DISCUSSION PAPER

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THE CONVERGENCE PROCESSES IN EUROPE AND LATVIA

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CONTENT

ABBREVIATIONS
CSB – Central Statistical Bureau of Latvia
EC – European Commission
EMU – Economic and Monetary Union
EU – European Union
EU27 – current EU countries
EU12 – countries which joined the EU on 1 January and 1 May of 2007
EU15 – EU countries before 1 May 2004
EURIBOR – Euro Interbank Offer Rate
Eurostat – EU Statistical Bureau
FDI – foreign direct investment
GDP – gross domestic product
IMF – International Monetary Fund
NACE (Rev. 1.1) – Statistical Classification of Economic Activities in the European Community
n.e.c. – not elsewhere classified
NUTS – Nomenclature of Territorial Units for Statistics
PPS – purchasing power standard

SUMMARY

This paper, attempting to tackle separately real and structural convergence, is an in-depth study of the convergence processes in Latvia and Europe. Latvia's structural convergence towards both the EU and other neighbouring (Baltic) countries is estimated using the Krugman index. Real convergence processes in the EU, distinguishing between σ-convergence and β-convergence, are likewise studied. In addition, cluster analysis with grouping European countries by their structural features is conducted.

In this study, the current β-convergence and σ-convergence processes within the EU are identified, yet an in-depth study disclosed that it was mostly the EU12 countries that were the convergence process drivers, with convergence at the regional level well behind that at the national level. The convergence among the EU Member States primarily depended on the wealthier regions of countries becoming richer (characteristic of EU12 in particular), with the process proceeding at a faster pace in relatively poorer countries. This suggests that within a country the discrepancies between rich and poor regions intensify over time. That leads to a conclusion that the European regional policy aimed at decreasing regional income heterogeneity did not prove efficient in the reference period.

Structural convergence in Latvia was mainly observed in 2008 and 2009, i.e. the years of real divergence enhanced by the onset of the crisis. Structural convergence in the breakdown of gross value added was mainly driven by the fluctuations of the value added ratio of trade, tourism and transport, manufacturing and construction sector.

The conducted cluster analysis demonstrates that over time European countries have become more homogenous or mutually similar in terms of economic structure. A particular focus on the specific economic characteristics of countries leads to a different conclusion: the countries in Europe agglomerated into several specific groups, thus clearly outlining the different drivers of growth in the post-crisis period.

Key words: Latvia, the EU, structural convergence, real convergence, specialisation, cluster analysis

JEL classification: C20, C50, F15, E13, E60

INTRODUCTION

Economic convergence is one of the conditions for efficient functioning of the EMU. Article 2 of Section II of the Treaty on European Union stipulates "to promote throughout the Community a harmonious and balanced development of economic activities, sustainable and non-inflationary growth respecting the environment, a high degree of convergence of economic performance, a high level of employment and of social protection, the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among Member States" (Official Journal of the European Communities (1993)). As yet, the economists have not been able to define the concept of convergence accurately. Convergence *per se* seems simple in the context of **income convergence**, which can be defined as a process of bringing countries closer together in terms of income, GDP per capita mostly, over time. The concept *income convergence* incorporates several notions used numerously in the economic literature, e.g. real convergence, σ-convergence and β-convergence, conditional and absolute convergence. Meanwhile, **structural convergence** and the estimation of related processes have deserved less attention. There are a number of studies focusing on the given subject, e.g. by Coevering (2003), Sassi (2007), Höhenberger and Schmiedeberg (2008), etc. The concept *structural convergence* is used to describe a process which brings countries closer together in terms of their economic structures. As a rule, economies are compared using their GDP structure and sectoral employment as measures.

Structural convergence is of particular importance for countries incorporated in a single economic area, e.g. the EU, and a single monetary area, e.g. the euro area. The larger the number of similarities among the countries, the smaller the possibility of asymmetric shocks hitting their economies and the greater the likelihood of the common monetary policy being fit for all of them. According to Mundell's theory of optimum currency area (1961), a monetary union is feasible only among those countries that are not affected by asymmetric shocks. Hence, the countries which are integrated within a monetary union or are getting ready to join one need to have synchronised economic volatility and achieved effective operation of non-monetary adjustment mechanisms. Meanwhile, Kenen (1969) who further developed Mundell's theory argued that the business cycle similarities across countries depend on the level of production diversification and structural similarities of economic sectors. Consequently, even though the Treaty on European Union does not prescribe structural convergence, the latter is indispensible for effective existence and evolvement of the EMU.

Since 2008, the Latvian economy has gone through severe hardships, and the economic policy makers opted to address them by means of the so-called internal adjustment principle. From the point of view economic theory, it inevitably leads to serious changes in the overall economic structure. Up to 2007, the process of real convergence of Latvia's economy towards the euro area countries had been buoyant; it was driven, among other things, by growing FDIs, financial market integration and expansion of lending. Real convergence, however, enhanced structural divergence: as a result of some sectors growing faster than others, their share in the value added structure of the economy increased, thus enhancing structural divergence vis-á-vis the EU27 and euro area countries. Under the impact of economic crisis, income convergence did not simply halt in 2008–2010 but, in fact, reverted, i.e. the opposite process of real divergence set in. In addition, the crisis enhanced structural

convergence induced by the adjustment of imbalances that had surfaced during the period of fast growth.

The recent crisis had a negative impact on Latvia's income convergence: income returned to long-term sustainable levels. At this juncture, however, the processes should be addressed from the future perspective: does structural convergence exist? Is there any relationship between real and structural convergence? Attempts to give answers to such questions have been made herein.

Latvia has set a goal to adopt the euro. In order to qualify for the euro, the country has to comply with with the Maastricht criteria of nominal convergence and also get the economy ready for a fully-fledged participation in the euro area. Effective participation in the EMU, sustained competitiveness of the Latvian economy and country's potential to act jointly with the other Member States require certain economic homogeneity (Mundell (1961)). Here in Latvia, the economic policy makers should proceed with the current structural reforms, thus enhancing not only income convergence but also structural convergence.

The authors have made an attempt to assess Latvia's integration into the EU and to find out whether the Latvian economy is structurally converging towards the other European countries and whether there are convergence processes within the EU and the euro area. Section 1 of the paper provides an insight into the basic theoretical principles of economic convergence. Section 2 presents the analysis of Latvia's income and structural convergence with the EU and euro area. Section 3 provides econometric estimations of the European convergence processes.

## 1. BASIC PRINCIPLES OF ECONOMIC CONVERGENCE

Economic convergence is defined as a tendency for two or more economies to become increasingly similar. It refers, e.g. to per capita income level, growth rates, inflation rate, interest rates and social policies (Black, Hashimzade and Myles (2009)). Convergence can be spurred by trade or other mechanisms of economic integration (Dixit (2007)). In the context of economic growth, real convergence means that the living standards in relatively low-income countries convergence with those in relatively high-income economies, with GDP per capita in PPS[1] used as the most conventional measure (Office for Official Publications of the European Communities (1993)). Although the convergence process is estimated with the help of several theoretical models, the obtained empirical results seem to be controversial (Black, Hashimzade and Myles (2009)).

The concept of convergence evolved in close association with the economic growth theories, which distinguish between exogenous and endogenous growth models. In the period between the 1950s and 1980s, the Solow-Swan model of exogenous growth took a dominant position in the theoretical literature (Solow (1956)). According to the neoclassical theory, the law of diminishing marginal product of capital ensures convergence towards steady state. Assuming a constant number of inhabitants, the economic growth rate in a long run will depend on technological

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[1] PPS shall mean the artificial common reference currency unit. It is used to express the volume of economic aggregates for the purpose of spatial comparisons in such a way that price level differences between countries are eliminated. Economic volume aggregates in PPS are obtained by dividing their original value in national currency by the respective purchasing power parity.

changes, i.e. a presumed exogenous factor in the theory of exogenous growth. Thus the economic growth in the long run would not depend on any economic decisions or activities; be it so, the effects of economic policy on the economy would just be transitory. According to Solow, the countries with a relatively high investment level and savings rate would also boast of higher income (GDP per capita) and capital levels in the long run. The neoclassical theory assumes that economies are converging towards a steady state which is determined by inhabitant or employment growth rate, savings rate and depreciation rate.

Chart 1
Types of convergence and factors enhancing it within the EU
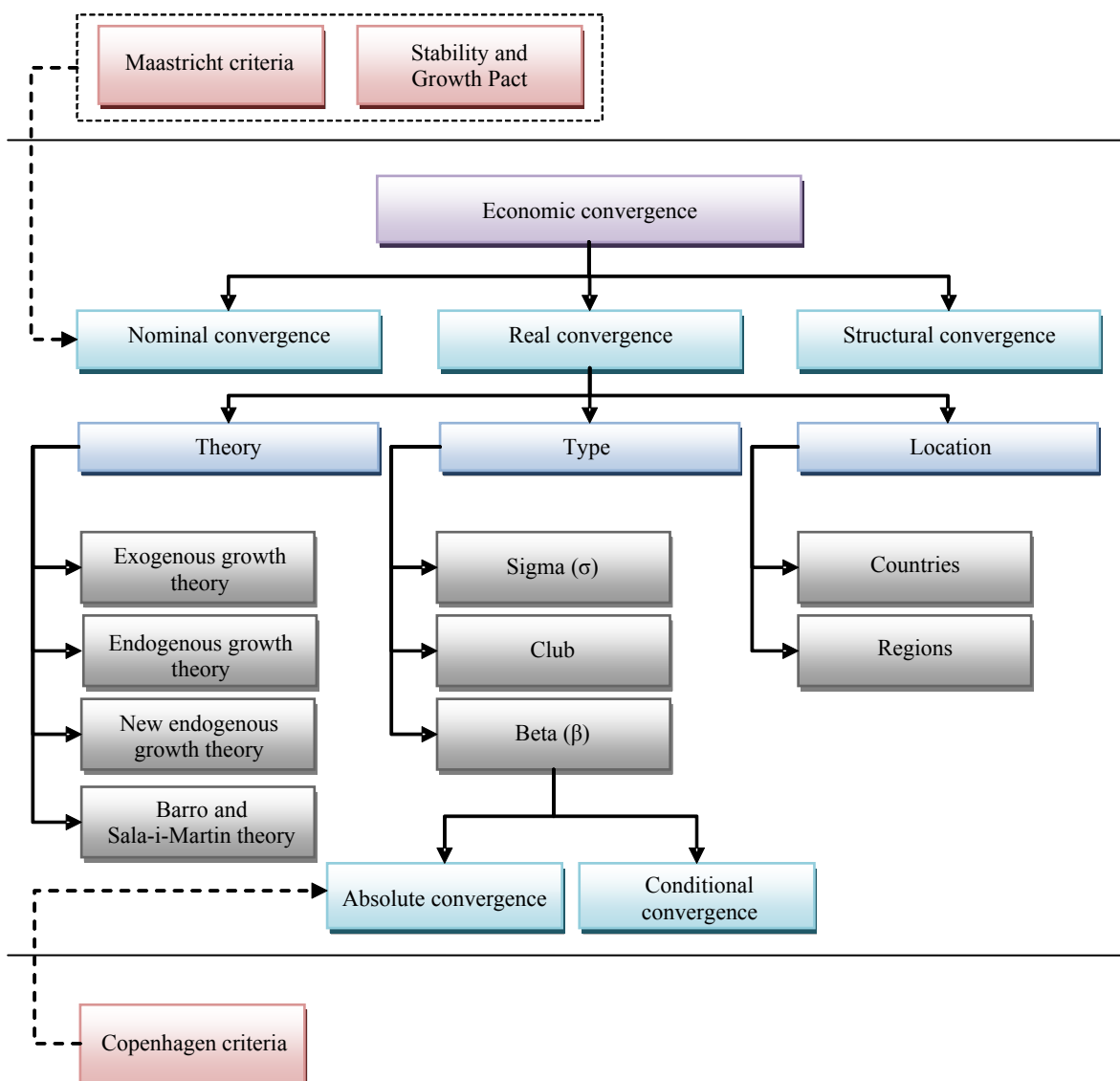
Source: authors' chart based on Potvorszki (55).

