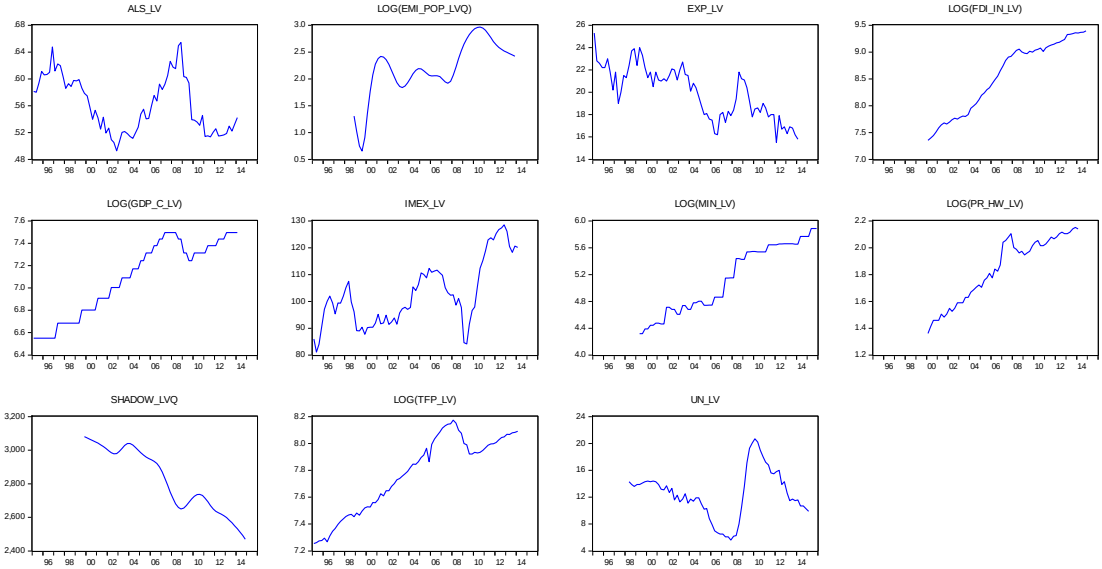
Source: Author's compilation based on EUROSTAT database and Schneider at al. (2010), Schneider (2015) for shadow economy.

Shocks to Productivity and FDI variables are less visible, whereas trade globalization measure seems to have a lot of volatility, which is not unusual for a small country as Estonia. Scatterplot graphs show the closer linear relationship of labor share in Estonia with trade globalization, whereas government expenditure seems to be more scattered.

In case of Latvia, the situation is even more unclear. Labor share shows two large spikes over the analyzed period of time, which correspond to two economic crises. This might point to unclear future trend when more data is available due to strength and frequency of external shocks. Other variables

mostly show one clear shock in their trends. Scatterplots in case of Latvia reveal rather diverse relationships, which in most cases do not seem linear with the labor share measure. The closest to linear relationship seems to be between labor share and government expenditure, which is consistent with visual observations of other Baltic countries.

Figure 13. Analyzed variables – case of Latvia.



Source: Author's compilation based on EUROSTAT database and Schneider at al. (2010), Schneider (2015) for shadow economy.

From the time series graphs we can deduct the non-stationary nature of the majority of analyzed variables and in some cases, a questionable relationship with labor shares in the Baltic countries. Nevertheless, stationarity of some variables is not very clear from the graphs alone. Thus, this issue will be further inspected using stationarity tests and if the primary notion regarding unit roots is confirmed and stationarity is visible at the first difference, then error correction model will be applied.

Time series stationarity analysis

After the graphical analysis variables were checked for unit roots with Augmented-Dickey Fuller unit root test to confirm non-stationarity of variables observed in graphical analysis. The results are presented in the appendixes 3-5

depict stationarity results performed on selected variables. Stationarity tests confirm the primary suspicion that the majority of analyzed variables are non-stationary.

The unemployment measure in Lithuania was found to be trend non-stationary at first difference, thus will be excluded from VECM model.

In case of Estonia, only inwards FDI measure was found stationary at level and minimum wage was found to be non-stationary at first difference, thus both will be removed from the model. Whereas, in Latvia unemployment level was found intercept stationary at level and minimum wage was found non-stationary at first difference, thus both will be removed from the model. Furthermore, in Latvia the shadow economy variable was found to be non-stationary at level, first or second difference, thus VECM model will not be possible with this variable in Latvia. This issue might be overcome in the future once more data is available for both variables.

Furthermore, some unit root values are close to 1 and ADF – Fisher test can have problems differentiating between unit root and a root close to one (Sjo, 2009), thus they were additionally checked using Dickey-fuller (ERS) test statistics.

VAR lag order selection and cointegration analysis

During data testing for stationarity, as common for majority of macroeconomic data, unit roots were found in most of all selected variables, thus the next important step is to determine, whether there is a linear combination of the variables that does not have a stochastic trend. Thus cointegration analysis for variables stationary at first difference was performed, which provides us information about cointegration (long-term) relationships between the analyzed variables. For the purpose of this thesis, VAR lag order selection was performed to select appropriate lags for the VAR-based Johansen cointegration test.

Suggested lag order for Lithuania's and Estonia's models is one and for Latvia - two. After the appropriate lags were selected, Johansen test of

cointegration was performed on all remaining variables since they are all non-stationary at level, but are integrated at the same order (first difference).

Johansen cointegration test shows (see appendixes 3-5) that models of three countries contain one cointegration relationship, thus use of vector error correction model is justified.

The correct lag order selection for the model of shadow economy in case of Lithuania was four lags (four quarters) and the model had one cointegrating equation, thus we were able to apply VECM model (appendixes 6-7). In case of Estonia, five lags were necessary to avoid serial correlation and also one cointegrating equation was present. As mentioned previously, in case of Latvia, VECM model is not possible with the shadow economy variable, due to different stationarity levels between labor share and shadow economy indicators.

Vector error correction model specification

There are two generally acceptable ways to arrive to the final combination of variables in the specific econometric model (Greene, 2012). One approach is "from simple to general"; it suggests starting simple specification and adding variables step by step as long as necessary. This approach enables researchers to maintain simplicity in their models, but it embeds the risk of omitting significant variables. Second approach "from general to simple", it suggests starting with all available variables and their possible transformations (lags). Then the final model specification is obtained by removing unnecessary variables step by step. This approach might overestimate the significance of some variables.

However, this is usually a smaller problem than biasness of the first approach. Thus, for this research, the second approach "from general to simple" model was used. The robustness check was also performed by removing variables from the equation and following specifications of the models were concluded:

$$ALS_{lt} = F\left(EXP_{lt}, FDI_{lt}, IMEX_{lt}, PRHW_{lt}, Dummy_{crisis_{lt}}\right) \quad (21)$$

$$ALS_{ee} = F\left(EMI_{ee}, IMEX_{ee}, PRHW_{ee}, Dummy_{crisis_{ee}}\right) \quad (22)$$

$$ALS_{lv} = F\left(EXP_{lv}, EMI_{lv}, FDI_{lv}, GDP_{C_{lv}}, Dummy_{crisis_{lv}}\right) \quad (23)$$

The models were constructed by removing necessary variables to meet the criteria of the stable model. First of all, variables were removed from VECM based on the stationarity analysis to ensure that all variables are integrated at the same level. Other variables were removed due to non-normal distribution of their errors, which is one of the preconditions of regression analysis. The other variables were removed due to the lack of cointegration relationship with labor share. Only some not cointegrated variables with labor share were included into the models to allow reasonable comparison of results between countries. The process of reducing the initial number of variables ensures stable and reliable results, however leaves the question about the effect of the removed variables unanswered until more data is available.

Additional models to investigate the effect of shadow economy on labor share in Lithuania and Estonia were constructed separately from the main models.

$$ALS_{lt} = F(SHADOW_{lt},) \quad (24)$$

$$ALS_{ee} = F(SHADOW_{ee},) \quad (25)$$

The decision to make a separate model was taken due to a large expected effect of shadow economy and its interrelation and effects on other variables. Another reason for treating the shadow economy measure differently is the lack of research related to labor share and shadow economy, its informal and rather different nature, in comparison to other variables.

Testing model residuals

The selected VEC models were tested using three tests: VECM Residual Serial Correlation LM Test, which informs if model is autocorrelated, White's heteroskedasticity test and Jarque-Bera normality test, which informs us if model is in line with data distribution normality assumption. The results of all tests are presented in the appendixes 3-7. The cointegration analysis confirms that each selected model contains only one cointegrating equation.

Furthermore, LM tests are performed to check for serial correlation, which can appear due to incorrect lag selection. Serial correlation LM tests' results confirm that models do not exhibit serial correlation among residuals, meaning that selected lag order is appropriate. Furthermore, the residuals of the selected model were checked for heteroskedasticity using White's test, which showed homoscedastic residuals in all models.

Finally, Jarque-Bera residual test was performed to check for normality of residuals. Lithuania's model showed the Jarque-Bera test probability value of 63.5%, which allows us to except the null hypothesis, that the model residuals are normally distributed. In Estonia's and Latvia's models, Jarque-Bera test probability values were 10.5% and 26.6% respectively. The models of Lithuania and Estonia with shadow economy had Jarque-Bera test probability values of 86.3% and 20.1% respectively. These results also confirmed that residuals are normality distributed since probability values are all above 5%.

VECM model short-term and long-term causality

The long-term[23] and short-term causality of variables in the three main and two shadow economy models were tested using error correction term coefficients and short-term causality obtained from VECM models. The models for all three countries are summarized in the table 3.

[23] Existence of cointegrated vectors is interpreted as indicator of long-term equilibrium relationship.

Table 3. Coefficients of VECM models for three Baltic countries (1995-2014)

	Change in labor share in Lithuania	Change in labor share in Estonia	Change in labor share in Latvia
Long-term effects			
$IMEX_{t-1}$	-0.000749 (-0.92828)	-0.001058*** (-3.89397)	
$Prod\_hw_{t-1}$	-0.220187 (-1.02413)	0.441361*** (5.82737)	
Exp_{t-1}	0.020209*** (3.14682)		0.028853*** (5.03417)
log $\_FDI\_in_{t-1}$	0.008339 (0.16466)		0.187786*** (3.68904)
Emi_{t-1}		0.044985*** (4.56472)	0.005611 (1.76968)
$log\_GDP\_capita_{t-1}$			0.283676*** (2.21956)
Short-term effects			
$\Delta\ IMEX_{t-1}$	-0.000628** (-2.06995)	-0.000485*** (-2.78950)	
$\Delta\ Prod\_hw_{t-1}$	0.092004 (1.53547)	-0.065168 (-1.41346)	
$\Delta\ Exp_{t-1}$	0.004799*** (2.731114)		0.006800*** (2.32567)
Δ log $\_FDI\_in_{t-1}$	0.027747 (1.06378)		0.049152 (0.75655)
$\Delta\ Emi_{t-1}$		-0.004008 (-0.96159)	-0.000577 (-0.36922)
Δ log $\_GDP\_capita_{t-1}$			-0.092800 (-1.22858)
Time Dummy	0.016647*** (3.19851)	0.009532* (1.94248)	0.017962*** (2.01381)
Time error correction term (ALS_{t-1})	-0.172064*** (-4.81967)	-0.168932*** (-2.70302)	-0.230016*** (-3.52839)
N	68	54	53
R^2	32%	27%	46%
$\Delta\ Shadow_{t-n}$	13.22095***	2.520230	
Time error correction term (ALS_{t-1})	-0.018393*** (-3.97036)	-0.008368*** (-2.33570)	
N	53	48	
R^2	38%	43%	

Source: author's compilation using calculations with Eviews statistical program

Note: T-statistics are indicated in parenthesis. ***p<.01. **p<.05. *p<.10. Shadow economy models contain Chi-square test p-values of Wald test and reflect long-term significance of the shadow economy.

From the table above, we can deduct, that an error correction term (i.e., the speed of adjustment towards long-term equilibrium of labor share) in the main

model of Lithuania is negative and significant, which points to a significant causality running from the selected group of independent variables to the dependent variable – adjusted labor share in Lithuania. The speed of adjustment to equilibrium shows that the system will converge to a long-term relationship (will return to long-term equilibrium). In Lithuanian model the speed of adjustment in one quarter is around 17%, meaning that 17% of disequilibrium (created by a shock to independent variables) in labor share will be corrected in one quarter.

In case of Estonia, as seen from the model, the negative and significant error correction term confirms the existence of a long-term relationship in the described model. We can also see that the speed of adjustment to equilibrium of Estonia's labor share is also around 17%. If we look at the model of Latvia, the error correction term in the main model is also negative and significant pointing to the existence of the relation between labor share and independent variables. The speed of adjustment of labor share to equilibrium level in Latvia is around 23%, a bit higher than in the other two countries.

In macroeconomic terms, the period of one quarter is perceived to be very short, thus it is not surprising that adjustment is rather small. Nevertheless, slow adjustments could also point to larger exposure of labor share in the Baltic countries to the effects of external factors.

If we look at separate independent variables and their significance to the main models, we can see that government expenditure exhibits long and short-term significant and positive effects on labor share in Lithuania and Latvia, meaning that decreases in government spending would push down labor share. These results are consistent with the visual analysis of scatterplot graphs and in line with the relationships explained and anticipated in the literature review.

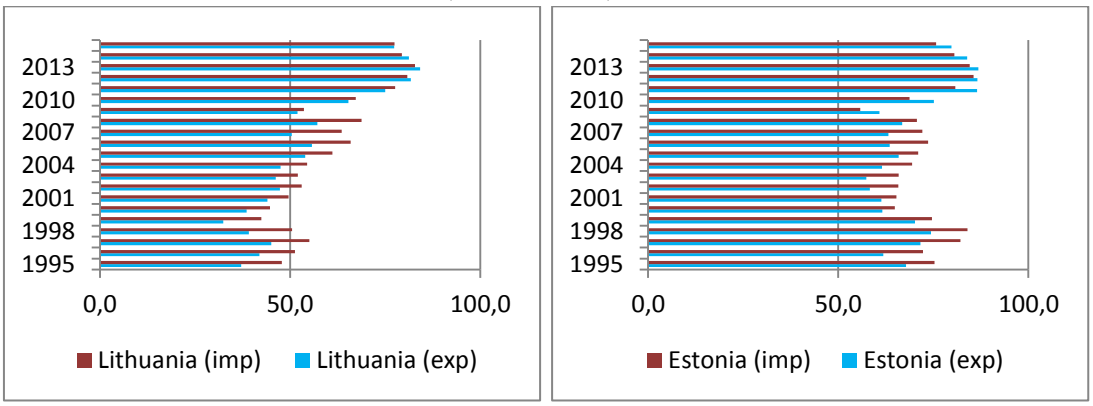
As established previously, government expenditure has declined during the analyzed period of time in all three Baltic countries. Nevertheless, general, not specifically targeted, increase in government spending might not give the desired effect – increase in labor share, since, retired citizens make up a significant part of the population in the Baltic countries, but are not part of the

employment (unless employed) statistics, thus their incomes (pensions) are excluded from the labor share statistics. Thus, gains from increased government expenditure might be distributed to retired part of the population, rather than employees.

Furthermore, public spending in GDP and taxation are rather limited in the analyzed countries when compared to EU average (Masso, Espenberg, Masso, Mierina, and Philips, 2012). This is especially visible in Lithuania, where taxation system is heavily dependent on consumption and other taxes, which are mainly levied on the working class rather than capital (IMF, 2016). Furthermore, capital income is usually concentrated in the hands of the wealthier citizens, who are few, and majority relies on income generated with labor. Additionally, labor unions are week (less than 20% of employees are members) and this further decreases labor bargaining powers (Masso, Espenberg, Masso, Mierina, and Philips, 2012). Thus, the proper policy measures should be taken in order to increase labor share. The author suggests: distributing taxation burden more equally between capital and labor owners by increasing property, land and overall progressivity of taxes on capital income; ensuring adequate protection to workers with lower bargaining power, such as tax free income for minimum wage receivers (the poorest part of population), support for families with children. At the same time measures to liberalize employment relations could be taken in order to benefit overall market, but changes need to be sensitive to employees with lower bargaining power. This would encourage employees to work rather than emigrate, live from social benefits or undertake shadow economy activities (receiving non-reported income).

Trade openness measure exhibits negative effect on labor share in both Lithuania and Estonia. This effect is significant during the short-term in both countries and during long-term in Estonia. Increase in trade openness causes a downwards shift in labor share. Harrison (2005) and Kristal (2010) find similar effects in large countries.

Figure 14. Changes in imports and exports of goods and services in the Baltic countries in 1995-2015 (% of GDP)



Source: Authors compilation based on Eurostat data.

Figure 14 illustrates that trade deficit persists in both countries – Lithuania and Estonia for the majority of the analyzed period. Thus, the negative effect of increasing trade openness on labor share could be explained by the fact, that imports outweigh export in both countries and increasing trade openness favors foreigners and hurts local producers, this way diminishing the returns to workers in the analyzed countries.

On the other hand, emigration and productivity measures are both significant and have a positive effect in Estonia in the long-term, but do not show significant effect on short-term labor share fluctuations. A positive impact of emigration on labor share in Estonia could be explained by emigration of lower-skilled workers rather than skilled workers which would cause the brain-drain effect[24] and labor share to shrink.

Moreover, a positive long-term effect of productivity on labor share in Estonia was also expected and can be confirmed by the graphical analysis. In case of Baltic countries, technological change importance was only measured through productivity, which did not show significance in Lithuania and showed only a long-term positive significance in Estonia. Nevertheless, the productivity measure event though not significant in the model, but showed a negative effect in the long-term in Lithuania and short-term in Estonia. These effects could be caused by productivity augmented through capital advances

[24] Opinion is based on the research completed by Anniste, K., et. al. (2012).

rather than labor. Thus, it would be interesting to explore the effects of additional investment and technological advances signaling indications, for instance, ITC or other sectors in these countries. Nevertheless, ITC sector is still rather small in all three economies and constituted only 2.14% in Lithuania, 2.80% in Latvia and 3.97% in Estonia of value added at factor cost in GDP in year 2012[25].

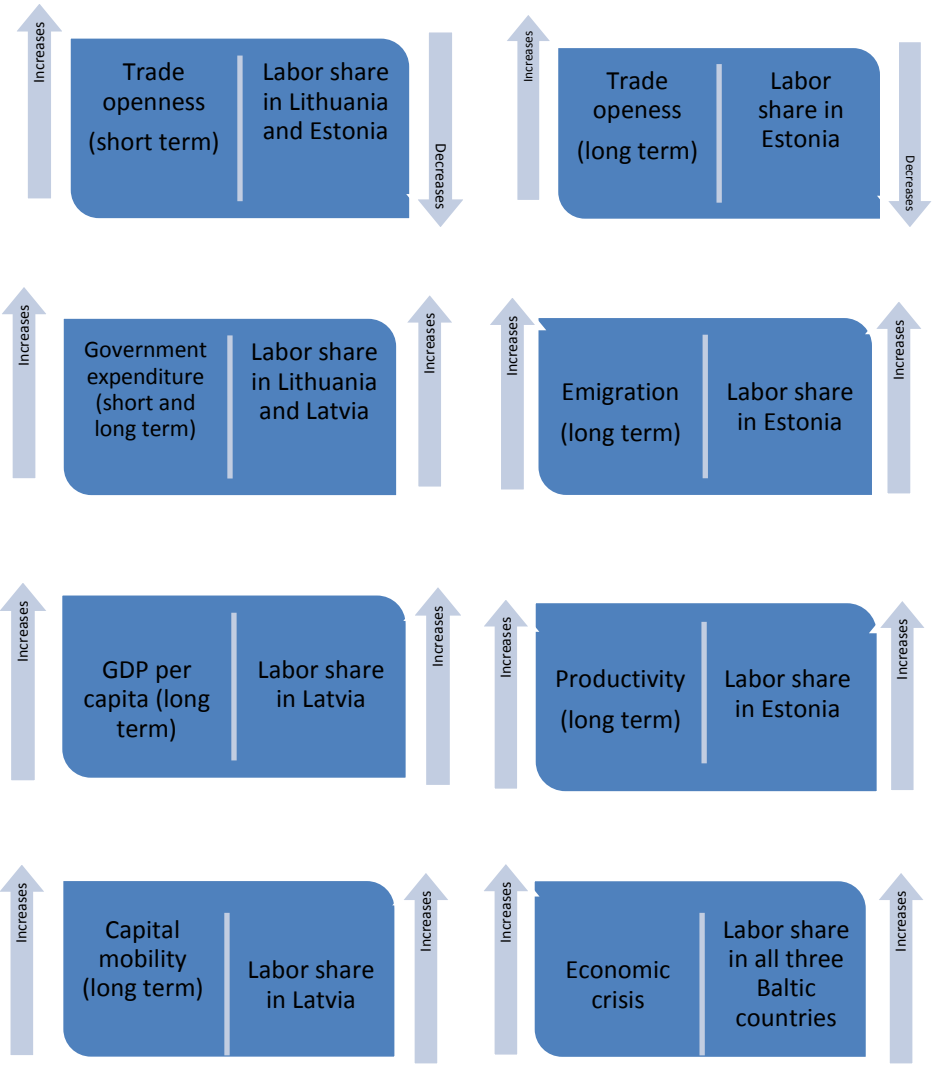
Furthermore, FDI and GDP per capita show only long-term significant and positive effects in Latvia's case. A positive effect of inwards FDI was expected, since an increase in FDI creates more jobs and increases competition in the labor market. As a county is competing for employees, international companies are willing to increase salaries to attract qualified work; this also increases GDP per capita measure, which in Latvia is showing a long-term significance with a positive sign. Some authors see GDP per capita as a proxy for factor endowments (Ortega and Rodrigueez, 2002) or capital-labor ratio (Finnoff and Jayadev, 2006).

Furthermore, the dummy variables are found to be significant in all three countries, which indicate the exposure to external economic distresses, which have a short-term positive effect on labor share levels in all three countries. This might be explained by the fact that labor share is a less flexible factor than capital and adjusts slower to economic fluctuations, especially rapid and dramatic downturns.

The directions of effects of independent variables are similar between countries. The summarized effects by the independent variables on labor share in the Baltic countries are presented in figure 15.

[25] Based on Eurostat data: Percentage of the ICT sector on GDP.

Figure 15. Direction of effects of significant independent variables on labor share in analyzed countries.



Source: Author's compilation.

If we look at the overall statistics of the Lithuanian model, F statistics show that there is a close to zero probability that results are accidental, Durbin-Watson test also confirms that the model does not show autocorrelation and adjusted R-squared points that the selected independent variables are able to explain around 32% of variations in the labor share of Lithuania. In Estonia's model the general statistics, such as F statistics and R-squared confirm that the results are not accidental and can explain around 27% of variations in Estonia's labor share. The overall model statistics in Latvia's case points to non-

accidental results and the model is able to explain 46% of variations in the labor share of Latvia.

Shadow economy models were constructed only for Lithuania and Estonia, since the independent variable in case of Latvia was not stationary at level or first and second differences and did not follow normal distribution, thus VECM model was not possible. Nevertheless, inability to statistically calculate the effect of shadow economy on Latvia's labor share in no way disproves its effect. Once a longer timeline of data is available this model might become possible.

The negative and significant error correction term in both shadow economy models confirms the existence of a long-term relationship between labor share and shadow economies in Lithuania and Estonia. Furthermore, it is important to notice that while main models with several explanatory variables were able to predict only 32% and 27% of variation in labor share of Lithuania and Estonia, models with shadow economy indicator alone are able to explain 38% and 43% of variations in labor share. A rather high value shows that shadow economy plays an important role in the long-term fluctuations of labor share.

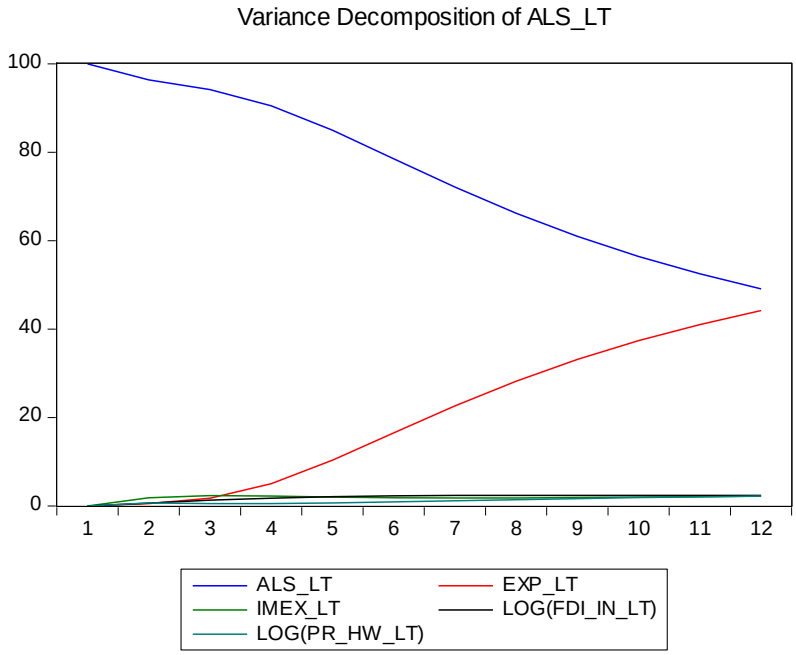
Furthermore, shadow economy models exhibit a long-term negative effect on labor share in both countries, and a short-term negative significant effect in Lithuania. The shadow economy measure was compiled taking into account both monetary (currency demand approach) and labor market indicators (labor force participation rate, growth rate of total labor force), thus it is difficult to elaborate which particular shadow activities and their changes contribute to the changes in labor share.

Variance decomposition for VECM model

Variance decomposition was performed to provide additional information about dynamic properties of the model, such as duration of the effect of significant predictor variables on dependent variable.

The variance decomposition of the Lithuania's model has confirmed that government's expenditure measure exerts the largest effect on labor share fluctuation and accounts for up to 44% of variation in labor share in Lithuania in three years, whereas own shock to labor share (unexplained variation) has a diminishing effect from 96% during the first quarter, to 49% in three years' time (Figure 16). The trade, productivity and inwards FDI variables show an increasing effect on labor share in Lithuania and reach around 2% in three years' time.