The neoclassical growth theory was good at interpreting the long-term growth trends of countries as depending on technological progress, yet it failed to adequately account for the origins of such technological progress and the factors affecting it. Therefore in the 1980s, fresh perceptions about the economic growth determinants

were introduced in the so-called endogenous growth theory. In accordance with this theory, technology that previously had been viewed as a public good and was exogenous became endogenous. Romer (1990) suggested that companies were motivated to invest in new technologies, for they ensured, at least for a time, a kind of monopoly status. Similarly, the endogenous theory introduced such concepts as human capital, technology and knowledge spillovers, and the law of diminishing marginal product of capital stock was replaced with constant rate of return on capital, at least at the macroeconomic level. Growth theories have been addressed by Dornbusch, Fischer and Startz (2008).

In the economic analysis, the concept of convergence is broad (see Chart 1). There are some difficulties in distinguishing between **nominal and real convergence** (Black, Hashimzade and Myles (2009)). Thus, for instance, with regard to convergence criteria Black, Hashimzade and Myles wrote that they were a set of four criteria, laid down for European Monetary Union by the Maastricht Treaty of 1993, that had to be met by a member state before it could adopt the euro. In fact, the authors address the criteria of only nominal convergence related to price stability, state budget deficit, sovereign debt level, interest rates and exchange rate stability (Official Journal of the European Communities (1993)). Consequently, the Treaty on European Union or the **Maastricht Treaty** not only formally established the EU but also provided for an official formulation of EU **nominal convergence**. Nominal convergence is a process of catching-up in such nominal indicators as price inflation, public finance, exchange rates and interest rates of countries; actually, these are four of the five convergence criteria which met would lead to the participation in the EMU (Martin, Velazquez and Funck (2001); Lawler and Seddighi (2001)). Within the EU, the Stability and Growth Pact plays an important role in the facilitation of nominal convergence.

The Stability and Growth Pact is the main framework for the coordination of fiscal policies within the EMU. The Pact aims at safeguarding financial stability of the EU countries, achieving fiscal discipline, and harmonising economic and budgetary policies of the EU countries in order to facilitate effective pursuit of the common monetary policy. As such, the Stability and Growth Pact enhances monetary stability across the EU Member States.

In contrast to nominal convergence, the issues of **real convergence** have been addressed previously, yet the concept and criteria lack accurate definitions even though real convergence is as important or even more important. Real convergence should take place in parallel with or, in fact, before nominal convergence, for a state cannot be properly assessed for nominal convergence until it has adequately converged in real terms (Lavrač and Žumer (2003)). Real convergence refers to catching-up in the living standards by most conventionally measuring GDP per capita in PPS; however, real convergence *per se* does not account for meeting the EMU convergence criteria (Martin, Velazquez and Funck (2001); Lawler and Seddighi (2001)). Although numerous economists studying long-term economic developments have often focused on real convergence issues, only the emergence of neo-classical models of economic growth ushered in the era of valuable and systematic studies. The studies of real convergence are based on the Solow growth model (Sollow (1956)). In essence, this neo-classical model argues that low-income countries will grow faster than high-income countries. Most of the studies focusing on economic growth and convergence are based on the Solow growth model

(Baumol (1986), Dowrick and Nguyen (1989), Barro (1991), Sachs and Warner (1995), Jones (1997), Pritchett (1997), Hall and Jones (1999), Young, Higgins and Levy (2008), Iancu (2009), etc.).

The law of diminishing marginal product is essential for the convergence hypothesis while only in this case preconditions of convergence process are met. This law postulates that the participants place the production factors (capital and labour) so that to increase maximally their own wealth; as a result, regional disparities of the return on production inputs will diminish over time. It is, however, important that the same technologies are available to all, as only they can ensure convergence in the long run (Lau (2009)).

Consequently, real convergence can be categorised as follows:

- The presumption that lower-income economies grow at a faster rate than do the higher-income countries over time is defined as **β-convergence**. β-convergence implies the real convergence process of less developed countries and regions vis-á-vis richer ones (Barro, Sala-i-Martin, (1992); Sala-i-Martin (1996), (2005); Ingianni and Žd'árek (2007)).

- A tendency for the dispersion of GDP per capita across a group of countries to decrease is defined as **σ-convergence**. σ-convergence implies diminishing differences across countries within a group. Its most conventional measure is standard deviation or variance coefficient of GDP per capita. β-convergence is a necessary but not a sufficient condition for σ-convergence, suggesting that theoretically the existence of β-convergence is possible without σ-convergence (Barro, Sala-i-Martin, (1992); Ingianni and Žd'árek (2007); Sala-i-Martin (1996), (2005)).

- **Club convergence** can exist among countries that have broadly similar structural characteristics and initial conditions and that follow the same growth trajectory.

Scientific literature differentiates between two types of β-convergence:
– absolute convergence;
– conditional convergence.

In the event of **absolute convergence,** all countries are converging towards the same long-term steady state level of growth rate irrespective of initial conditions in these countries (initial per capita production output). In contrast to absolute convergence, in the case of **conditional convergence** countries have structural distinctions, and the convergence process is different, i.e. countries converge to their own long-term steady state economic growth rate due to essentially different economic fundamentals (market participants' preferences, available technology, level of knowledge, institutionalisation, economic policy, structure of the economy, etc.). Thus it can be assumed that the countries with similar determinants of economic growth converge towards the same long-term steady state level of the economic growth rate. The economic models using available technology and its eventual transfers to the other countries as determinants of long run growth assume that those countries that are lagging behind may converge towards the level of developed countries. If a part of the countries share similar economic growth factors, over time club convergence can take place, i.e. two different country groups converge to two different steady state levels. However under the impact of globalisation and

economic integration, club convergence may change into absolute convergence in the long run.

In the EU, the conditions for absolute convergence of the Member States can be said to be in place, as all countries within this economic area are in possession of approximately similar technology due to free flows of capital, work force and ideas. Likewise, prior to acceding to the EU, all countries met the Copenhagen eligibility criteria[2], thus even more reducing the differences between absolute and conditional convergence within the EU. The Copenhagen criteria significantly focus on the quality of institutional environment (e.g. free market, property rights and the rule of law), which is so vital for effective functioning of the economy and its sustainable growth. They are similarly significant for businesses enabling them to earn income from innovative investment. The protection of property (including intellectual property) and a reasonably benign labour market for employers enhance gains from innovations, thus, in turn, spurring both new investment in innovative projects and higher productivity. The fact that property protection figures among the growth enhancing factors is well seen from the last two century history of economic growth and recent studies of institutional economy (Hall, Jones (1999); Acemoglu, Johnson and Robinson (2001)). Market regulations are also of large importance (Aghion, Burgess, Redding and Zilibotti (2003)).

Along with the institutional factor, another factor outside the Copenhagen criteria and associated with both overall globalisation processes and the EU is also of large importance: it is the information technology revolution thanks to which the flow of ideas and transfer of technologies became more accessible, intensifying the evolution of absolute convergence. One aspect of the information technology revolution is that ideas spread at a much faster pace, and any new innovation becomes promptly known to all interested parties and can be easily reproduced. This supports the assumption about universal accessibility of technology and its effects on productivity growth. As a result, under the condition of free flows of ideas and in the absence of any hurdles for their transfer and implementation, convergence can take place even though the economy is closed and foreign commodities or production factors cannot be imported into it. When an economy is open to free commodity flows, relative advantages surface and production factor gains level out, the idea flows are enhanced and result in new commodities and services, with the return on production inputs adjusting accordingly. The main outcome of the information technology development is economic and technological internationalisation and cultural decentralisation (Møller (1995)). Economists have made notable efforts to explore the effects of the information technology revolution on productivity, yet the studies in this direction so far have faced serious data problems because it is extremely difficult to quantify the impact of information technologies on the production process. Nevertheless, most empirical studies support the importance of information technology revolution (since the 1990s in particular) for productivity growth. In addition, it is the information technology revolution that has given momentum to the spillover of information, knowledge and experience and substantially reduced technological disparities of countries (Brynjolfsson and Yang (1996); Oliner and Sichel (2002); Bartel, Ichniowski and Shaw (2007)).

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[2] First, countries must have achieved stability of institutions guaranteeing democracy, the rule of law, human rights and respect for and protection of minorities. Second, they must have a functioning market economy. Third, they must enact *acquis communautaire* and support the various goals of the EU (A Plain Guide to Eurojargon (2011)).

The flows of capital (including FDI) as a rule go to the areas where they are scanty, albeit with higher returns, i.e. to the developing countries. Labour is subject to the same laws, with the respective flows from developing to developed countries. The result is the levelling out of factor returns. The neoclassical economic theory asserts that convergence takes place as a result of the operation of given mechanisms. Market integration and income convergence take place simultaneously. The neoclassical theory is based on the principles of liberalisations (elimination of barriers, free flows of trade and production factors). Absolute convergence is possible in a world where economies are fully integrated and effective, where transaction costs are insignificant and institutional disparities are non-existent (White (2010)).

Most theoretical literature tackling convergence aspects addresses income convergence. In the meantime, **structural convergence** has deserved less attention. Structural convergence, however, is an important enough process for building and functioning of a single economic and monetary area as is proved by the EU and euro area. That is why economic analysts have been more actively exploring the properties, aspects and developments of structural convergence in the past decade, including serious studies of regional convergence (Cuadrado-Roura, Mancha Navarro and Garrido Yserte (1999); Longhi and Musolesi (2007); Guerrieri and Iammarino (2003)). Interrelations between income and structural convergence processes have also been analysed (Imbs and Wasziarg (2003)). The discourse about structural convergence involves two conflicting areas. On the one hand, the increasing accessibility to technologies is likely to boost both income and structural convergence (Pigliaru (2003)). Also, internationalisation is likely to affect the production structure in European countries, apparently bringing about a Europe-wide uniform specialisation in technology-intensive and capital-intensive sectors. On the other hand, as country specialisation usually occurs in branches enjoying particular comparative advantages, structural disparities are going to persist or even intensify over time (Ohlin (1933)).

2. CONVERGENCE OF LATVIA'S ECONOMY TOWARDS THE EU AND EURO AREA COUNTRIES

In this section, the real convergence process in Latvia is briefly describe and a detailed analysis of the structural convergence process in the breakdown by six and 15 branches of the Latvian economy as well as manufacturing subsectors is provided.

2.1 Real convergence

W. Spanjers (p. 164, (2009)) gives the following definition of real convergence: "Real convergence is defined as the standard of living of the one country approaching that of another country or a group of countries. It is usually measured by GDP per capita in purchasing power parity, which excludes the impact of different price levels and measures the value of goods and services available in the relevant economy." It is worth noting that a number of other indicators, such as wage dynamics, the share of manufacturing in gross value added, real labour unit costs, etc., are used when estimating real convergence.

In his paper, Frankel (p. 15, (2005)) enlists a number of conditions for real convergence:
– synchronised or mutually correlating business cycles;
– similar economic structure;
– similar levels of productivity, per capita income and relative prices of non-tradable goods.

However, GDP has been and remains the key and most informative indicator of all. That is why real convergence can be defined as converging of per capita real output of two or more countries towards the same or uniform level (Ingianni and Žd'árek (2007)). As a rule, the so-called adjustment by PPS is used in the estimation of cross-country real convergence. Adjusting by price level differences, thereby encouraging a quality assessment of real convergence processes of countries and of customers' purchasing power and to some extent also their social well-being, is the core and most important strength of PPS. Undeniably, the indicator is quiet synthetic and its economic interpretation questionable (Magnien (2002)). It is so because the basket of goods and services as an underlying factor of computations is void of the quality aspect, i.e. the included goods and services are homogeneous. Nevertheless, so far it has been most widely used in macroeconomic analysis as a real convergence estimation instrument.

In 1995 in Latvia, GDP per capita in PPS was only 31% of the EU27 (GDP of EU27 is the weighted average GDP of all current EU27 countries in 1995) average level.[3] It was a result of the sharp economic downturn associated with the transition from planned to market economy after regaining independence in 1991, during which the Latvian economy lost around a half of value added. In addition, Latvia went through a banking crisis in 1995 when a part of households lost both their saving accounts and confidence in the banking system. In the meantime, convergence of the Latvian economy towards the EU27 average level went on in 1996 and 1997. In 1997, a financial crisis hit Asia, and its negative repercussions affected the global economy, including a heavy blow on the Russian economy, with its central bank forced to devalue national currency in 1998, thus destabilising the situation in the region even more.

The Russian financial crisis of 1998 had an essential impact on the manufacturing sector in Latvia, whose market diversification was weak and the demand from Russia was of substantial significance. As a result, the process of real convergence slowed somewhat down in 1998–1999, to recommence in the upcoming years. The driver of real convergence in Latvia was the services sector, because manufacturing was seriously engaged in market reorientation to European countries. In 2000, Latvia's GDP per capita in PPS amounted to 37% of the EU27 average.

Having successfully coped with the consequences of the Russian financial crisis of 1998, the growth in the Latvian economy was again on upswing in 2000–2003, with real average GDP growing by around 7.2% in this period. The robust growth, relatively effective economic and institutional reforms, low inflation and gradually rising disposable income of households triggered an increase in FDI inflows which supported a further economic expansion. By 2003, GDP per capita in PPS in Latvia had amounted to 43% of the EU27 average.

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[3]   The study uses the statistical data that were available as at 1 September 2011.

Like in other EU12 countries, real convergence was very buoyant in Latvia in 2004–2008. After the accession to the EU, growth did not cease but gained momentum with every coming year. The process was spurred by many factors, including FDI inflows, expansionary lending policies of banks, EU funding, government's expansionary and simultaneously pro-cyclical fiscal policy, and optimistic expectations of inhabitants associated with anticipated fast convergence towards the EU15 countries. By 2008, the PPS-adjusted GDP per capita in Latvia had risen to 56% of the EU27 average (see Chart 2).

Chart 2
GDP per capita in PPS of selected euro area countries in 1995–2010
(in percent of EU27 average)
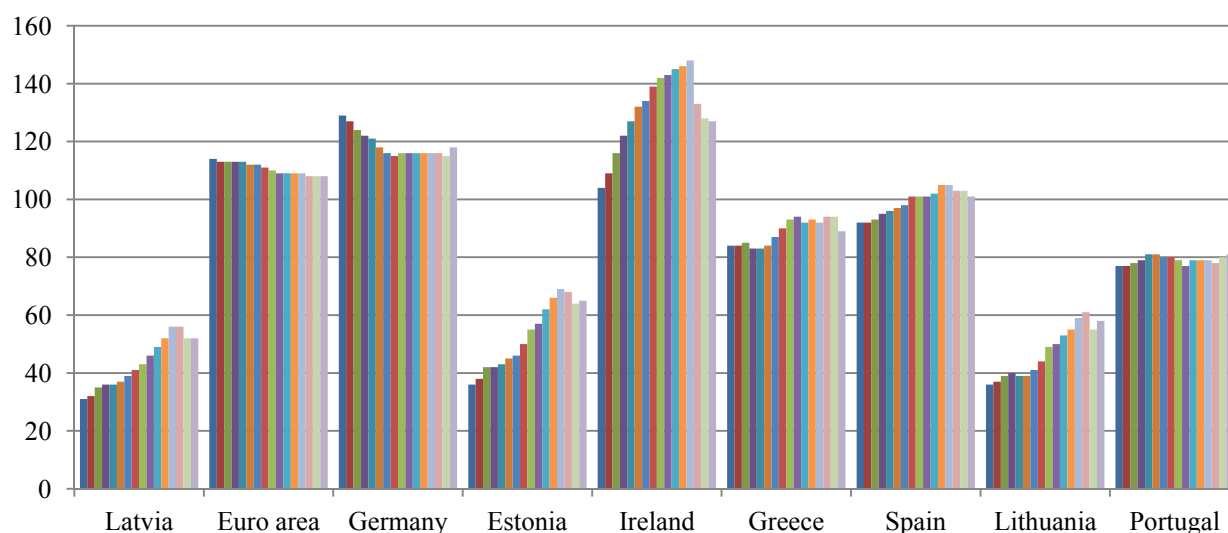
Source: Eurostat.

Despite the buoyant economic growth in 2004–2007, certain developments took place, which along with the global financial crisis caused a sharp decline in the Latvian economy in 2008–2010 due to specific domestic factors. Although in 2004–2007 such nominal economic indicators like GDP, inflation, wages, etc. improved markedly, the policy makers failed to attend imminent signs of threat: imbalanced economic growth (with manufacturing growth rates notably lagging behind those of services), wage and productivity gaps, rapidly rising current account deficit, incommensurably hiking asset prices, and also the actual GDP growth rates that notably exceeded those of potential growth. Economic and institutional reforms to address structural problems in the economy were lacking, and fiscal conservatism and sustainable fiscal responsibility to combat cyclical problems were absent in the budget planning process. In 2004–2008, Latvia was under strong inflationary pressure as the effect of overheating.

Although the signs of economic overheating had surfaced as early as 2005 (Bank of Latvia (2005)), the Cabinet of Ministers of the Republic of Latvia adopted an anti-inflation plan only in March 2007 (Ministry of Finance (2007)). It envisaged the containing of fast growing remuneration in public administration, lending (with tougher conditions for mortgage lending) as well as the passing of a balanced budget. As a result of these measures, the pace of lending was contained. From the initial months of 2008, the annual growth rate of retail trade became negative. It was

primarily underpinned by declining household confidence, as the perspective of household future income had turned negative. Simultaneously, the real disposable income of households lost much of its growth momentum on account of strong inflation pressures on real wages and salaries and increasing debt servicing costs due to higher EURIBOR.

This retail trade contraction produced a second round effect. With private consumption shrinking, business sentiments for the future began to deteriorate, bringing about a downfall in gross fixed capital formation and also in overall production output. The economic downturn had been apparent as early as the beginning of 2008 (confirmed by seasonally adjusted GDP data), while a more notable deterioration was recorded in the second half of 2008.

First, the global financial crisis was on its way; subsequently, the yields on debt securities rose, borrowing costs increased and credit availability, at corporative, household and government levels alike, was impaired. Second, the public learned about the JSC *Parex banka* facing short-term liquidity problems, which the Latvian government fixed by taking the bank over and injecting the needed liquidity. Third, the financial crisis in European countries gradually spilled over into the real economy, thereby causing GDP and foreign trade to contract in most of them. The global financial crisis also underpinned the contractions in capital inflows, which formerly had supported both the fast growth and accumulation of disparities. Minimisation of imbalances and adjustment in current account deficit were remarkable in the crisis period.

In December 2008, Latvia entered into a loan agreement with the IMF and the European Commission and, in accordance with its provisions, undertook to reduce the budget deficit below 3% of GDP by 2012. In 2009, the Latvian economy experienced a record GDP drop (18.0% at constant prices).

Due to all the above described problems, the real convergence process of the Latvian economy became negative: in fact, the economy diverged from the EU27 level. In 2010, Latvia's GDP per capita in PPS was 52% of the EU27 average (4 percentage points below the level of 2007 and 2008).

2.2 Structural convergence

In the course of time, economic researchers have developed various indices to provide quantitative description of structural convergence processes. One of them is the Grubel-Lloyd index, which, though, is most often used to estimate foreign trade ratios in certain sectors rather than structural differentials of the economy. But as the foreign trade dynamics and structure are directly dependent on the growth trends in the economy, manufacturing in particular, the Grubel-Lloyd index can be useful for assessing the structural convergence process in the economy indirectly (Egger, Egger and Greenaway (2004); Bitāns and Kaužēns (2004)).

Another index has been developed by Cuadrado-Roura and group (1999). It is based on quadratic deviations of a country's sectoral shares in gross value added from the respective sectoral shares of another country with which the comparison is made.

In order to assess the level of structural convergence for Latvia's economy, the Krugman index has been applied in this paper (Krugman (1991)). In essence, the

Krugman index is a comparison of the composition (or structure) of value added of different economies, with differentials in percentage points of comparative country groups as an outcome. Thus this index can be easily applied when comparing the economic structures from sectoral positions; in addition, the components of the economy can be distinguished and individual sectors making up the index value identified:

$$K_k(t) = \sum_i \left| V_k^i(t) - \bar{V}^i(t) \right| \qquad [1]$$

where $K_k(t)$ is the value of Krugman index for country k;

$V_k^i(t)$ is the percentage share of sector i in gross value added in country k;

$\bar{V}^i(t)$ is the percentage share of sector i in the country or country group with which the comparison is made (excluding country k).

The Krugman index shows to what extent the economic structure of country k has converged towards that of the country or country group with which the comparison is made. Lower and closer-to-zero index values confirm stronger structural convergence of the economy. The index values may range from zero to 200, with the zero value indicating perfect homogeneity and the 200 value pointing to heterogeneity of economies.

The authors had access to aggregated information on the composition of value added up to 2010, and a more detailed breakdown for the period up to 2009. In order to arrive at more accurate assumptions on structural convergence processes, the estimation of both detailed and aggregated data to assess the most recent tendencies was conducted. All in all, convergence processes have been estimated for six branches up to 2010 and for 15 branches up to 2009.

In the computations of Krugman index, country value added at current prices is used. Value added of the respective economic sectors of Latvia is subtracted from value added of the EU27 countries with the aim to avoid double accounting of the former.

2.2.1 Structural convergence in six-branch breakdown

In this paper, the value of Krugman index for the Latvian economy is computed and compared with the EU27 countries. The Krugman index is estimated at NACE (Rev. 1.1) six-branch-level in this subsection. Value added is thus broken down by branch, hereinafter designated by the largest branch for the sake of convenience. A complete list of sectors is provided in Appendix A.2.

The dynamics of the Krugman index value illustrates to what extent the Latvian economy has converged with the euro area and EU27 countries in terms of the value added structure. The index computations suggest that a lower index value is indicative of a stronger structural similarity of the Latvian economy with gross value added in the EU27 and euro area countries. With regard to the value added structure, there are no large differences between the euro area and EU27 countries. Chart 3 shows a notable elevation in the Krugman index value in 1996, which is an indication of structural divergence. In 1998, in turn, this respective value dropped sharply, rising gradually in the upcoming years to reach a maximum in 2005; afterwards, a gradual process of structural convergence commenced to be completed in 2009.