Figure 16. Variance decomposition of Lithuania's VECM model



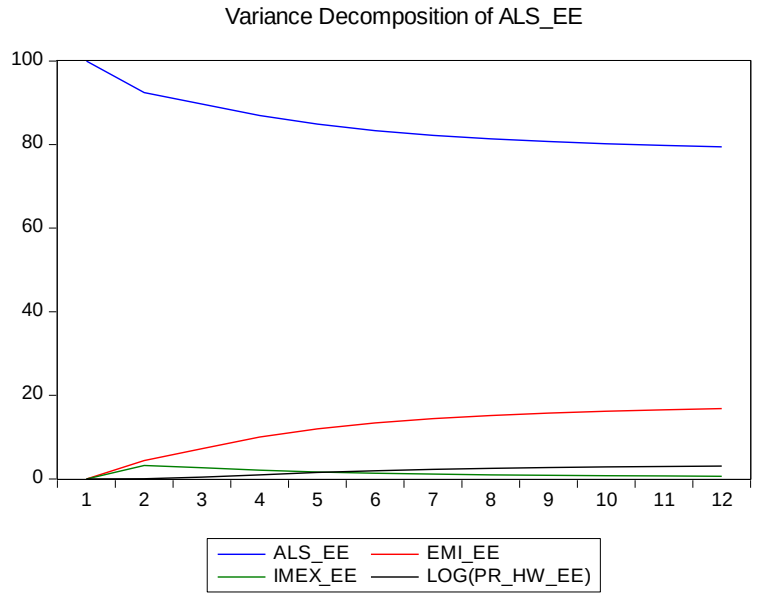
Source: author's compilation using Eviews statistical program

The results of variance decomposition are similar to the short and long-term analysis, despite the fact that variance decomposition is performed on non-differenced data.

Furthermore, unexplained variation in Lithuania's labor share in the first quarters is large and shows significant decrease through time. The adjustment time to economic changes of labor share indicators is rather long, which confirms the findings of relations revealed in Lithuania's VECM model.

The adjustment starts earlier and at a more rapid pace in the case of Estonia's labor share when compared to Lithuanian and Latvian cases. Already in the second quarter emigration and trade globalization measures can each explain 4% and 3% of labor share variation.

Figure 17. Variance decomposition of Estonia's VECM model



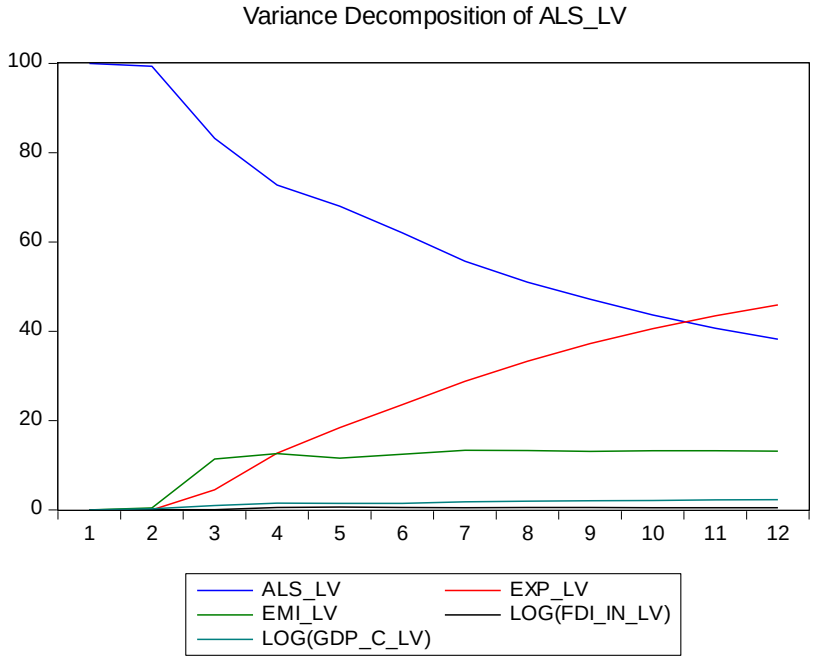
Source: author's compilation using Eviews statistical program

When considering separate indicators, emigration measure in Estonia seems to explain the most variation in labor share in the long-term. It explains around 16.8% of variance in labor share in the period of three years. Productivity measured in hours worked explains only up to 3% of variation in three years' time. On the other hand, trade globalization measure exhibits larger effect earlier (at the second half of the first year) and can explain up to 3%, which decreases with time (to 0.63% in three years).

Lithuania's variance decomposition results are similar to the relationships determined by VECM model, whereas Estonia's variance decomposition results differ. In the model when looking at single variables, all three variables were indicated as significant, but variance decomposition showed that most variance in Estonia's labor share can be explained by emigration variable. These discrepancies can be caused by the fact that

variance decomposition uses transformed data at level and VECM model uses lagged data, thus VECM model specifications will be perceived superior if the results differ.

Figure 18. Variance decomposition of Latvia's VECM model

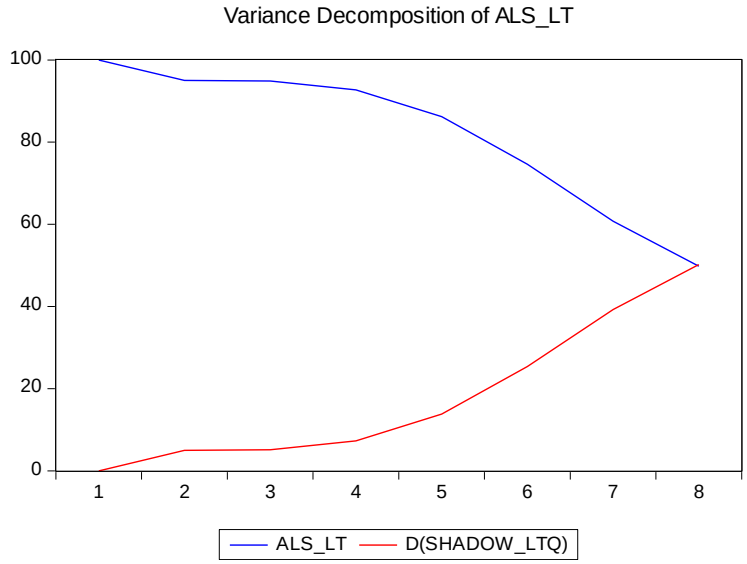


Source: author's compilation using Eviews statistical program

The variance decomposition of the Latvia's model has confirmed that government's expenditure has the largest effect on labor share, which reaches close to 46% of variation in labor share in Latvia in three years' time. This is consistent finding with VECM model relationships.

The unexplained variation of Latvia's labor share diminishes from 98% to 38.2% in three years. Another variable explaining a large part of variation in labor share is emigration, in three years' time it can explain up to 13.1% of variation. The GDP per capita measure and FDI show less effect on labor share in case of Latvia, in three years' time they can explain up to 2.3% and 0.5% respectfully.

Figure 19. Variance decomposition of Lithuania's Shadow economy VECM model

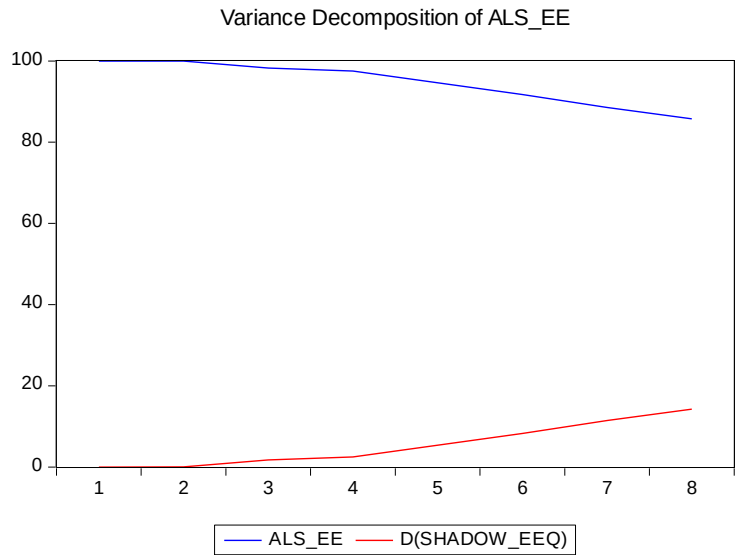


Source: author's compilation using Eviews statistical program

Variance decomposition of shadow economy model for Lithuania reveals that shadow economy has a substantial effect on labor share in Lithuania. Furthermore, the effect does not wear off over time. Shadow economy can explain over 50% of fluctuations in two years and effect further increases.

These effects are consistent with significant long-term VECM model and can explain more long-term variation in labor share than the main VECM model. Nevertheless, shadow economy might be influencing other macroeconomic factors, thus the percentages explaining labor share of two models in Lithuania cannot be simply added and self-induced variation (unexplained variation) might remain.

Figure 20. Variance decomposition of Estonia's Shadow economy VECM model



Source: author's compilation using Eviews statistical program

In case of Estonia, the situation differs in the shadow economy variance decomposition model from Lithuanian's case. From figure 19 we can observe that shadow economy can explain only up to 14% of variations in labor share in two years. This is much lower when compared to Lithuania's 50%. Thus, much variation in Estonia's labor share remains unexplained by the analyzed factors and will require further research once more data is available.

To sum up, the performed econometric analysis confirms the findings of scientific literature analysis. Labor shares in the small open economies are declining and the economic factors demonstrate significant effect on the development of labor share over the long-term. The main predictors, although some country specific factors exist, are globalization factors together with public policy decisions. These two factors are often mentioned in the scientific literature as significant contributors to labor share developments. The main country specific factors are emigration and shadow economy. These findings show similarities to findings of large economies; however, country specific factors also play an important role and should not be ignored.

Conclusions

The author has performed the systemic scientific literature and empirical research analysis, which revealed that functional income distribution is under researched topic especially lacking analysis for small economies on labor share dynamics and factors affecting it. The performed empirical research revealed labor share is not stable over the analyzed period and that economic factors play an important role in the income distribution at the macro level.

1. There are clear differences between different schools of thought. Nevertheless, most of economic models provided by Neoclassical, Keynesian and Marxian economists use over restrictive assumptions of closed economy and full employment and relaxation of these assumptions might be problematic in overviewed models. These restrictive assumptions are far from the analyzed situation which is very dynamic. This is especially relevant to small open economies that experience a rapid liberalization process, structural unemployment, declining labor unions, structural changes, etc.
2. The theoretical labor share trend analysis revealed that majority of authors find a declining trend of labor share when analyzing large economies or their groups, but they are not able to fully justify this decline. Furthermore, there is a lack of research and substantial differences between results obtained in respect to small open economies, such as Baltic Countries, where the trend of labor share is even less explained.
3. Economic factors effecting labor share were identified in the scientific research analysis. Some factors are more often researched than others and have shown more significant effect on labor share. The most often mentioned factor group is globalization, nevertheless others, such as technological change, bargaining power of employees and macroeconomic policy of the State also showed significance in several researches. Based on observation, we can conclude, that some factors, such as intensifying trade are relevant in majority of countries, but others, such as shadow economy or emigration can be case specific and can exhibit effect only in particular countries.

4. The importance of self-employed is stressed while calculating labor share. There are different opinions on the share of self-employed which should be attributed to labor share, but the opinion about the general need to take into account the income of self-employed prevails. The data for Baltic countries has shown, that sectors with the highest self-employed numbers are agriculture and wholesale and retail, which are both labor intensive, thus for the purpose of this thesis income of self-employed was entirely attributed to labor share. Thus, the preferred measure used was compensation of employees' data adjusted for income of self-employment and divided by gross value added. This measure provides a well accessible and rather simplified measure which could be further improved. Furthermore, aggregated labor share measure is used in this thesis, since sectorial data is fragmented.

5. The trend analysis of the labor shares in the Baltic countries has revealed that the volatility of labor shares in the Baltic countries exceeds the volatilities of the developed countries presented in the analyzed literature. Furthermore, the productivity growth is not fully realized in employees' compensation increases in all three Baltic countries, which should push labor share upwards, but we observe a negative trend, thus there might be other factors at play as stipulated in the literature analysis. The declining trend of labor share in all three Baltic countries is well in line with the findings of literature analysis. Available scientific literature mostly focuses on large and well developed economies, whereas our research shows that trends of labor share is similar to the trend of large economies. Nevertheless, these conclusions are only valid for the medium-term (20 years). Once more data is available for the analyzed countries the research could be repeated to confirm results over the long-term.

6. To summarize the econometric analysis, long-term models were significant in all three countries. This confirms the stipulation that declining labor share trend cannot be fully explained by technological advances and other economic factors are at play.

In case of Lithuania and Latvia, **government expenditure** had a positive effect on labor shares, meaning that policy makers can influence further development of income distribution at the macro level by changing the re-distributional priorities. Nevertheless, not specifically targeted increase in government spending might not give the desired effect – increase in labor share, since, retired citizens make up a significant part of the population in the Baltic countries, but are not part of the employment (unless employed) statistics, thus their incomes (pensions) are excluded from the labor share statistics. Thus, gains from increased government expenditure might be distributed to retired part of the population, rather than employees.

Furthermore, public spending in GDP and taxation are rather limited in the analyzed countries. This is especially visible in Lithuania, where taxation system is heavily dependent on consumption and other taxes, which are mainly levied on the working class rather than capital. Furthermore, capital income is usually concentrated in the hands of the wealthier citizens, who are few, and majority relies on income generated with labor. Thus, the proper policy measures should be taken in order to increase labor share. Thus, distributing taxation burden more equally between capital and labor owners by increasing property, land and overall progressivity of taxes on capital income is suggested. As well as ensuring adequate protection to workers with lower bargaining power, such as tax free income for minimum wage receivers, support for families with children. At the same time measures to liberalize employment relations could be taken in order to benefit overall market, but changes need to be sensitive to employees with lower bargaining power. This would encourage employees to work rather than emigrate, live from social benefits or undertake shadow economy activities.

Opening borders and increasing amount of cross-border trade had a negative effect on labor shares in Lithuania and Estonia, this most likely would also be reflected in Latvia, but due to data normality issues the author was not able to produce proof. Nevertheless, trade globalization has a long-term effect only in Estonia, in Lithuania this effect wears off in time. Both findings are in

line with the findings for large economies as overviewed in the scientific literature analysis.