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Chart 3
The Krugman index in breakdown by sector for Latvia vs. the EU27 and euro area countries
(in points)
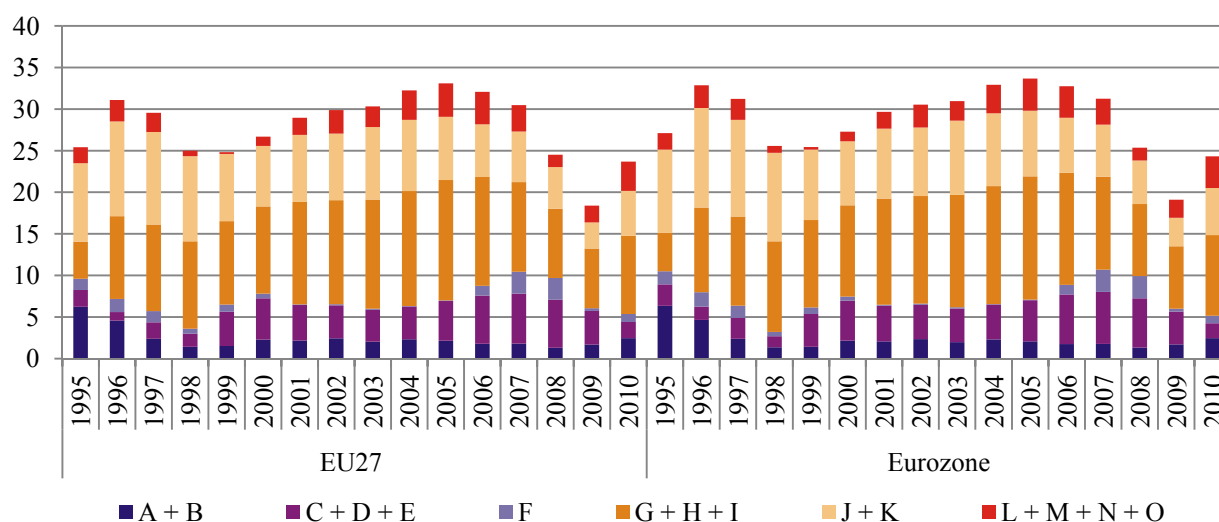
Sources: Eurostat and authors' calculations.

As is seen from the Chart, the value of the Krugman index was unstable between 1995 and 1998. The statistics of that time display certain controversy. For instance, real growth in the trade, tourism and transport sector in 1996 (G + H + I) was 0.8%, while the nominal increase amounted to 20.4%. This can be explained by the extremely high deflator applied by the CSB to the time series of the given branch. This lacks somewhat reasonable explanation, as, for instance, the GDP deflator was 16.3% in 1996, while the private consumption deflator, whose value theoretically should be similar with that of the trade (G) deflator, was 16.6% (see Appendix A.8). Apparently, for the purpose of balancing national accounts and in the circumstances of statistical data shortage, some economic sector deflators at the beginning of the series are used as the so-called balancing items, due to which statistical information up to 1997 herein is deemed controversial and cannot be interpreted.

The Krugman index allows for a sectoral breakdown to estimate the contribution of individual sectors to its total value, i.e. to distinguish between sectors facilitating the convergence or divergence processes. Within this paper, the authors make use of this property and disaggregate the Krugman index value by sector to assess the contribution of individual sectors to the total index value.

In 1998, the Latvian economy faced the consequences of the Russian financial crisis. In 1998, the structure of Latvia's value added in the economy buoyantly converged towards that of the EU27 and euro area countries. It is true, that the Russian financial crisis caused not only the pace of real convergence to slow down but affected the process of structural convergence as well, yet there are no clear reasons to allege that it spurred up or slowed down the structural convergence process substantially. In 1998, the value of the Krugman index sharply dropped due to contracting contributions of all sectors. Indeed, the share of agriculture (A + B) declined to 4.0%, thus converging towards the EU27 average (2.6%); the share of public services (L + M + N + O) increased to 21.4% almost catching up with the EU27 average (22.1%); the share of construction sector (F) went up to 6.1%

approaching the EU27 construction sector share (5.5%). This crisis spurred the structural convergence process only in one way, i.e. via its adverse effect on manufacturing in Latvia. In 1998, the share of industry (C + D + E) in the value added structure of Latvia went down to 21.5% (25.3% in 1997), thus reducing the gap with the EU27 manufacturing share (20.0%).

Under the impact of the 1998 Russian financial crisis on the Latvian economy the process of structural divergence commenced to last till 2005 when the composition of Latvian economic sectors started to approach the EU and euro area average economic structure. The divergence process was determined by a further accelerated decrease in the share of industry (C + D + E) in Latvia's value added on account of adverse effects from global financial markets and financial crises in Asian countries and Russia (1998). Thus, for instance, in 1999, the share of industry (C + D + E) in the composition of Latvia's value added fell by 3.8 percentage points due to insufficient foreign market differentiation of some manufacturing subsectors (D). The upcoming years also saw a downturn in the industry (C + D + E) share as a result of which the gap with the EU and euro area averages widened.

In addition, the share of trade, tourism and transport (G + H + I) in value added increased gradually between 2000 and 2005 on account of the overall economic growth, higher private consumption, easier access to loans, and inhabitants' positive future expectations. Meanwhile between 2006 and 2009, the composition of Latvia's value added (depending on economic sector) was notably catching up with that of the EU27 and euro area, with the trade, tourism and transport sector (G + H + I) contributing to it most.

Historically, the EU27 trade, tourism and transport sector (G + H + I) accounts for 21%–22% of value added, while in Latvia this indicator was generally much higher, at around 34%–36% in 2001–2006. Its relatively higher value is underpinned by two factors. The first one is associated with the growth of the trade, tourism and transport sector (G + H + I): as disposable income of households was on a buoyant rise and availability of credit resources improved rapidly, consumption accelerated sharply and facilitated the expansion of trade (G). Second, the share of transport and communication (I) in gross value added is relatively large in Latvia as a country with favourable geographical location (at the sea, with growing port facilities and good opportunities for the construction of east-west transport corridor), while for the EU27 countries it is less typical because some of them simply lack natural preconditions for the development of transport and communications. Later the share of trade, tourism and transport (G + H + I) in Latvia's gross value added started to decline step by step, thus driving the process of divergence (see Chart 3).

The shares of financial intermediation and real estate (J + K) in the composition of value added accounted for the second important distinction between Latvia and the EU27. Historically in the EU27, financial intermediation and real estate (J + K) contributed 24%–26% to value added in 1995–2000 and 26%–29% in 2001–2010. Meanwhile in Latvia, the respective shares increased to 13%–19% in 1995–2000 and 18%–26% in 2001–2010. Obviously, the share of financial intermediation and real estate operations (J + K) in Latvia's value added has historically been smaller than in Europe on average, which is quite understandable because Latvia's financial system was built anew and it took time to bring foreign investors to Latvia's banking and insurance segments. Also at the end of the reference period, i.e. in 2010,

financial intermediation and real estate (J + K) in Latvia still accounted for lower shares than in Europe apparently due to the inclusion of not only financial intermediation (J) but also real estate, renting and other business activities (K), with almost half of value added contributed by support services activities (computer software, cash registers, security services, etc.; see Subsection 2.2.2). In Europe by contrast, in order to ensure their operation, a major part of businesses widely rely on outsourcing.

In 2008 and 2009, on account of weakening disparities in almost all sectors, the composition of Latvia's value added moved notably closer to that of the euro area and EU27. The reduction in differences was most pronounced for trade, tourism and transport (G + H + I), construction (F), and financial intermediation and real estate (J + K), i.e. those very sectors that had triggered overheating of the Latvian economy. In the course of the two years, the gap in value added shares of construction (F) almost closed, and differences in industry (C + D + E) shares also decreased rapidly due to the sector losing its importance in the EU27. However, it was trade, tourism and transport (G + H + I) that recorded the strongest catching-up with the value added shares of the EU27 due to generally falling value added in Latvia as a result of shrinking disposable income of households.

The estimated Krugman index shows that some structural divergence recommenced in 2010 on account of a number of factors. First, the fiscal consolidation programme pursued by the Latvian government changed the sectoral proportions, as a result of which the public services sector (L + M + N + O) lost some of its weight in the composition of gross value added of Latvia's economy. In the meantime, i.e. in 2009 and 2010, Europe was addressing the consequences of the global financial crisis by opposite activities, e.g. by "heating the economy" with additional fiscal expenditure. As a result, the share of EU27 public services sector (L + M + N + O) in the overall economic structure rose from 22.5% in 2008 to 23.8% in 2010, while in Latvia it contracted from 21.0% in 2008 to 20.2% in 2010.

Likewise, larger disparities arouse from the share of Latvia's financial intermediation and real estate sector (J + K) shrinking in the composition of value added in 2010, with the respective share in Europe remaining almost unchanged. Apparently, the financial system of Latvia, its banking sector in particular, had suffered from the financial crisis more than its EU counterparts on average. In 2009–2010, most Latvian banks, making provisions for non-performing loans, incurred losses. Starting with 2011, since the credit portfolio quality began to improve gradually, profit-making trends were re-emerging (primarily at the expense of decreasing provisions), thus giving rise to projections about the financial sector regaining its position in the composition of value added in 2011. Also in 2010 overall, Latvia's trade sector, tourism and transport (G + H + I) continued to record the largest structural differences vis-á-vis the countries in Europe, exceeding the EU27 or euro area averages by almost 10 percentage points. It can be explained by both the large trade (G) share and major transport and communication (I) contribution to sector's value added, which, though, is absolutely reasonable for a transit-oriented country.

It is interesting to compare the economic structures of Latvia and its neighbouring countries. Historically, the economic sector structures of Lithuania, Latvia and Estonia have been almost homogeneous (see Charts 4 and 5). By 2003, the process

of structural adjustments in Latvia's value added had been relatively stable vis-á-vis Lithuania and Estonia; then Latvia started to diverge from both of them, Lithuania at a faster pace. The structural convergence process (stronger towards Estonia) started in 2005, to last till 2008 with Lithuania and till 2009 with Estonia.

Chart 4
The Krugman index in breakdown by sector for Latvia vs. Estonia
(in points)
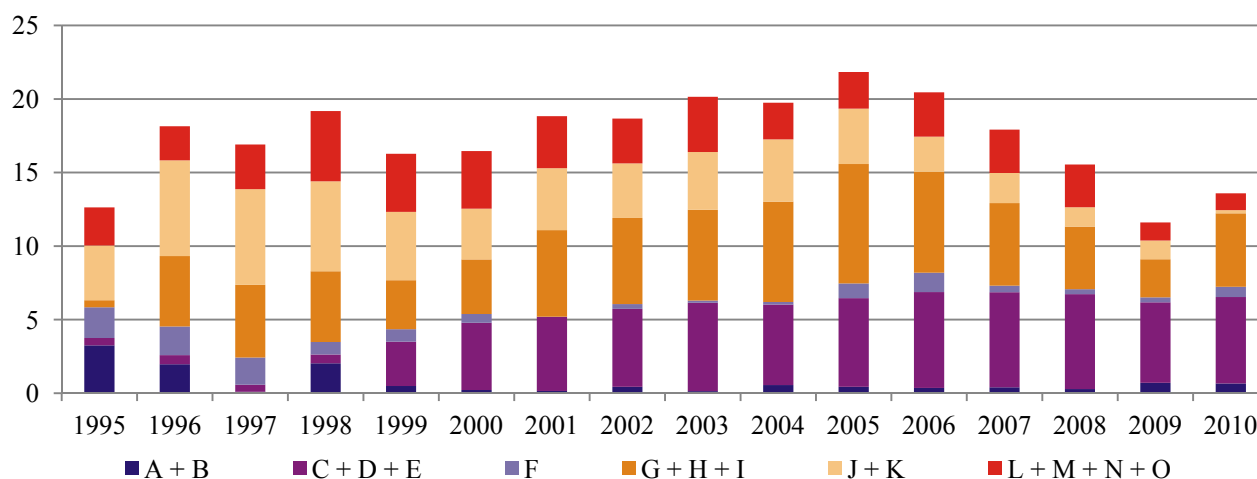
Sources: Eurostat and authors' calculations.