Emigration could be perceived as a country specific factor and had a positive effect on labor share over the long-term in Estonia. Nevertheless, it did not show significant effects in Latvia. A positive impact of emigration on labor share in Estonia could be explained by emigration of lower-skilled workers rather than skilled workers.

FDI and GDP per capita show only long-term significant and positive effects in Latvia's case and did not show significant effects in Lithuania. A positive effect of inwards FDI was expected, since an increase in FDI creates more jobs and increases competition in the labor market. As competition for employees intensifies, international companies are willing to increase salaries to attract qualified work; this also increases the GDP per capita measure, which in Latvia is showing a long-term significance with a positive sign.

A positive and significant long-term effect of **productivity** on labor share is observed in Estonia. Nevertheless, the productivity measure even though not significant in the model, but showed a negative effect in the long-term in Lithuania. These effects could be caused by productivity augmented through capital advances rather than labor. Thus, it would be interesting to explore additional indications signaling investment and technological advances, for instance, ITC or other sectors in these countries. ITC sector is still rather small in all three economies, but with time could confirm the stipulation about capital augmenting technological progress.

Variance decompositions of dependent factor for most part confirm the VECM model findings, showing that government expenditure has the largest impact on labor share in Lithuania and Latvia and emigration measure, even though insignificant over short-term, but exhibits the largest effect on labor share in Estonia.

Another significant factor in the regressions was the exogenous variable accounting for the effects of **economic crisis**. It showed significance in all three countries. This effect was expected, can be explained by the fact that

small and open economies are much less resilient to economic distresses originating abroad.

Furthermore, **shadow economy** had a negative long-term effect on labor share in Lithuania and Estonia. Variance decomposition of shadow economy models revealed that the effects of this indicator vary across two countries; there is a substantial effect on labor share in Lithuania and a much milder effect in Estonia. Nevertheless, due to the complex measure of shadow economy it is difficult to elaborate which particular shadow activities and their changes contribute to changes in labor share.

Conclusively, the effects on labor shares in the large countries discussed in the scientific literature are similar to the effects on labor shares in small open economies. However, single country analyses reveal that country specific factors also play an important role and should not be disregarded. In case of the Baltic countries, emigration and shadow economy can be perceived as country specific factors.

Further research foreseen

Expansion of this dissertation could follow in lines of examining the factors affecting the other part of functional income distribution – capital. Furthermore, it would be interesting to explore the relationship between functional income distribution and economic growth; this would allow us to determine whether small open economies follow the same wage-led model as large economies and would enable us to provide policy recommendations.

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Appendixes

Appendix 1

Overview of scientific literature on changes in factor shares.

Publication	Dependent variable	Independent variables	Sample
Acemoglu (2003)	Labor share	Capital and labor intensive technological progress	n/a
Arpaia, Perez, Pichelmann (2009)	Labor share	Capital deepening, capital-augmenting technology, labor substitution depending on skills	9 of EU15, 1970-2004
Azmat, Manning, Reenen (2007)	Labor share (sectorial)	Privatization (public ownership, barriers to market entry)	3 network industries in 18 OECD, 1970-2000
Berthold, Fehn, Thode (1999)	Impulse responses to wage shocks	Labor share; Unemployment; Nominal wages; capital-labor ratio	Germany, France, US, 1970-1995 (semi-annual)
Bertoli, Farina (2007)	Factor shares	Sectorial composition of production; country-specific factors; technological progress (skill based also); institutional change;	EU
Bertolila, Saint-Paul (2003)	Labor share	Capital-output ratio; Real price of Oil; Total factor productivity; Employment growth rate; Worker's bargaining power.	12 OECD (1972-1993); 13 sectors
Blanchard (1997)	Factor price ratio	Biased technological progress: distribution of rents	OECD, France
Daudey, Decreuse(2006)	Labor share	Higher education; capital per worker, union density; minimum to medium wage ratio; unemployment rate; degree of openness; tax wedge; R&D spending; interest rate; capital account openness	11 OECD countries, 1970-2000
Decreuse, Maarek (2007)	Labor share in manufacturing sector	FDI-stock to GDP; other variables: capital-output ratio, unemployment rate; control for: female participation, public spending to GDP.	89 non-OECD countries, 1980-2000
Diwan (2001)	Labor share	Economic policies; financial structure; change in GDP; economic environment	135 countries (1975-1990)
Dunhaupt (2013)	Labor share	Liberal policies; financialization; biased technological change; globalization; labor market and product market policies; sectorial composition; privatization.	OECD
EC (2007)	Labor share	Cyclical movements; capital to labor ratio; ICT-intensity of production process; variables effecting rents in goods market; relative bargaining power; active labor market policies; direct government take in value added .	EU, 1960-1980 and 1981-2006
Ellis, Smith (2007)	Profit share (1-LS)	Technological progress**;** business cycle fluctuations; oil prices; exchange rates; regulations; share of exports from emerging	OECD, 1961-2004

		manufacturing economies in total world exports	
Finnoff, Jayadev (2006)	Labor share	Feminization of labor force; control variables: real GDP per capita; government share of GDP; trade union memberships; unemployment; trade taxes to trade; capital mobility measure; part-time to full-time ratio	OECD, 1970-2000
Giammarioli, Messina, Steinberger (2002)	Labor share	Business cycle fluctuations; employment protection legislation, union power	EU and US, 1960-1998
Giovannoni (2010)	Labor share	Geography and history; Economic policy; Economics; trade and international prices; Institutions and politics	25 countries
Gollin (2002)	Labor share	Sectorial composition; self-employed income	41 countries
Guerriero (2012)	Labor share	International trade; globalization; technical change; level of economic development and structural change; education and human capital; labor market regulation	89 countries, developing and developed. 1970-2009
Guscina (2006)	labor share; Gini coefficient	Factor-biased technological progress; openness to trade; changes in employment protections	18 OECD, 1960-2000
Harrison (2005)	Labor share	Factor endowments; government spending; trade shares; exchange rate crisis; movements in foreign investment and capital controls	over 100 countries, 1960-1997
Hein (2013)	Functional distribution; personal distribution, composition of top income	Financialization (shift in sectorial composition; trade union bargaining power; prices of raw materials and imported goods; price competition; overhead costs and gross profit targets	15 Advanced capitalist economies, since 1980
Hein, Vogel (2007)	Aggregate demand; Economic growth	Functional income distribution (profit share)	France, Germany, 1960-2004
Hutchinson, Persyn (2011)	Labor share in 8 manufacturing sectors	Changing technology; factor prices; adjustment costs and the bargaining power of unions; trade costs; foreign competition; changes in market structure; skill-biased technological change and capital accumulation.	12 EU15 countries, 1970-2005
ILO (2011)	Labor share	Capital-labor ratio; bargaining power; financialization; trade openness; control variables: structure of population	About 70 countries, 1970-2000; 16 advanced economies, 1981-2003
Young (2010)	Labor share (sectorial)	Trend	35 US industries, 1958-1996
Jayadev (2007)	Labor share	Capital account openness; government share of GDP, budget	many countries (does not

		deficit; trade openness; GDP per capita	specify)
Jaumotte, Tytell (2007)	Labor share	Export and import prices; labor to capital ratio; immigration; offshoring; capital stock; ICT capital; labor market policies	18 OECD, 1982-2002
Jones (2003)	Capital share	Trend	1950-1997
Kristal (2010)	Labor share; employment growth; compensation growth; product growth	Workers bargaining power; control variables**:** productivity growth, unemployment, and inflation	16 OECD, 1961-2005
Krueger (1999)	Labor share	Trend	n/a
Krusell, Ohanian, Rios-Rull, Violante (2000)	Skill premium (Skilled and unskilled labor)	Skill biased technology	US, 1963-1992
Lin, Tomaskovic-Devey (2011)	Labor share	Financialization	US industries, 1970-2008
Lucifora (1993)	Wages (Gross remuneration)	Union density, industrial disputes, age, firm size, occupation, tenure, wage differentials (from weighted average)	Different industries in Italy
Maarek (2012)	Labor share in manufacturing sector	Level of development; control variables: capital-output ratio; investment-output ratio, trade ratio of ex and imports, index for financial openness	About 120 countries, 1963-2003
Ortega, Rdriguez (2002)	Capital share; manufacturing capital share	Openness; controls for population density; aging population; life expectancy; female labor force participation; expenditures for education; population over 65 years	175 countries, 1960-1999
Rodric (1998)	Average level of dollar wages/compensation of employees in manufacturing	Level of democracy; Control variables: labor average labor productivity, income levels, average prize level of consumption	138 countries, and 29 countries; 1960-1994
Rodriguez, Jayadev (2010)	Labor share; Wage share	Trend	129 countries, 1950-2005; 181 countries, from 1977
Serres, Scarpetta (2002)	Labor share	Shifts in sectorial composition (wage gap, tax wedge, labor productivity, unemployment rate, inflation)	5 EU countries and US; 1971-1998
Slaughter, Swagel (1997)	wages of skilled and unskilled workers	International trade; international capital mobility; international labor mobility; transfer of technology	n/a

Stockhammer (2009)	Labor share	Technological change, globalization, financialization, bargaining power.	OECD
Stockhammer, Hein, Grafl (2007)	Aggregate demand	Labor share	Germany, 1970-2005
Stockhammer, Onaran, Ederer (2009)	Aggregate demand	Labor share	Euro area, 1960-2005
Torrini (2005)	Profit share (Manufacturing and services)	Real cost of labor; ratio of consumption price index to value added deflator; labor productivity	Italy, 1970-1990

Source: Author's compilation

Appendix 2

Variables used for econometric analysis, their sources and measurements

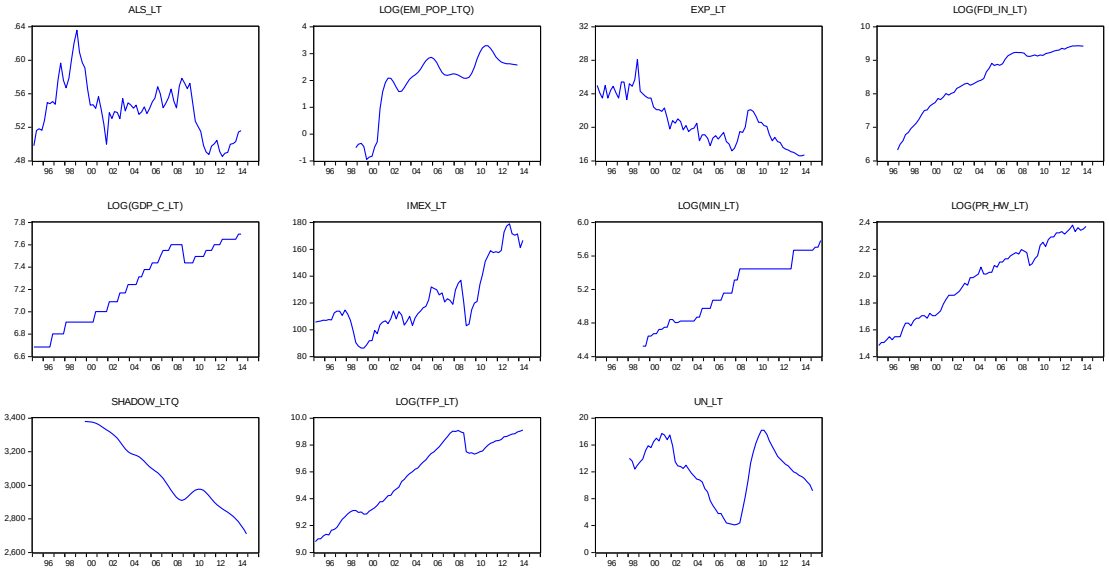
Variable name	Definition	Units	Data sources	Period
Adjusted Labor share	Compensation of employees plus income of self-employed as a share of GVA (or GDP-indirect taxes, plus subsidies) - (Stochammer, 2009)	Percent	Eurostat	1995Q1-2014Q2
Technological change				
Capital-augmenting tech change	Total factor productivity (Hutchinsnon and Persyn, 2011) - (ZVGDF)		Eurostat	1995Q1-2014Q2
Productivity	Real labor productivity per hour worked (Guscina, 2006)	Euro per hour worked	Eurostat	1995Q1-2014Q2
GDP per capita	GDP per capita (Ortega and Rodriguez, 2001; Finnoff and Jayadev, 2006; Jayadev, 2007; Maarek, 2012)	Euro per capita	Eurostat	1995Q1-2014Q2
Globalization				
Trade globalization	Sum of exports and imports as a share of GDP (IMF 2015; Daudey and Decreuse, 2006; Harrison, 2005; Maarek, 2012)	Percent	Eurostat	1995Q1-2014Q2
Capital mobility	FDI inflows/GDP	Mln Euro	Eurostat	1996Q4-2015Q1
Bargaining power of Employees				
Emigration	Emigration/total population	Percent	Eurostat	1998Q1-2013Q4
Unemployment	unemployed rate - quarterly average (Finnoff and Jayadev, 2006; Stockhammer, 2009)	Percent	Eurostat	1998Q1-2015Q1
Redistributive (macroeconomic) policies				
Government spending	Government final consumption expenditure/GDP (IMF 2015; Harrison, 2005)	Percent	Eurostat	1995Q1-2014Q2
Minimum wage	Monthly minimum wages (EC 2007))	Euro	Eurostat	1999Q1-2015Q2
Shadow economy				
Shadow economy	Accounts for both monetary (currency demand approach) and labor market indicators (labor force participation rate, growth rate of total labor force), complimenting with GDP per capita indicator, measured in purchasing parity power rates, presented as percentage of GDP.	Percent	Schneider at al. (2010), Schneider (2015)	1999Q1-2014Q4

Source: Author's compilation

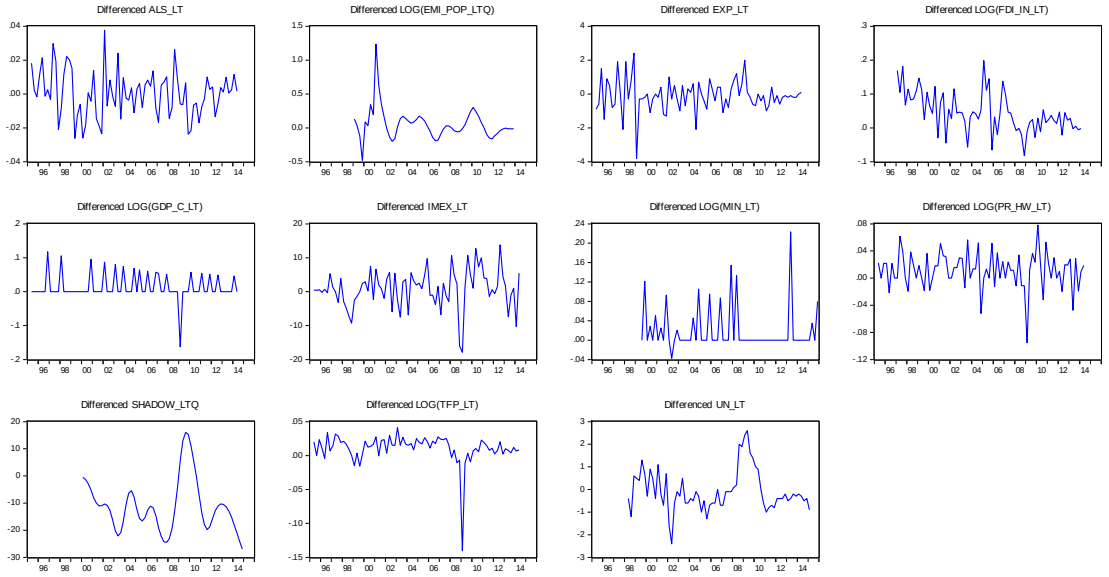
Appendix 3

Vector error correction model specification data - Lithuania.

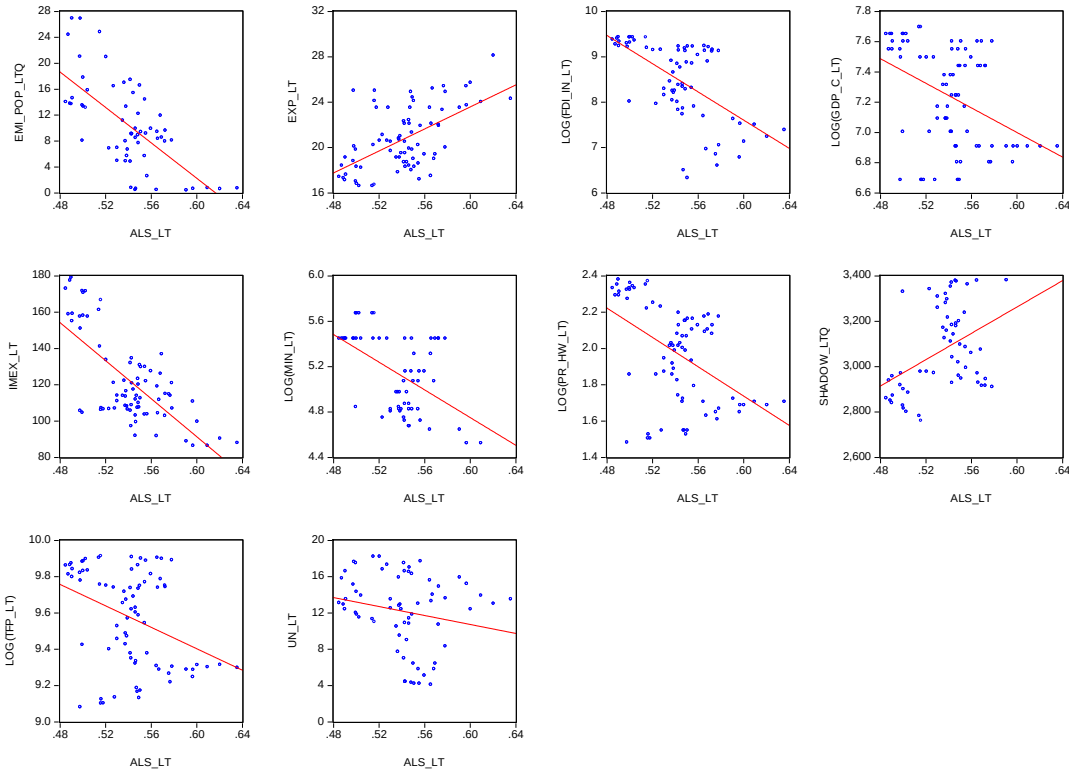
Time series plots at level



Time series plots at first differences



Time series scatterplots at level



Time series stationarity analysis

Variable			Result
	Intercept	Intercept and trend	
ALS_LT	0.2811	0.1453	Non-stationary
EMI_LT	0.3075	0.3560	Non-stationary
EXP_LT	0.5066	0.1798	Non-stationary
l_FDI_IN_LT	0.7196	0.2419	Non-stationary
IMEX_LT	0.8430	0.3745	Non-stationary
l_MIN_LT	0.8031	0.2663	Non-stationary
l_PR_HW_LT	0.7196	0.2419	Non-stationary
l_TFP_LT	0.5762	0.8895	Non-stationary
UN_LT	0.1148	0.2966	Non-stationary
l_GDP_C_LT	0.7759	0.6494	Non-stationary
SHADOW_LTq	0.9888	0.6755	Non-stationary
* Probabilities are computed. Null hypothesis assumes individual unit roots.			

Variable			Result
	Intercept	Intercept and trend	Stationary
D(ALS_LT)	0.0000	0.0000	Stationary
D(EMI_LT)	0.0000	0.0000	Stationary
D(EXP_LT)	0.0001	0.0000	Stationary
D(l_FDI_IN_LT)	0.0000	0.0000	Stationary
D(IMEX_LT)	0.0000	0.0000	Stationary
D(l_MIN_LT)	0.0000	0.0000	Stationary
D(l_PR_HW_LT)	0.0000	0.0000	Stationary
D(l_TFP_LT)	0.0000	0.0000	Stationary
D(UN_LT)	0.0210	0.0871	Stationary
D(l_GDP_C_LT)	0.0000	0.0000	Stationary
D(SHADOW_LTq)	0.6196	0.9000	Non-Stationary
DD(SHADOW_LTq)	0.0383	0.1328	Trend non-stationary
* Probabilities are computed. Null hypothesis assumes individual unit roots.			

VAR lag order selection and cointegration analysis

VAR Lag Order Selection Criteria
Endogenous variables: ALS_LT EXP_LT IMEX_LT LOG(FDI_IN_LT)
LOG(PR_HW_LT)
Exogenous variables: DUMMY_CRISIS_LT
Date: 04/12/16 Time: 16:00
Sample: 1995Q1 2015Q4
Included observations: 64

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-378.3236	NA	0.109645	11.97886	12.14753	12.04531
1	185.8569	1022.577*	5.29e-09*	-4.870528*	-3.858552*	-4.471860*
2	197.7195	19.64735	8.09e-09	-4.459983	-2.604693	-3.729090
3	215.7280	27.01276	1.04e-08	-4.241499	-1.542895	-3.178382
4	226.9881	15.13076	1.72e-08	-3.812127	-0.270209	-2.416787
5	248.0287	24.98573	2.21e-08	-3.688396	0.696835	-1.960832
6	268.8700	21.49266	3.05e-08	-3.558439	1.670106	-1.498651

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Cointegration test

Date: 04/12/16 Time: 16:02
Sample (adjusted): 1997Q2 2014Q1
Included observations: 68 after adjustments
Trend assumption: Linear deterministic trend
Series: ALS_LT EXP_LT IMEX_LT LOG(FDI_IN_LT) LOG(PR_HW_LT)
Exogenous series: DUMMY_CRISIS_LT
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.359234	79.98178	69.81889	0.0062
At most 1 *	0.325550	49.71561	47.85613	0.0331
At most 2	0.145118	22.93328	29.79707	0.2494
At most 3	0.126656	12.27146	15.49471	0.1444
At most 4	0.044038	3.062535	3.841466	0.0801

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

VECM model

Dependent Variable: D(ALS_LT)
Method: Least Squares
Date: 04/12/16 Time: 15:52
Sample (adjusted): 1997Q2 2014Q2
Included observations: 69 after adjustments
D(ALS_LT) = C(1)*(ALS_LT(-1) - 0.0202091274437*EXP_LT(-1) + 0.000749181973289*IMEX_LT(-1) - 0.00833945111091 *LOG(FDI_IN_LT(-1)) + 0.220187356811*LOG(PR_HW_LT(-1)) - 1.38077584514) + C(2)*D(ALS_LT(-1)) + C(3)*D(EXP_LT(-1)) + C(4) *D(IMEX_LT(-1)) + C(5)*D(LOG(FDI_IN_LT(-1))) + C(6) *D(LOG(PR_HW_LT(-1))) + C(7) + C(8)*DUMMY_CRISIS_LT

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.167405	0.035122	-4.766323	0.0000
C(2)	-0.084672	0.118705	-0.713301	0.4784
C(3)	0.004799	0.001757	2.731114	0.0082
C(4)	-0.000563	0.000291	-1.931197	0.0581
C(5)	0.029164	0.025948	1.123935	0.2654
C(6)	0.087305	0.059458	1.468350	0.1471
C(7)	-0.004223	0.002136	-1.977275	0.0525
C(8)	0.016701	0.005189	3.218587	0.0021

R-squared	0.316794	Mean dependent var	-0.000457
Adjusted R-squared	0.238393	S.D. dependent var	0.013849
S.E. of regression	0.012086	Akaike info criterion	-5.884951
Sum squared resid	0.008910	Schwarz criterion	-5.625924
Log likelihood	211.0308	Hannan-Quinn criter.	-5.782187
F-statistic	4.040699	Durbin-Watson stat	2.087458
Prob(F-statistic)	0.001072		

LM tests are performed to check for serial correlation

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 04/12/16 Time: 15:57
Sample: 1995Q1 2015Q4
Included observations: 68

Lags	LM-Stat	Prob
1	31.09769	0.1858
2	25.10423	0.4565
3	14.27759	0.9567
4	18.74606	0.8091

Probs from chi-square with 25 df.

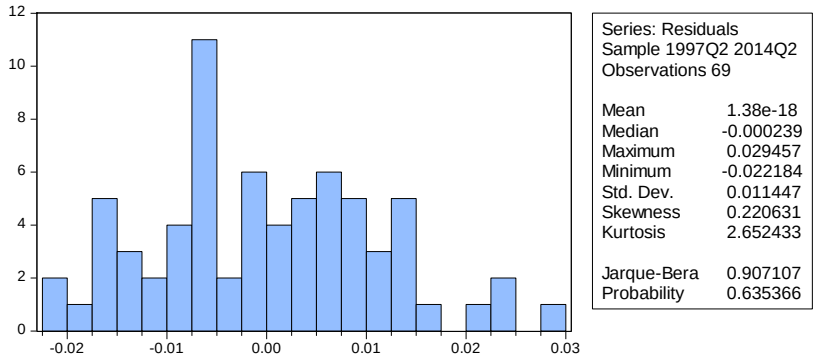
Checking for heteroskedasticity using White's test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/12/16 Time: 15:59
Sample: 1995Q1 2015Q4
Included observations: 68

Joint test:

Chi-sq	Df	Prob.
214.5796	195	0.1602

Jarque-Bera residual test was performed to check for normality of residuals:



Variance decomposition table

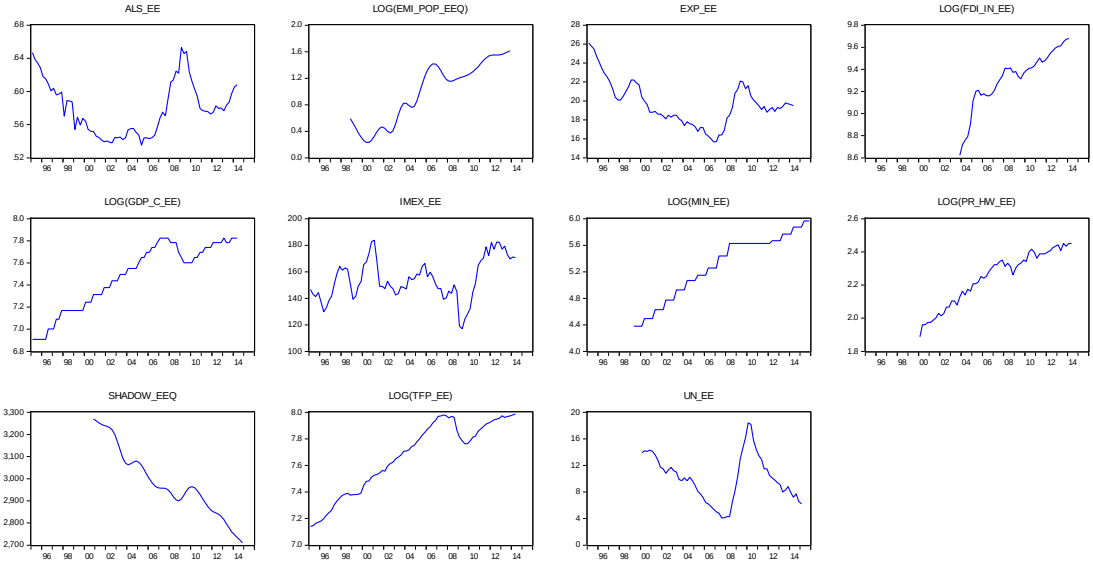
Period	S.E.	ALS_LT	EXP_LT	IMEX_LT	LOG(FDI_IN_LT)	LOG(PR_HW_LT)
1	0.012121	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.016179	96.36435	0.507442	1.856597	0.622404	0.649209
3	0.018364	94.15944	1.724752	2.317316	1.274404	0.524086
4	0.019776	90.50785	5.022383	2.229338	1.735992	0.504441
5	0.020986	84.94219	10.34298	1.984059	2.066656	0.664114
6	0.022163	78.53120	16.50317	1.818364	2.253602	0.893668
7	0.023353	72.10494	22.61716	1.770441	2.348058	1.159398
8	0.024543	66.18106	28.20859	1.806546	2.386256	1.417549
9	0.025716	60.94357	33.12063	1.887351	2.395028	1.653422
10	0.026859	56.39848	37.36565	1.984714	2.389662	1.861493
11	0.027966	52.47447	41.02096	2.083311	2.378408	2.042852
12	0.029037	49.08045	44.17771	2.176002	2.365340	2.200493