What were the determinants of structural changes vis-á-vis Estonia and Lithuania? In 1998–2002, the largest differences between Latvia's and Estonia's economic structures were on account of industry (C + D + E), i.e. this sector had better copped with the Asian and 1998 Russian financial crises in Estonia where the sales of industrial output were less dependent on the external demand from Russia. Likewise, large differences were recorded also for the shares of financial intermediation and real estate (J + K): in Estonia, financial intermediation and real estate (J + K) accounted for 21%–22% while in Latvia for only 15%–19%. FDI flows from Scandinavia faster reached the financial sector of Estonia and spurred the expansion of financial intermediation and real estate (J + K) there.

Meanwhile vis-á-vis Lithuania, the largest structural sectoral economic differences were recorded for trade, tourism and transport (G + H + I): in Latvia, trade accounted for a 32%–34% share, while in Lithuania it was around 27%–31% (see Chart 5). The share of industry (C + D + E) in Lithuania also increased over years, while in Latvia, by contrast, its decrease was observed. Similarly, the disparities between the shares of financial intermediation and real estate (J + K) in value added of the Latvian and Lithuanian economies amplified with every year: in Lithuania, the share remained robust, at around 12%, until 2005 when it started to increase.

Starting with 2004, a new tendency emerged: the structure of the Lithuanian economy was diverging from that of Latvia at a faster pace than that of Estonia. The Krugman index value for Latvia vis-á-vis Estonia was volatile in 2003–2005; later, however, convergence started. Trade, tourism and transport (G + H + I) and industry (C + D + E) displayed the largest differences between the Latvian and Estonian economic structures in 2003–2005. Trade accounted for an approximate 28% share in value added in Estonia and around 35% in Latvia. At the same time, industry

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(C + D + E) in Estonia recorded an approximate 22% share, while that of Latvia was around 16%.

Chart 5
The Krugman index in breakdown by sector for Latvia vs. Lithuania
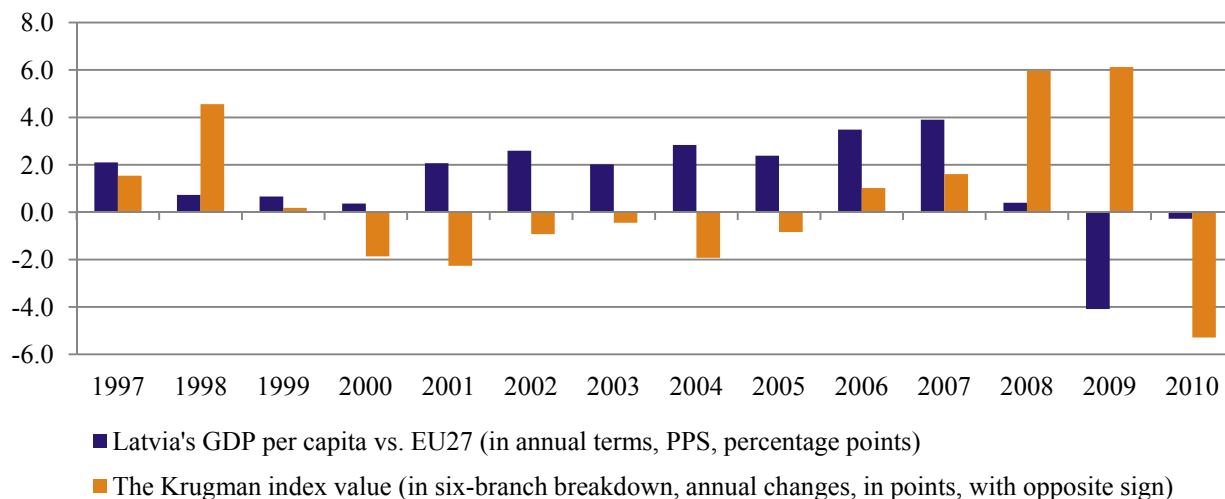(in points)
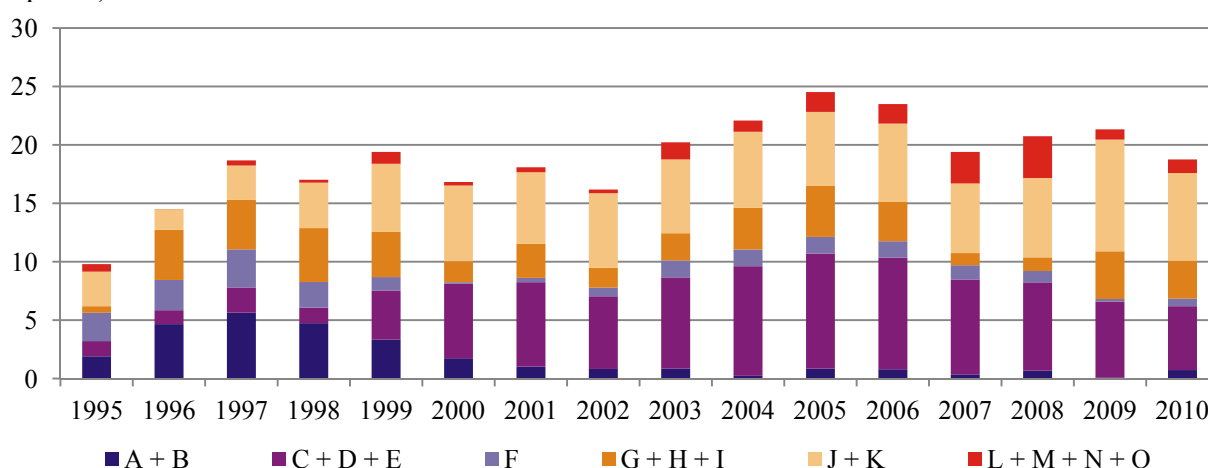
Sources: Eurostat and authors' calculations.

Around 2006, the converging of economic structure, driven by a gradually contracting Latvia's trade, tourism and transport sector (G + H + I) share, began. In addition, from 2008 convergence was accelerated by the financial crisis, which almost completely closed the gap in value added shares of financial intermediation and real estate (J + K) and public services (L + M + N + O) between Latvia and Estonia. As of 2010, the divergence process recommenced under the impact of increasing share of trade, tourism and transport (G + H + I) in value added of the Latvian economy.

In the meantime vis-á-vis Lithuania, the economic structure of Latvia continued to diverge in 2003–2005. Afterwards, two years of convergence set in, to be followed by a new divergence process. These developments depended mainly on two sectors, i.e. industry (C + D + E) and financial intermediation and real estate (J + K). Starting with 2003, the share of Lithuania's industry in value added was constantly 7–10 percentage points above that of Latvia, partly so because of oil processing industry's performance in Lithuania. By contrast, the share of financial intermediation and real estate (J + K) operations in Latvia was 6–7 percentage points above that of Lithuania, with this very sector contributing most to the rise in the Krugman index value in 2008 and 2009. In 2010, owing to contractions in financial intermediation and real estate operations in Latvia, the Lithuanian and Latvian economic structures converged somewhat again.

When viewed together (see Chart 6), real and structural convergence processes disclose an obvious tendency of real convergence mainly persisting in Latvia in the years of structural divergence. 1997 and 1998 were exceptional years, with both simultaneous real and structural convergence taking place. In 2006 and 2007, real and structural convergence also co-existed due to decreasing trade, tourism and transport (G + H + I) share in value added of the Latvian economy.

Chart 6
Relationship of Latvia's real and structural convergence vs. EU27

■ Latvia's GDP per capita vs. EU27 (in annual terms, PPS, percentage points)

■ The Krugman index value (in six-branch breakdown, annual changes, in points, with opposite sign)

Sources: Eurostat and authors' calculations.

Even though most studies (Wacziarg (2001); Barrios, Barry and Strobl (2002)) suggest that structural convergence is accompanied by real convergence, Latvia's tendency is opposite: in most years of on-going real convergence structural divergence had been observed as well. However, this relationship can also be viewed from another angle: compared with the other EU27 countries, in 1998 the Krugman index value for Latvia was 25.0 points, while GDP per capita in PPS was 36% of the EU27 average level. The figures for 2010 were 23.7% and 52% respectively. Consequently, substantial real convergence had taken place over these years, while the economic structures were somewhat catching up. Hence, despite real and structural convergence possibly going into different directions during a period of business cycle volatility, over a longer term Latvia had, nevertheless, been converging towards the EU countries in both real and structural terms.

2.2.2 Structural convergence in 15-branch breakdown

The estimation of structural convergence in the breakdown by six branches does not lead to an accurate assessment of the contribution each branch makes to this process, therefore, in order to conduct an in-depth study of the aspects which determined structural convergence in Latvia in comparison with the EU27 countries, Estonia and Lithuania, this subsection deals with the Krugman index in the breakdown by 15 branches (see Appendix A.3).

The conclusions with regard to structural homogeneity of the economy in the breakdown by 15 branches are very much alike those discussed above when dealing with six branches; however, in this case, a more detailed analysis of the differences and their causes is possible. Chart 6 shows somewhat different periods of structural changes in the economy. Thus, in the case of 6 branches, maximum differences between the economic structures of Latvia and the EU27 countries occurred in 2005, whereas in the case of 15 branches it was one year later. Nevertheless, the trend was very much the same, and in 2009 Latvia's economy was structurally converging towards the average structure of EU27 economies (see Chart 7).

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Chart 7
The Krugman index in breakdown by sector for Latvia vs. the EU27 and the euro area countries
(in points)
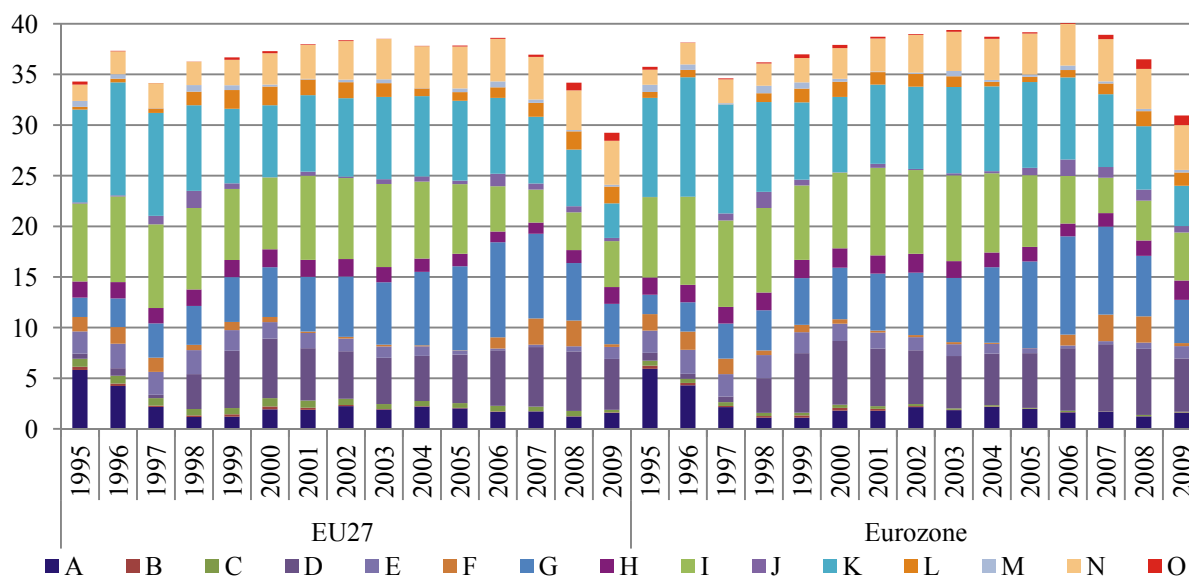
Sources: Eurostat and authors' calculations.

As has been noted in Subsection 2.2.1, at the beginning of time series for 1995–1996, illogical sub-sector fluctuations of value added are observed, therefore structural convergence during these years is difficult to evaluate. Chart 7 shows, in turn, that in comparison with the six-branch breakdown no essential convergence process was observed under the 15-branch breakdown for 1998. Consequently, the Krugman index in the breakdown by 15 branches better captures a decline of the manufacturing share in gross value added. Under the six-branch breakdown, the share of industry (C + D + E) includes also the mining and quarrying industry as well as electricity, gas and water supply; hence prior to 1998, the share of manufacturing in gross value added was higher in Latvia than in the EU27. Under the 15-branch breakdown, the shares of manufacturing (D) in Latvia and the EU27 had been largely similar already prior to the 1998 Russian financial crisis, so when the share of Latvia's manufacturing dropped under the impact of the crisis, the Krugman index value rose in 1998.

From 1997 to 2006 (with 2004 and 2005 recording minor convergence), the Latvian economy in structural terms was diverging from that of European economies. Manufacturing (D), trade (G), transport and communication (I), real estate, renting and business activities (K) as well as health and social work (N) displayed historically largest structural differences between the economies of Latvia and the EU countries. Over time, these five brunches accounted for around 70%–80% of the Krugman index value. In 1997, the largest structural value added differences were recorded for transport (I) and real estate, renting and business activities (K).

Over time, the share of transport (I) in Europe has become very stable, at around 7%; in Latvia, its share in value added had amounted to 15.1% already in 1997, and although it gradually slid down to 10%–11% in the following period, this share was still by around 4 percentage points above that of the EU countries. As has been noted in Subsection 2.2.1, starting with 1998, the divergence process of value added

structure between Latvia and the EU countries was driven by manufacturing (D), which lost some of its share in Latvia's gross value added after the Asian and Russian financial crises.

Historically in the EU, the real estate and other business activities (K) contributed from 19.9% (1997) to 23.4% (2009) to gross value added. Meanwhile in Latvia in 1997, this branch accounted for mere 9.7% of gross value added. Over time, its share in the Latvian economy increased, moving up to 20.0% (2009) and somewhat reducing the Krugman index value. It was the narrowing absolute difference in the real estate and other business activities (K) that contributed most to the contracting Krugman index value, i.e. to the structural convergence process in 2009.

In order to explain the extent of differences between the real estate and other business activity (K) shares in Latvia and the EU countries, the focus herein was placed on the data of even higher disaggregation, which show that almost half of the Krugman index value is contributed by Subsection 74, i.e. the other business activities. Over time, some difference of around 1.5 percentage points was on account of Subsection 71 (renting of transport equipment, machinery and equipment as well as personal and household goods) and Subsection 72 (computer and related activities). Real estate operations made up the remaining value of the Krugman index.

Thus it may be concluded that the effects of the real estate and other business activity (K) on the Krugman index value can be associated with real estate operations only in part, as the major contribution comes from business support activities. Most likely it can be explained by the fact that businesses in Latvia strive to ensure operation on their own rather than use professional services. Thus, for instance, relatively numerous enterprises in Latvia use their own accounting programmes or do not use them at all, ensure security and cleaning of their objects, and do not rely on staff recruitment company services. This may be interpreted as an issue of corporative culture or reluctance to transfer some company functions to administrative service providers.

In 1997, the share of trade (G) in gross value added was 15.2% in Latvia; with years to come, it started to pick up in line with gradually growing gross wages and purchasing power. The growth of the trade (G) share became particularly swift after Latvia's accession to the EU when it was driven by a sharp increase in disposable income of the population and better availability of credit resources, not to speak about the households' wish to improve the living standards. Thus at its peak in 2006, the share of trade (G) amounted to 20.8%, thus contributing even more to the disparities in the structure of EU27 and Latvian value added. However, as a result of the crisis which slowed down private consumption step by step, the effects of trade (G) on the overall Krugman index value started to ease gradually in 2008, and in 2009, its contribution to the total index value lagged behind that of manufacturing (D) and health and social care (N).

Since 2006, the share of construction (F) in the composition of value added in Latvia vs. the EU27 had been picking up; however, this period of upswing ended already in 2009. In addition, it can be assumed on the basis of construction sector statistics that the sector share in value added structure vs. the EU27 had reversed in 2010.

The structural convergence processes viewed vis-á-vis other neighbouring Baltic States generate similar inferences to those made for the six-branch breakdown. In

recent years, the structure of Latvia's value added in the economy has notably caught up with that of Estonia (see Chart 8), while the trends vs. Lithuania have preserved their volatility (see Chart 9). Historically, the differences between the structure of value added in economies of Latvia and Lithuania depend on three 3 sectors: manufacturing (D), trade (G) and financial intermediation (J).

Chart 8
The Krugman index in breakdown by sector for Latvia vs. Estonia
(in points)
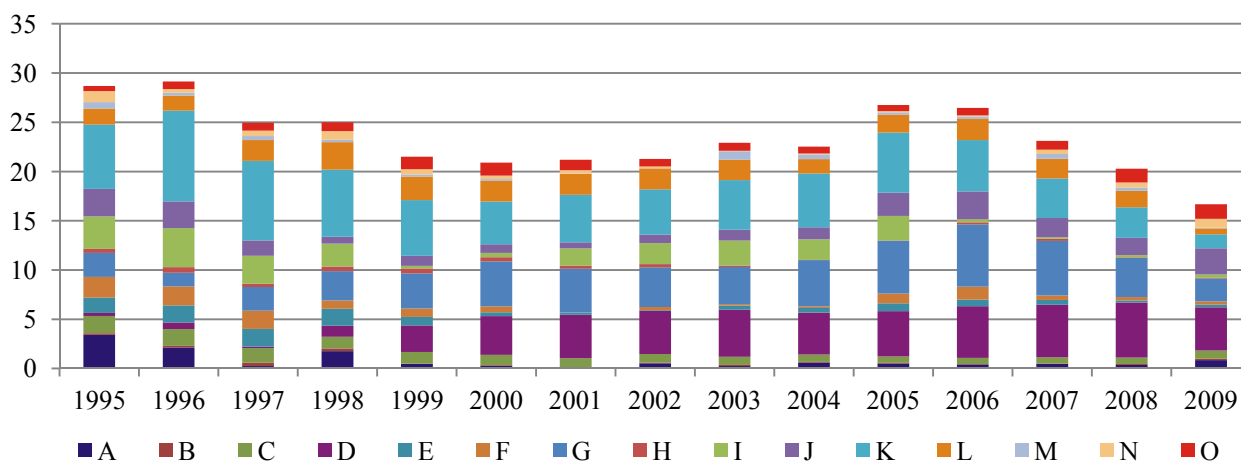
Sources: Eurostat and authors' calculations.

Also, the share of manufacturing (D) in Estonia's value added historically is some 4 to 5 percentage points higher than in Latvia. It is largely dependent on Estonia's geographical location, which favours inflows of FDI from Scandinavia, and a well-thought economic policy to spur such investment. The situation in trade (G), in turn, is just the opposite: the share of trade in Latvia's value added has historically been 5 to 6 percentage points higher than in Estonia. And only in 2009, the crisis-hit Latvian trade (G) share decreased, thus notably bringing down the overall Krugman index value as well.

Chart 9
The Krugman index in breakdown by sector for Latvia vs. Lithuania
(in points)
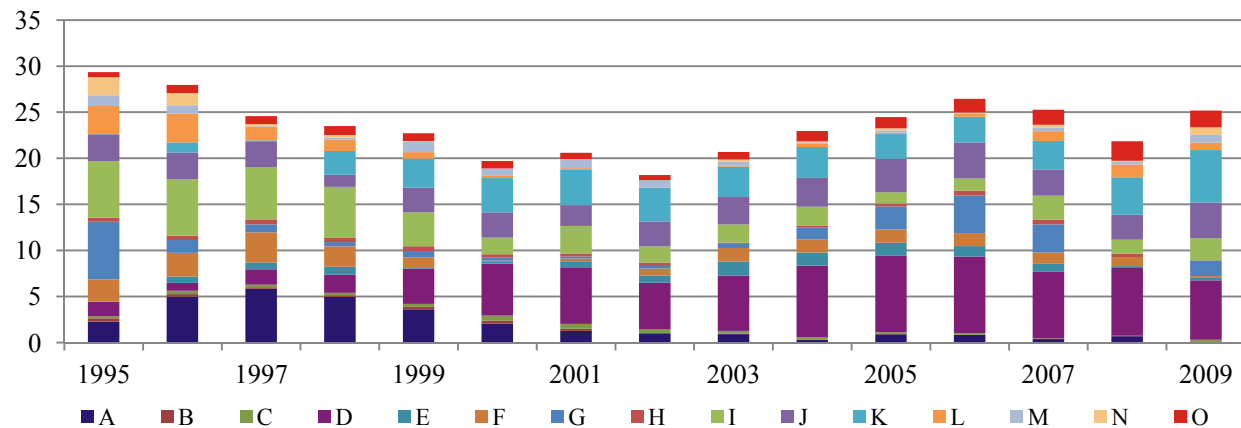
Sources: Eurostat and authors' calculations.

Similarly, around 2 percentage point disparity was observed between the Latvian and Estonian shares of financial intermediation (J); moreover, the Latvian share

exceeded that of Estonia. When studying the value added differences vs. Lithuania, the large difference in the manufacturing (D) share immediately comes into focus: in Lithuania this share historically reached 16%–20%, whereas in Latvia it was 10%–13%. It is quite logical that such disparity gives rise to similar gaps in other sector shares as well. Thus, for instance, real estate and other business activities (K) in Latvia boast of a 4 to 5 percentage point and that of financial intermediation (J) of a 3 to 4 percentage point larger share than in Lithuania.

2.2.3 Structural convergence in manufacturing

In the presence of free capital flows (with unimportant legal and transaction barriers), a higher return on capital in more backward regions boosts capital flows to economies and sectors that are in need of capital, and, thus, via balancing out return on capital, structural convergence of these economies is facilitated. The spillovers of knowledge and technologies enhance also convergence and balancing of productivity levels, thus, according to Aiginger (2000), ensuring convergence in terms of both output and productivity structure.

Meanwhile, Gugler and Pfaffermayr (2003) found out that the convergence process within the EU manufacturing in 1985–1998 was faster for productivity than for the structure itself (measured either by value added or employment).

According to the classical economic theory, economic integration and removal of obstacles in foreign trade underpin a faster process of structural divergence and specialisation of manufacturing subsectors. Each country specialises in the production of output for which it has some natural endowments. The New Trade Theory stipulates at the same time that economic integration reduces structural specialisation and promotes structural convergence of the economy (Krugman (1991)).