Cholesky Ordering: ALS_LT EXP_LT IMEX_LT LOG(FDI_IN_LT) LOG(PR_HW_LT)

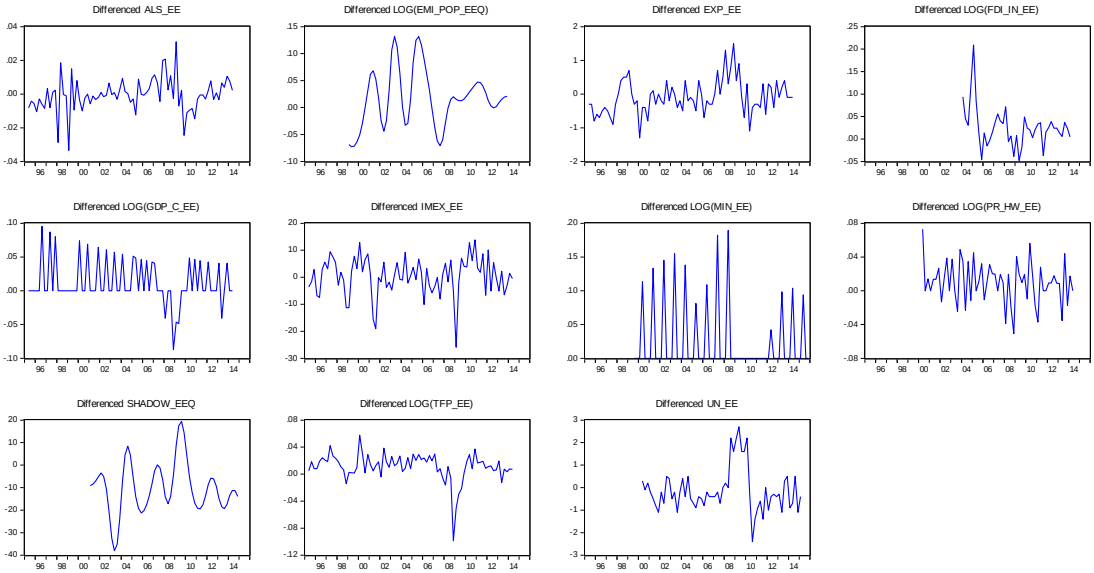
Appendix 4

Vector error correction model specification data - Estonia.

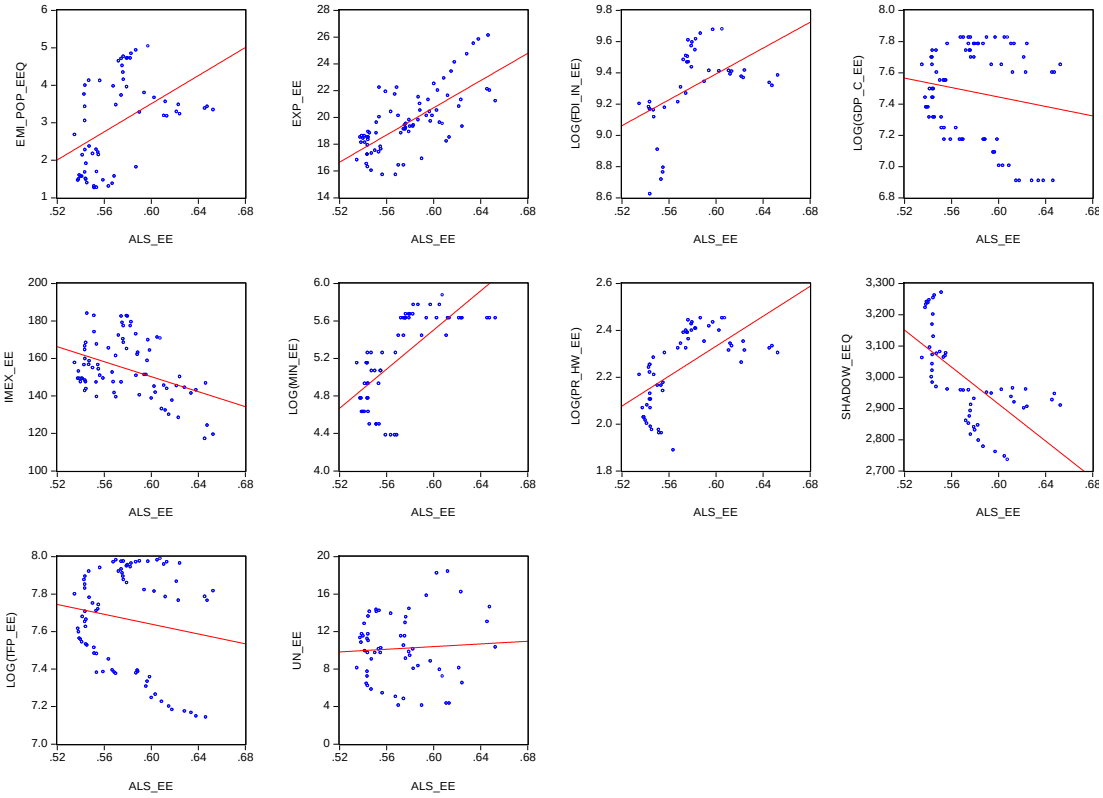
Time series plots at level



Time series plots at first differences



Time series scatterplots at level



Time series stationarity analysis

Variable			Result
	Intercept	Intercept and trend	
ALS_EE	0.2564	0.5188	Non-stationary
EMI_EE	0.9188	0.1881	Non-stationary
EXP_EE	0.1242	0.4677	Non-stationary
l_FDI_IN_EE	0.0163	0.0137	Stationary
IMEX_EE	0.0959	0.2173	Non-stationary
l_MIN_EE	0.5692	0.4842	Non-stationary
l_PR_HW_EE	0.3842	0.2143	Non-stationary
l_TFP_EE	0.3686	0.7421	Non-stationary
UN_EE	0.1891	0.4502	Non-stationary
l_GDP_C_EE	0.4076	0.9070	Non-stationary
SHADOW_EEq	0.9923	0.9686	Non-stationary
* Probabilities are computed. Null hypothesis assumes individual unit roots.			

Variable			Result
	Intercept	Intercept and trend	
D(ALS_EE)	0.0005	0.0015	Stationary
D(EMI_EE)	0.0000	0.0000	Stationary
D(EXP_EE)	0.0023	0.0097	Stationary
D(IMEX_EE)	0.0000	0.0000	Stationary
D(l_MIN_EE)	0.3244	0.5353	Non-Stationary
D(l_PR_TE_EE)	0.0000	0.0000	Stationary
D(TFP_EE)	0.0001	0.0005	Stationary
D(UN_EE)	0.0057	0.0293	Stationary
D(l_GDP_C_EE)	0.0000	0.0000	Stationary
D(SHADOW_EEq)	0.9023	0.9941	Non-Stationary
DD(SHADOW_EEq)	0.0025	0.0054	Stationary
* Probabilities are computed. Null hypothesis assumes individual unit roots.			

VAR lag order selection and cointegration analysis

VAR Lag Order Selection Criteria
Endogenous variables: ALS_EE EMI_EE IMEX_EE
LOG(PR_HW_EE)
Exogenous variables: DUMMY_CRISIS_EE
Date: 04/12/16 Time: 17:21
Sample: 1995Q1 2015Q4
Included observations: 52

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-227.8322	NA	0.087609	8.916622	9.066718	8.974166
1	135.2764	656.3886*	1.40e-07*	-4.433708*	-3.683229*	-4.145992*
2	150.0403	24.41726	1.48e-07	-4.386166	-3.035305	-3.868278
3	163.6432	20.40432	1.68e-07	-4.293969	-2.342726	-3.545908
4	169.1781	7.450784	2.65e-07	-3.891464	-1.339838	-2.913231

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Cointegration test

Date: 04/12/16 Time: 17:21
Sample (adjusted): 2000Q3 2013Q4
Included observations: 54 after adjustments
Trend assumption: Linear deterministic trend
Series: ALS_EE EMI_EE IMEX_EE LOG(PR_HW_EE)
Exogenous series: DUMMY_CRISIS_EE
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.446928	52.09695	47.85613	0.0189
At most 1	0.196435	20.11456	29.79707	0.4151
At most 2	0.113682	8.304888	15.49471	0.4334
At most 3	0.032572	1.788188	3.841466	0.1811

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

VECM model

Dependent Variable: D(ALS_EE)
Method: Least Squares
Date: 04/12/16 Time: 17:25
Sample (adjusted): 2000Q3 2014Q1
Included observations: 55 after adjustments
D(ALS_EE) = C(1)*(ALS_EE(-1) - 0.044985190132*EMI_EE(-1) + 0.00105838147758*IMEX_EE(-1) - 0.441360736684 *LOG(PR_HW_EE(-1)) - 0.438971633375) + C(2)*D(ALS_EE(-1)) + C(3)*D(EMI_EE(-1)) + C(4)*D(IMEX_EE(-1)) +C(5) *D(LOG(PR_HW_EE (-1))) + C(6) + C(7)*DUMMY_CRISIS_EE

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.160383	0.061229	-2.619399	0.0118
C(2)	0.040120	0.136265	0.294423	0.7697
C(3)	-0.004173	0.004145	-1.006670	0.3191
C(4)	-0.000482	0.000173	-2.787963	0.0076
C(5)	-0.071528	0.045157	-1.583999	0.1198
C(6)	0.000386	0.001533	0.251916	0.8022
C(7)	0.008714	0.004769	1.827140	0.0739

R-squared	0.269318	Mean dependent var	0.000936
Adjusted R-squared	0.177983	S.D. dependent var	0.008758
S.E. of regression	0.007941	Akaike info criterion	-6.715190
Sum squared resid	0.003027	Schwarz criterion	-6.459712
Log likelihood	191.6677	Hannan-Quinn criter.	-6.616395
F-statistic	2.948680	Durbin-Watson stat	2.132271
Prob(F-statistic)	0.015675		

LM tests are performed to check for serial correlation

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 04/12/16 Time: 17:26
Sample: 1995Q1 2015Q4
Included observations: 54

Lags	LM-Stat	Prob
1	15.95763	0.4559
2	13.29499	0.6511
3	11.86405	0.7533
4	12.99671	0.6730

Probs from chi-square with 16 df.