In addition, the New Economic Geography Framework emphasises the principle of economic agglomeration, implying that in a specific region agglomeration of specialised suppliers, knowledge spillovers and specialised labour takes place, by which specialisation of an economy or region is increased (Fujita, Krugman and Venables (1999)).

The data of even higher disaggregation levels (14 manufacturing sections), i.e. the structure of manufacturing, which leads to a more specific assessment of economic homogeneity levels, are analysed in this paper. Herein, the Krugman index is applied also to disaggregated manufacturing data. Some studies confirm that real convergence in the EU12 countries was simultaneous with divergence of manufacturing specialisation (Marelli and Signorelli (2010)).

It should be noted that with the number of groups included in the index computations increasing, the Krugman index value usually increases as well, so the results obtained are not directly comparable with the Krugman index values for structure indicators of gross value added, yet their trends can be well-compared. Chart 10 shows that structural convergence of manufacturing towards the European countries did take place over time, yet the pace was not very fast. It is quite natural because for smaller economies a few large enterprises within one sector will be enough for it to stand out against the general background.

Chart 10
The Krugman index of manufacturing for Latvia vs. the EU27 and euro area countries
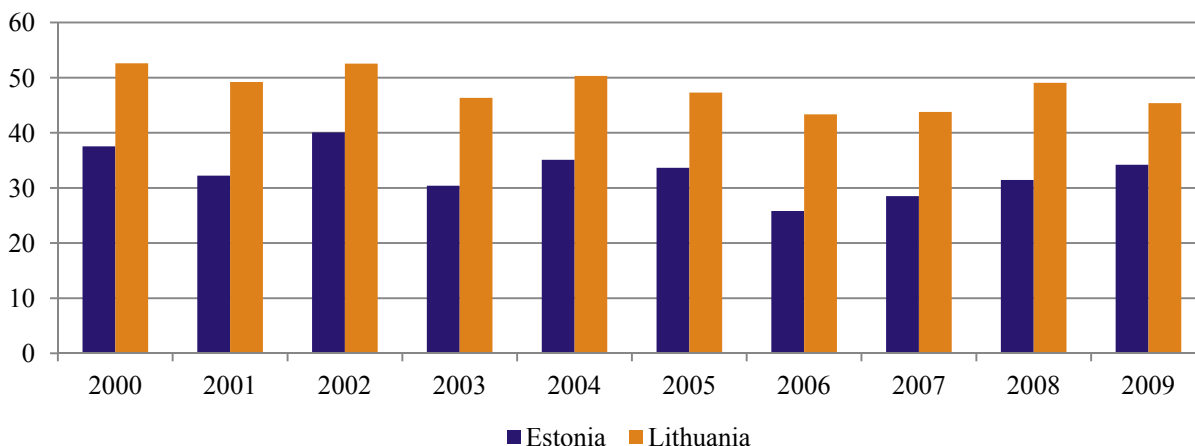(in points)
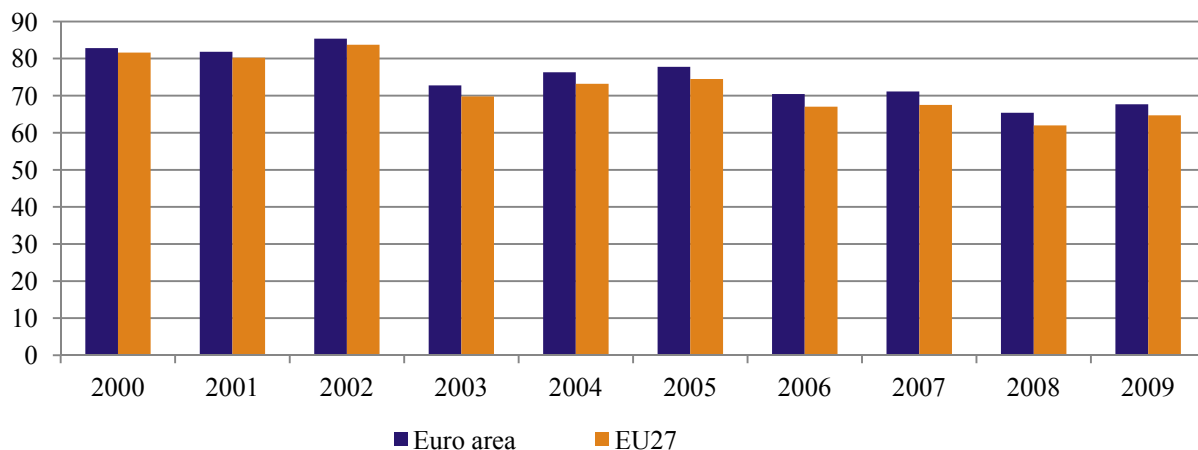
Sources: Eurostat and authors' calculations.

If in this setting a comparison between Latvia and the EU27 countries is made regarding the value added structure in manufacturing, the largest differences are seen to be on account of those branches, which historically have been important for Latvia's manufacturing. Thus, the largest positive differences (subsectors with a larger share in the manufacturing structure in Latvia than in EU27) vis-á-vis the value added structure of EU27 in 2009 were contributed by manufacture of wood and wood products (DD; 16.8 percentage points), food products, beverages and tobacco (DA; 10.7), chemicals, chemical products and man-made fibre (DG; 4.6), and basic metals and fabricated metal products (DJ; 4.0). On the negative side, differences arise from some subsector shares being substantially lower than the EU27 averages, e.g. the manufacture of transport equipment (DM) and electrical and optical equipment (DL), with 6.4 and 9.0 percentage points respectively. If compared with the averages of the euro area countries, the results are around the same, for the euro area and EU27 averages were similar.

Chart 11
The Krugman index of manufacturing for Latvia vs. Lithuania and Estonia
(in points)

Sources: Eurostat and authors' calculations.

The comparison of the structure of Latvia's value added in manufacturing with the other two Baltic States points to a higher homogeneity with the Estonian manufacturing sector (see Chart 11). Three manufacturing subsectors, i.e. food products, beverages and tobacco (DA), wood and wood products (DD), and electrical and optical equipment (DL), accounted for around 60% of the gap between the Latvian and Estonian manufacturing branches. Latvia dominated in the structure of the first two (DA and DD) and Estonia in the manufacture of electrical and optical equipment (DL).

The assessment of the Latvian manufacturing structure vis-á-vis Lithuania shows stronger differences between the respective shares of manufacture of wood and wood products (DD) and coke, refined petroleum products and nuclear fuel (DF). For Latvia, the share of wood in overall manufacturing is substantially higher, while for Lithuania the manufacture of energy products (oil processing) dominates. Similarly, the share of basic metals and fabricated metal products (DJ) in the structure of Latvia's manufacturing is larger, while that of chemicals, chemical products and man-made fibres (DG) in total manufacturing value added is smaller.

In order to assess the degree of specialisation in manufacturing, the Herfindahl-Hirschman index (Meilak (2008)) can be used:

$$H = \sum_{i=1}^{N} s_i^2, \hspace{4cm} [2]$$

where s_i is the sector share in overall manufacturing value added, and N is the number of subsectors.

The index value interval is from 1/N to 1, with smaller index values denoting larger heterogeneity within the sector. The index value calculated for 2009 shows that specialisation in Latvia's manufacturing was the strongest of all Baltic States. The index value was 0.130 for Latvia, 0.096 for Estonia, and 0.112 for Lithuania. In Estonia, the manufacture of food products, beverages and tobacco (DA), wood and wood products (DD), and machinery and equipment (DK) account for the largest shares, while in Lithuania they are the manufacture of food products, beverages and tobacco (DA), chemicals, chemical products and man-made fibres (DG) as well as manufacturing n.e.c. (DN). Speaking about the EU27 countries, the value of the Herfindahl-Hirschman index is 0.099. Viewed from an overall perspective, the manufacturing sectors of the Baltic States were mutually more homogeneous than they were in comparison with the EU27 or euro area countries.

3. IS CONVERGENCE TAKING PLACE IN EUROPE?

This section deals with the concepts of β-convergence and σ-convergence as well as the methods of their estimation; β-convergence and σ-convergence for EU Member States and their territories using NUTS 2 classification are likewise estimated with the help of related equations.

3.1 β-convergence estimation method

In neo-classical growth models, the growth rate of capital per capita is inversely proportional to the initial level of production or per capita income (Ramsey (1928); Cass (1965); Koopmans (1963)). Assuming that there is a driver to promote convergence of per capita income and under the condition of similar preferences and

technologies in different economies, lower-income countries are growing faster than the higher-income ones.

β-convergence and its conditions are derived from the Solow model, which is based on the production function with constant returns to scale:

$$Y = AF(K, L) \qquad [3]$$

where Y is output, K is capital, L is labour, and A is technological progress.

By dividing equation [3] with labour L, an equation in which income per capita depends on technological progress and capital level per capita is obtained:

$$y = Af(k) \qquad [4]$$

where y and k are output and capital per unit of labour respectively.

At the same time, the basic non-linear equation, which relies on the production function and describes the economic growth tendency towards steady state, according to the Solow model is as follows:

$$\dot{k} = sAf(k) - (\delta + n)k \qquad [5]$$

where $\dot{k}$ is growth rate of capital level per worker, s is saving rate, δ is capital depreciation rate and n is population (and consequently labour) growth rate.

In order for poorer and richer countries to converge, two conditions shall be met:
– the law of diminishing marginal returns (i.e. with capital growing by one unit, aggregate income increases by less than one unit) shall be attributable to physical capital stock;
– constant and equal rates of saving across countries and constant and equal rates of capital depreciation and population growth.

When both sides of equation [4] are divided by k, the growth rate of capital (g_k) is derived:

$$g_k = sAf(k)/k - (\delta + n) \qquad [6].$$

Parameter $sAf(k)/k$ of equation [6] presents the saving curve, while $(\delta + n)$ is depreciation norm. Steady state (k^*) is achieved when growth on capital per worker is zero, thus equation (4) becomes:

$$sAf(k)/k = (\delta + n) \qquad [7].$$

In order to realise convergence across all countries, lower-income countries with smaller GDP and physical capital per worker need to grow at a faster rate than higher-income countries with larger GDP and capital per worker levels.

Chart 12 presents the so-called absolute convergence: countries with different initial income levels may achieve absolute convergence (the only steady state) under the condition of similar saving rates (s), technologies (similar parameters A and δ) and population (labour) growth (n) across different countries. In the absence of these similarities, no convergence can be achieved.