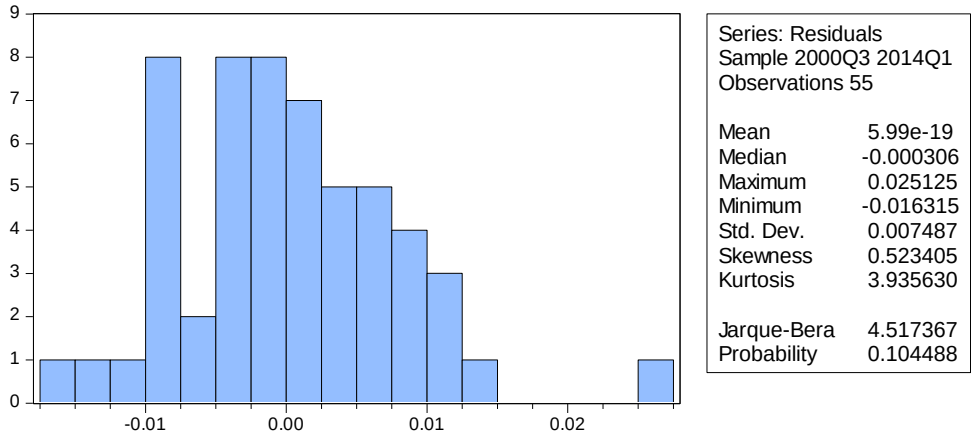
Checking for heteroskedasticity using White's test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/12/16 Time: 17:27
Sample: 1995Q1 2015Q4
Included observations: 54

Joint test:

Chi-sq	df	Prob.
99.05807	110	0.7637

Jarque-Bera residual test was performed to check for normality of residuals:



Variance decomposition table

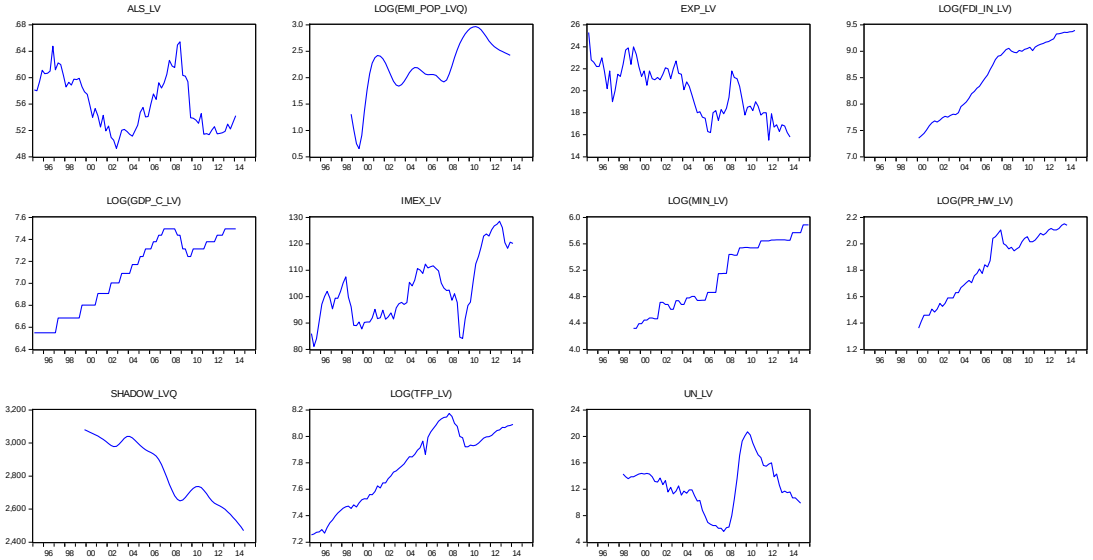
Period	S.E.	ALS_EE	EMI_EE	IMEX_EE	LOG(PR_HW_EE)
1	0.007975	100.0000	0.000000	0.000000	0.000000
2	0.012033	92.40969	4.380711	3.184288	0.025306
3	0.015439	89.68542	7.229362	2.653923	0.431296
4	0.018313	86.94034	9.990430	2.090397	0.978835
5	0.020850	84.88674	11.95164	1.643460	1.518153
6	0.023125	83.33239	13.37963	1.341219	1.946762
7	0.025199	82.19577	14.40024	1.130272	2.273718
8	0.027115	81.35022	15.15412	0.976429	2.519230
9	0.028903	80.70664	15.72658	0.859467	2.707317
10	0.030586	80.20257	16.17515	0.767580	2.854701
11	0.032181	79.79738	16.53594	0.693481	2.973195
12	0.033701	79.46436	16.83265	0.632456	3.070538

Cholesky Ordering: ALS_EE EMI_EE IMEX_EE LOG(PR_HW_EE)

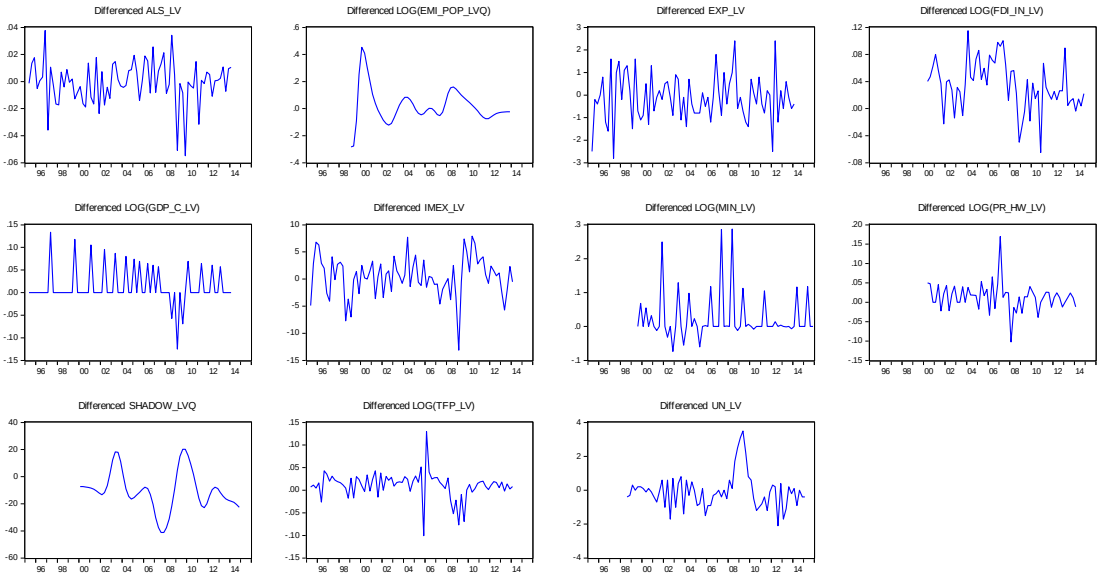
Appendix 5

Vector error correction model specification data - Latvia.

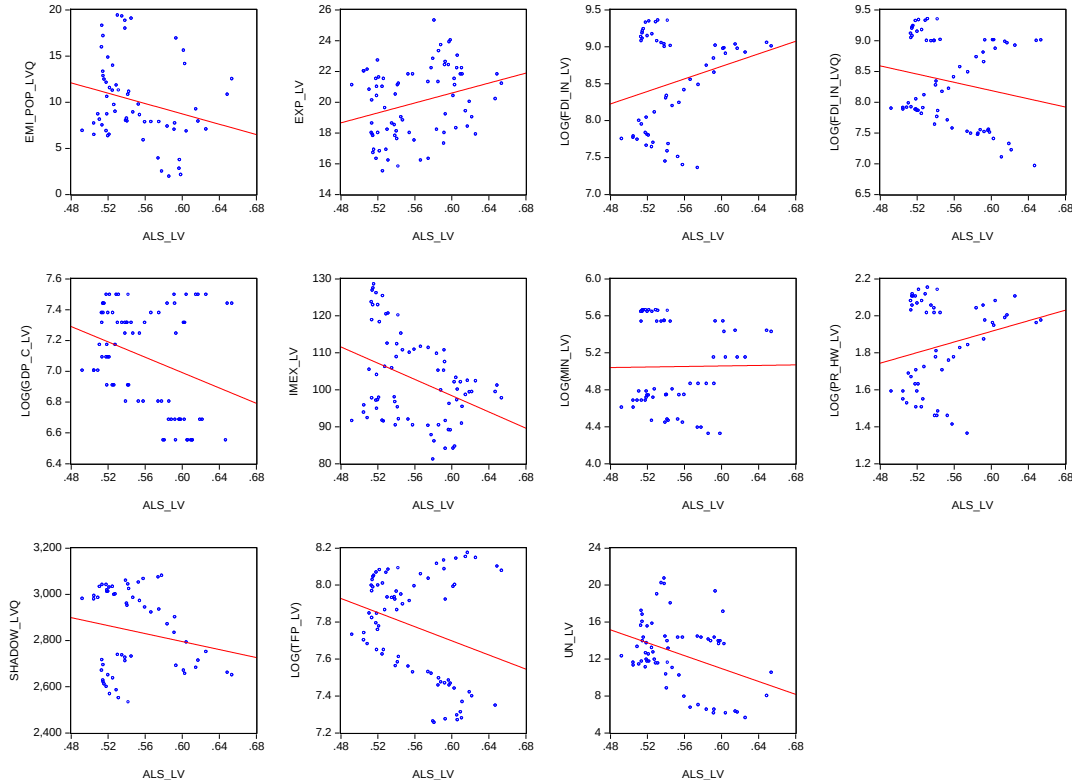
Time series plots at level



Time series plots at first differences



Time series scatterplots at level



Time series stationarity analysis

Variable	ADF Fisher unit root test*		Result
	Intercept	Intercept and trend	
ALS_LV	0.4401	0.6844	Non-stationary
EMI_LV	0.3974	0.6831	Non-stationary
EXP_LV	0.1686	0.0287	Trend stationary
l_FDI_IN_LV	0.3758	0.9639	Non-stationary
IMEX_LV	0.2608	0.1458	Non-stationary
l_MIN_LV	0.8364	0.3561	Non-stationary
l_PR_HW_LV	0.4209	0.6434	Non-stationary
l_TFP_LV	0.4560	0.6716	Non-stationary
UN_LV	0.0361	0.1389	Intercept stationary
l_GDP_C_LV	0.7267	0.8743	Non-stationary
SHADOW_LVq	0.9970	0.0059	Trend stationary
* Probabilities are computed. Null hypothesis assumes individual unit roots.			

Variable	ADF Fisher unit root test*		Result
	Intercept	Intercept and trend	
D(ALS_LV)	0.0000	0.0000	Stationary
D(EMI_LV)	0.0000	0.0000	Stationary
D(EXP_LV)	0.0001	0.0000	Stationary

D(l_FDI_IN_LV)	0.0001	0.0002	Stationary
D(IMEX_LV)	0.0000	0.0000	Stationary
D(l_MIN_LV)	0.0133	0.0602	Stationary
D(l_PR_HW_LV)	0.0000	0.0000	Stationary
D(l_TFP_LV)	0.0005	0.0021	Stationary
D(l_GDP_C_LV)	0.0000	0.0000	Stationary
D(SHADOW_LVq)	0.5651	0.7881	Non-Stationary
DD(SHADOW_LVq)	0.1331	0.3840	Non-Stationary
* Probabilities are computed. Null hypothesis assumes individual unit roots.			

VAR lag order selection and cointegration analysis

VAR Lag Order Selection
Criteria
Endogenous variables: ALS_LV EXP_LV EMI_LV LOG(FDI_IN_LV)
LOG(GDP_C_LV)
Exogenous variables:
DUMMY_CRISIS_LV
Date: 04/12/16 Time: 20:02
Sample: 1995Q1 2015Q4
Included observations: 51

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-271.1210	NA	0.034698	10.82827	11.01767	10.90065
1	216.2185	860.0108	4.66e-10	-7.302684	-6.166316*	-6.868445*
2	242.1874	40.73562*	4.62e-10*	-7.340683*	-5.257341	-6.544576
3	263.2743	28.94286	5.80e-10	-7.187229	-4.156914	-6.029256
4	277.8149	17.10648	1.02e-09	-6.777053	-2.799765	-5.257214
5	309.3539	30.92064	1.03e-09	-7.033487	-2.109225	-5.151781

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Cointegration test

Date: 04/12/16 Time: 20:13
Sample (adjusted): 2000Q4 2013Q4
Included observations: 53 after adjustments
Trend assumption: Linear deterministic trend
Series: ALS_LV EXP_LV EMI_LV LOG(FDI_IN_LV) LOG(GDP_C_LV)
Exogenous series: DUMMY_CRISIS_LV
Warning: Critical values assume no exogenous series
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.545008	87.37403	69.81889	0.0011
At most 1	0.332790	45.63786	47.85613	0.0796
At most 2	0.257851	24.19137	29.79707	0.1925
At most 3	0.119417	8.386472	15.49471	0.4250
At most 4	0.030587	1.646400	3.841466	0.1994

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

VECM model

Dependent Variable: D(ALS_LV)
Method: Least Squares
Date: 04/12/16 Time: 20:11
Sample (adjusted): 2000Q4 2014Q1
Included observations: 54 after adjustments
D(ALS_LV) = C(1)*(ALS_LV(-1) - 0.0288531619442*EXP_LV(-1) - 0.00561116849239*EMI_LV(-1) -0.18778570954*LOG(FDI_IN_LV(-1)) - 0.283676096215*LOG(GDP_C_LV(-1)) - 0.582630421727) + C(2)*D(ALS_LV(-1)) + C(3)*D(ALS_LV(-2)) + C(4)*D(EXP_LV(-1)) + C(5) *D(EXP_LV(-2)) + C(6)*D(EMI_LV(-1)) + C(7)*D(EMI_LV(-2)) + C(8) *D(LOG(FDI_IN_LV(-1))) + C(9) * D(LOG(FDI_IN_LV(-2))) + C(10) *D(LOG(GDP_C_LV(-1))) + C(11)* D(LOG(GDP_C_LV(-2))) + C(12) + C(13)*DUMMY_CRISIS_LV

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.236405	0.065151	-3.628601	0.0008
C(2)	-0.226690	0.136402	-1.661926	0.1042
C(3)	-0.156916	0.134140	-1.169800	0.2488
C(4)	0.006618	0.002929	2.259663	0.0292
C(5)	0.001834	0.002836	0.646898	0.5213
C(6)	-0.000513	0.001567	-0.327163	0.7452
C(7)	0.002738	0.001519	1.802520	0.0788
C(8)	0.042499	0.064907	0.654761	0.5163
C(9)	0.025911	0.072674	0.356539	0.7233
C(10)	-0.095536	0.075738	-1.261409	0.2143
C(11)	-0.019408	0.070914	-0.273689	0.7857

C(12)	-0.003934	0.003430	-1.146957	0.2580
C(13)	0.018370	0.008941	2.054633	0.0463

R-squared	0.447592	Mean dependent var	4.94E-05
Adjusted R-squared	0.285912	S.D. dependent var	0.016246
S.E. of regression	0.013729	Akaike info criterion	-5.532607
Sum squared resid	0.007727	Schwarz criterion	-5.053778
Log likelihood	162.3804	Hannan-Quinn criter.	-5.347942
F-statistic	2.768380	Durbin-Watson stat	2.061907
Prob(F-statistic)	0.007530		

LM tests are performed to check for serial correlation

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 04/12/16 Time: 20:15
Sample: 1995Q1 2015Q4
Included observations: 53

Lags	LM-Stat	Prob
1	25.17071	0.4528
2	23.35662	0.5567
3	17.53670	0.8614
4	25.35972	0.4424

Probs from chi-square with 25 df.

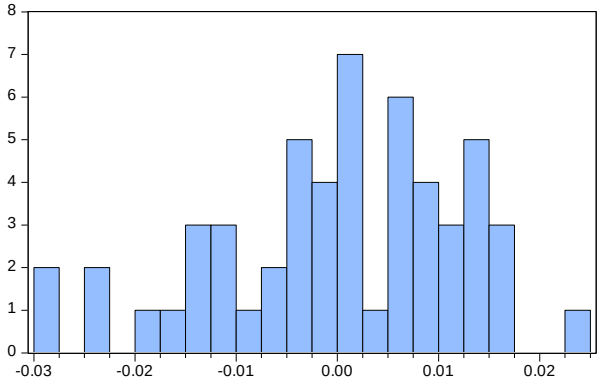
Checking for heteroskedasticity using White's test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/12/16 Time: 20:15
Sample: 1995Q1 2015Q4
Included observations: 53

Joint test:

Chi-sq	df	Prob.
356.1766	345	0.3277

Jarque-Bera residual test was performed to check for normality of residuals



Series: Residuals
Sample 2000Q4 2014Q1
Observations 54

Mean	-6.23e-18
Median	0.001286
Maximum	0.023146
Minimum	-0.029983
Std. Dev.	0.012075
Skewness	-0.531982
Kurtosis	2.791918
Jarque-Bera	2.644468
Probability	0.266539

Variance decomposition table

Period	S.E.	ALS_LV	EXP_LV	EMI_LV	LOG(FDI_IN_LV)	LOG(GDP_C_LV)
1	0.013685	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.015462	99.34467	5.18E-05	0.424091	0.000401	0.230785
3	0.017622	83.21794	4.474690	11.36401	0.001012	0.942346
4	0.020171	72.73842	12.66648	12.57609	0.520076	1.498937
5	0.022258	67.99331	18.38854	11.55546	0.598224	1.464462
6	0.024213	62.04140	23.55097	12.43363	0.519525	1.454479
7	0.026413	55.64782	28.75405	13.34248	0.486200	1.769445
8	0.028527	50.97504	33.26557	13.28101	0.528791	1.949592
9	0.030525	47.14717	37.24079	13.08909	0.509982	2.012967
10	0.032503	43.64618	40.56507	13.20569	0.480664	2.102394
11	0.034462	40.67014	43.42571	13.21272	0.469910	2.221527
12	0.036339	38.21548	45.91620	13.10626	0.463877	2.298179

Cholesky Ordering: ALS_LV EXP_LV EMI_LV LOG(FDI_IN_LV) LOG(GDP_C_LV)

Appendix 6

Lithuania's Shadow economy model

Dependent Variable: D(ALS_LT)
Method: Least Squares
Date: 04/12/16 Time: 16:50
Sample (adjusted): 2001Q2 2014Q2
Included observations: 53 after adjustments
D(ALS_LT) = C(1)*(ALS_LT(-1) + 0.0652997298892*D(SHADOW_LTQ(-1)) + 0.191742241688) + C(2)*D(ALS_LT(-1)) + C(3)*D(ALS_LT(-2)) + C(4)*D(ALS_LT(-3)) + C(5)*D(ALS_LT(-4)) + C(6)*D(SHADOW_LTQ(-1),2) + C(7)*D(SHADOW_LTQ(-2),2) + C(8)*D(SHADOW_LTQ(-3),2) + C(9)*D(SHADOW_LTQ(-4),2) + C(10)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.018393	0.004633	-3.970357	0.0003
C(2)	-0.305403	0.144527	-2.113121	0.0404
C(3)	-0.422202	0.144874	-2.914266	0.0056
C(4)	-0.310860	0.146239	-2.125703	0.0393
C(5)	-0.085365	0.144247	-0.591795	0.5571
C(6)	-0.002193	0.001823	-1.203123	0.2355
C(7)	0.008215	0.003911	2.100500	0.0416
C(8)	-0.006744	0.003893	-1.732380	0.0904
C(9)	0.003223	0.001871	1.722503	0.0922
C(10)	-0.001098	0.001492	-0.735590	0.4660

R-squared	0.379610	Mean dependent var	-0.000768
Adjusted R-squared	0.249761	S.D. dependent var	0.012311
S.E. of regression	0.010663	Akaike info criterion	-6.075786
Sum squared resid	0.004889	Schwarz criterion	-5.704033
Log likelihood	171.0083	Hannan-Quinn criter.	-5.932828
F-statistic	2.923473	Durbin-Watson stat	2.065384
Prob(F-statistic)	0.008567		

VAR lag order selection and cointegration analysis

VAR Lag Order Selection
Criteria
Endogenous variables: ALS_LT
D(SHADOW_LTQ)
Exogenous variables:
Date: 04/12/16 Time: 16:47
Sample: 1995Q1 2015Q4
Included observations: 53

Lag	LogL	LR	FPE	AIC	SC	HQ
1	18.08354	NA	0.002015	-0.531454	-0.382753	-0.474271
2	72.05812	99.80206	0.000306	-2.417288	-2.119885	-2.302921
3	98.46334	46.83190	0.000131	-3.262768	-2.816664	-3.091218
4	106.6110	13.83561*	0.000113*	-3.419282*	-2.824477*	-3.190549*
5	109.8630	5.276862	0.000116	-3.391057	-2.647550	-3.105140

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Cointegration test:

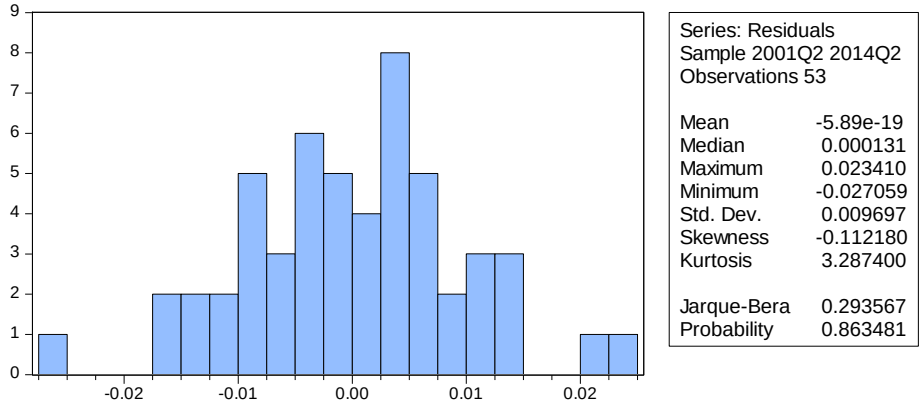
Date: 04/12/16 Time: 16:47
Sample (adjusted): 2001Q2 2014Q2
Included observations: 53 after adjustments
Trend assumption: Linear deterministic trend
Series: ALS_LT D(SHADOW_LTQ)
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.335799	25.61299	15.49471	0.0011
At most 1 *	0.071416	3.926978	3.841466	0.0475

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Jarque-Bera residual test was performed to check for normality of residuals:



LM tests are performed to check for serial correlation

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 04/12/16 Time: 16:51
Sample: 1995Q1 2015Q4
Included observations: 53

Lags	LM-Stat	Prob
1	3.252382	0.5165
2	7.798808	0.0992
3	8.940524	0.0626
4	3.688663	0.5207
5	0.430298	0.9799

Probs from chi-square with 4 df.

Checking for heteroskedasticity using White's test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/12/16 Time: 16:49
Sample: 1995Q1 2015Q4
Included observations: 53

Joint test:

Chi-sq	df	Prob.
62.73074	54	0.1943

Variance decomposition table:

Period	S.E.	ALS_LT	D(SHADOW_LTQ)
1	0.010663	100.0000	0.000000
2	0.012968	95.02939	4.970609
3	0.013634	94.86264	5.137364
4	0.014185	92.74106	7.258944
5	0.015408	86.19437	13.80563
6	0.017987	74.61635	25.38365
7	0.021172	60.73664	39.26336
8	0.024571	49.82017	50.17983

Cholesky Ordering: ALS_LT D(SHADOW_LTQ)

Appendix 7

Estonia's Shadow economy model

Dependent Variable: D(ALS_EE)
Method: Least Squares
Date: 04/12/16 Time: 19:51
Sample (adjusted): 2002Q3 2014Q2
Included observations: 48 after adjustments
D(ALS_EE) = C(1)*(ALS_EE(-1) + 0.0612083447725*D(SHADOW_EEQ(-1)) - 0.00945426175605*@TREND(95Q1) + 0.554032971777) + C(2) *D(ALS_EE(-1)) + C(3)*D(ALS_EE(-2)) + C(4)*D(ALS_EE(-3)) + C(5) *D(ALS_EE(-4)) + C(6)*D(ALS_EE(-5)) + C(7)*D(SHADOW_EEQ(-1),2) + C(8)*D(SHADOW_EEQ(-2),2) + C(9)*D(SHADOW_EEQ(-3),2) + C(10) *D(SHADOW_EEQ(-4),2) + C(11)*D(SHADOW_EEQ(-5),2) + C(12)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.008368	0.003583	-2.335705	0.0252
C(2)	0.005315	0.157956	0.033650	0.9733
C(3)	0.211674	0.151429	1.397843	0.1707
C(4)	-0.141454	0.158288	-0.893651	0.3774
C(5)	0.370390	0.160666	2.305342	0.0270
C(6)	0.252649	0.173323	1.457676	0.1536
C(7)	0.000391	0.000757	0.515990	0.6090
C(8)	-0.000626	0.001377	-0.454689	0.6521
C(9)	0.001983	0.001486	1.334741	0.1903
C(10)	-0.001872	0.001338	-1.399342	0.1703
C(11)	0.000823	0.000790	1.041420	0.3046
C(12)	0.000983	0.001207	0.814523	0.4207

R-squared	0.429713	Mean dependent var	0.001439
Adjusted R-squared	0.255459	S.D. dependent var	0.009268
S.E. of regression	0.007997	Akaike info criterion	-6.607191
Sum squared resid	0.002302	Schwarz criterion	-6.139390
Log likelihood	170.5726	Hannan-Quinn criter.	-6.430408
F-statistic	2.466014	Durbin-Watson stat	1.932827
Prob(F-statistic)	0.020378		

VAR lag order selection and cointegration analysis

VAR Lag Order Selection
Criteria
Endogenous variables: ALS_EE
D(SHADOW_EEQ)
Exogenous variables:
Date: 04/12/16 Time: 19:54
Sample: 1995Q1 2015Q4
Included observations: 49

Lag	LogL	LR	FPE	AIC	SC	HQ
1	5.657808	NA	0.003204	-0.067666	0.086769	-0.009073
2	52.79775	86.58358	0.000551	-1.828480	-1.519611	-1.711295
3	77.07582	42.61048*	0.000241	-2.656156	-2.192853*	-2.480379*
4	79.51330	4.079055	0.000258	-2.592380	-1.974642	-2.358011
5	83.07453	5.668884	0.000264*	-2.574470*	-1.802299	-2.281510

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Cointegration test:

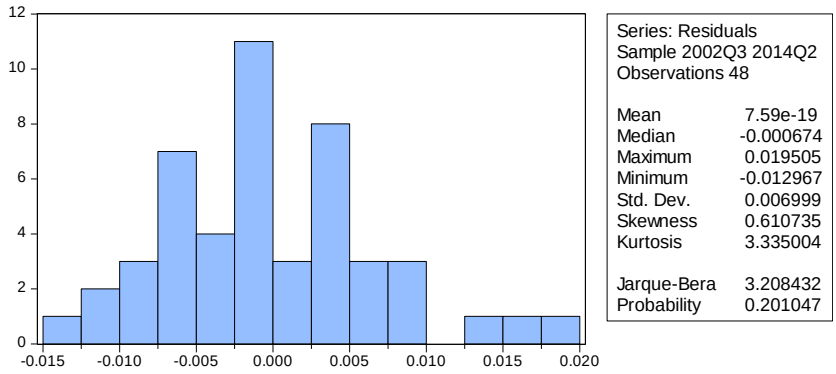
Date: 04/12/16 Time: 19:56
Sample (adjusted): 2002Q3 2014Q2
Included observations: 48 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: ALS_EE D(SHADOW_EEQ)
Lags interval (in first differences): 1 to 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.389571	44.91592	25.87211	0.0001
At most 1 *	0.357350	21.22348	12.51798	0.0014

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Jarque-Bera residual test was performed to check for normality of residuals:



LM tests are performed to check for serial correlation

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 04/12/16 Time: 19:58
Sample: 1995Q1 2015Q4
Included observations: 48

Lags	LM-Stat	Prob
1	4.220724	0.1127
2	6.105939	0.1914
3	5.546104	0.2357
4	2.549300	0.6358
5	3.676412	0.4516

Probs from chi-square with 4 df.

Checking for heteroskedasticity using White's test

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 04/12/16 Time: 19:58
Sample: 1995Q1 2015Q4
Included observations: 48

Joint test:

Chi-sq	df	Prob.
63.47561	66	0.5653

Variance decomposition table:

Period	S.E.	ALS_EE	D(SHADOW_EEQ)
1	0.007997	100.0000	0.000000
2	0.011323	99.97622	0.023778
3	0.015338	98.25546	1.744543
4	0.018172	97.51128	2.488718
5	0.022786	94.63398	5.366022
6	0.028210	91.75974	8.240263
7	0.033844	88.54739	11.45261
8	0.038622	85.76435	14.23565

Cholesky Ordering: ALS_EE D(SHADOW_EEQ)