Chart 12
The neoclassical Solow-Swan growth model
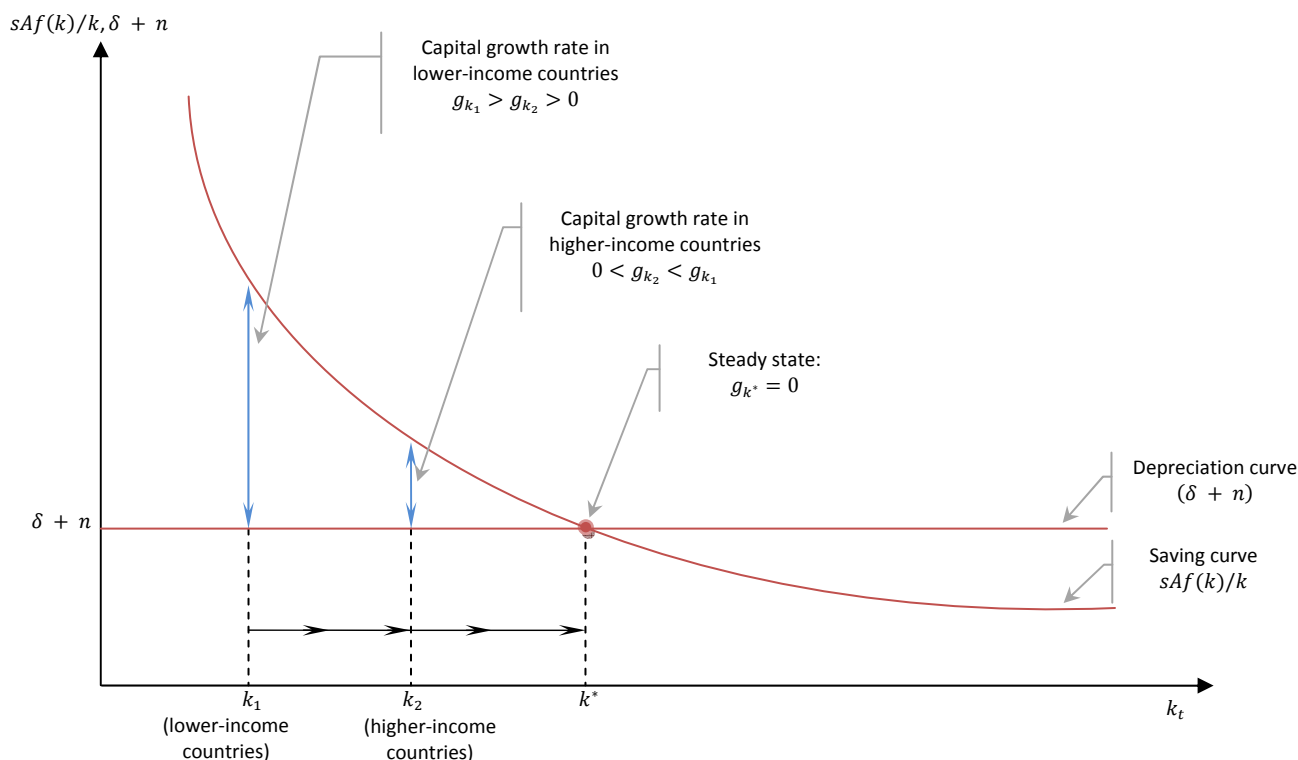
Source: chart drawn by authors.

The core objective of empirical studies is to assess whether convergence processes across countries take place and at what speed they proceed. It can be achieved by assessing the Barro and Sala-i-Martin β-convergence model (Barro and Sala-i-Martin (1992)). The following equation shows the dynamics of capital per effective worker in a closed economy (Le^{xt}, where L is labour (population) and x is exogenous labour-augmenting technological progress):

$$\dot{\hat{k}} = f(\hat{k}) - \hat{c} - (\delta + x + n)\hat{k} \tag{8}$$

where $\hat{c}$ is consumption per effective worker ($\hat{c} = {C}/{Le^{xt}}$), δ is capital depreciation rate, and n is labour growth rate. The representative household maximises its utility function as follows:

$$U = \int_0^\infty u(c)e^{nt}e^{-\rho t}\, dt \tag{9}$$

where c is consumption per worker ($c = {C}/{L}$), ρ is time preference rate, and

$$u(c) = \frac{c^{1-\theta}-1}{1-\theta} \tag{10},$$

with $\theta > 0$ so that marginal utility ($u'(c)$) is with constant elasticity θ against c. It is assumed that $\rho > n + [1 - \theta]x$ to ensure the condition of transversality.

First order condition for maximisation of utility function (U) is as follows:

$$\frac{\dot{c}}{c} = \frac{1}{\theta}\left[f'(\hat{k}) - \delta - \rho\right]$$ [11].

The effective variables ($\hat{y}$, $\hat{k}$ and $\hat{c}$) remain constant in steady state, and per capita variables (y, k and c) increase at rate x. Capital per effective worker in steady state is expressed by the following formula:

$$f'(\hat{k}^*) = \delta + \rho + \theta x$$ [12].

If the economy begins to grow at capital level $\hat{k}$, which is lower than $\hat{k}^*$, $\hat{k}$ gradually rises to the $\hat{k}^*$ level. This relationship can be directly transferred to output (GDP) per worker (per capita) with the help of the production function. Consequently, if two economies have the same preference parameters and similar technology, the initially poorer economy (with a lower initial capital level $\hat{k}$) tends to grow at a faster rate in per capita terms.

The transition dynamics can be derived by log linearising equations [8] and [11] around the steady state. Employing the production function, the solution is as follows:

$$ln(\hat{y}_t) = ln(\hat{y}_0)e^{-\beta t} + ln(\hat{y}^*)(1 - e^{-\beta t})$$ [13]

where the positive parameter β describes convergence or real per capita income break-even speed, which is calculated using the following formula:

$$2\beta = \left\{\varphi^2 + 4\left(\frac{1-\alpha}{\theta}\right)(\rho + \delta + \theta x)\left[\frac{\rho + \delta + \theta x}{\alpha} - (n + \delta + x)\right]\right\}^2 - \varphi$$ [14]

where $\varphi = \rho - n - (1 - \theta)x$.

As a result, average speed of change y in the period from t_0 to $t_0 + T$ can be written as:

$$\frac{1}{T}ln\left(\frac{y_T}{y_0}\right) = x - \left(\frac{1-e^{-\beta T}}{T}\right)ln\left(\frac{\hat{y}^*}{\hat{y}_0}\right)$$ [15].

The model presents the conditional convergence process, i.e. at the given x and $\hat{y}^*$, the growth rate is faster if the initial income level (y_0) is lower. Convergence is conditional, because parameters x and $\hat{y}^*$ can differ across countries. However, in respect to the EU countries it can be assumed that the differences across Member States in parameters x and $\hat{y}^*$ are minor, hence there is no need to distinguish between conditional and absolute convergence.

Proceeding from the theoretical arguments stated above, this study employs a model proposed by Sala-i-Martin in 1996 for assessing β-convergence of the EU countries and their territories:

$$\frac{1}{T}ln\left(\frac{y_{i,t_0 + T}}{y_{i,t_0}}\right) = x - \left(\frac{1-e^{-\beta T}}{T}\right)ln(y_{i,t_0}) + u_{i,t_0,t_0 + T}$$ [16]

where y is GDP per capita in PPS, t_0 is the initial period, T denotes the number of periods, β is constant which represents the average speed of β-convergence in the period from t_0 to T and u is mean error in the period from t_0 to T.

3.2 σ-convergence estimation method

σ-convergence is another type of convergence, which shows a tendency for the dispersion of per capita real income across countries to decrease over time. Despite much attention given to β-convergence and its vast investigation in scientific literature, β-convergence is acknowledged not to be a sufficient condition for σ-convergence (Barro and Sala-i-Martin (1996)). From the point of view of social economics, σ-convergence can even be considered a more important indicator than β-convergence, because σ-convergence directly demonstrates whether income distribution across countries is or is not becoming more homogenous (Friedman (1992)).

Sala-i-Martin (1996) proved that β-convergence is a necessary but not a sufficient condition for σ-convergence. Assuming that β-convergence across regions exists in discrete time, real per capita income in economy i can be given by such formula:

$$log(y_{i,t}) = a + (1 - \beta)log(y_{i,t-1}) + u_{i,t} \qquad [17]$$

where a and β are constants ($0 < \beta < 1$), and $u_{i,t}$ is error term. The condition $\beta > 0$ is the determinant of β-convergence. The larger the β value, the faster the speed of per capita income level convergence. The equation error term incorporates transitory shocks due to which $u_{i,t}$ mean in time can be assumed to equal zero, and its dispersion $\sigma_{i,t}^2$ is constant for all economies.

Log of income sample dispersion in period t is:

$$\sigma_t^2 = \left(\frac{1}{N}\right) \Sigma_{i=1}^N [log(y_{i,t}) - \mu_t]^2 \qquad [18]$$

where μ_t is log of income sample mean.

If N is a large number, sample dispersion is close to population dispersion, and equation [17] can be used to calculate σ_t^2 dynamics:

$$\sigma_t^2 \cong (1 - \beta)^2 \sigma_{t-1}^2 + \sigma_u^2 \qquad [19].$$

Only in the case of $0 < \beta < 1$, equation is stable and, accordingly, β-convergence is a necessary condition for σ-convergence. In this setting, steady state dispersion is given as:

$$(\sigma^2)^* = \frac{\sigma_u^2}{[1-(1-\beta)^2]} \qquad [20].$$

In such a way, the cross-section dispersion decreases along with β and increases along with σ_u^2. Combining equations [19] and [20] gives:

$$\sigma_t^2 = (1 - \beta)^2 \sigma_{t-1}^2 + [1 - (1 - \beta)^2](\sigma^2)^* \qquad [21],$$

which is a first order linear equation with constant coefficients.

Equation [21] can be solved as:

$$\sigma_t^2 = (\sigma^2)^* + (1 - \beta)^{2t}[\sigma_0^2 - (\sigma^2)^*] + c(1 - \beta)^{2t} \qquad [22]$$

where c is an arbitrary constant.

As $\lim_{t \to \infty}(1 - \beta)^{2t} = 0$, σ_t^2 is stable: $\lim_{t \to \infty}\sigma_t^2 = (\sigma^2)^*$. Moreover, taking into account that $(1 - \beta) > 0$, σ_t^2 catching-up with $(\sigma^2)^*$ is monotonous. σ_t^2 can either increase or decrease on its way to steady state depending on its initial value. In such a way, σ can increase in the transition period even if $\beta > 0$. To sum it up, β-convergence is not a sufficient condition for σ-convergence.

3.3 Estimation of β-convergence and σ-convergence

In this section, β-convergence and σ-convergence in the EU countries are estimated using equations [16] and [18] respectively. GDP per capita in PPS is used in the estimation. The regional national economic accounts of the Eurostat database are the data source. These data sources provide access not only to country data but also to regional data. The regional breakdown is made in accordance with the NUTS classification.

The NUTS classification is a hierarchical system for dividing up the economic territory of the EU for the purpose of:

- The collection, development and harmonisation of EU regional statistics.
- Socio-economic analyses of the region:
  NUTS 0: countries;
  NUTS 1: major socio-economic regions;
  NUTS 2: basic regions for the application of regional policies;
  NUTS 3: small regions for specific diagnoses.
- Framing of EU regional policies.

This study has a particular focus on NUTS 2 regional division, because at this level both the EU and national regional policies are enacted, hence the estimation results will enable inferences not only in regard to regional convergence processes but also about the effectiveness of the pursued regional policies in promoting β-convergence and σ-convergence.

3.3.1 The EU: inter-state estimation

To start with, β-convergence for the EU27 countries[4] in compliance with NUTS 0 level is estimated using equation [16] (see Table 1).

Table 1
β-convergence among EU27 countries
(NUTS 0 level)

| Period	β	*p*-value
1995–2008	0.027	0.000
1995–2010	0.022	0.000
1995–1999	0.000	0.958
2000–2004	0.034	0.000
2005–2008	0.036	0.000
2005–2010	0.022	0.000

Sources: Eurostat and authors' calculations.

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[4] The EU27 countries (including the group of the given countries prior to their accession to the EU) are Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK. Here and hereinafter, the data on Romania are available only starting with 1996.

For 1995–2010, statistically significant β-convergence among the EU27 countries was observed. Its average annual speed was 2.2%. It may be concluded that the global financial crisis that cropped up in 2008 substantially subdued the average speed of convergence (2.7% in 1995–2008). The breakdown of the period leads to the conclusion that from 1995 to 1999 convergence within the EU27 was practically non-existent. This may have resulted from the 1997 global financial crisis and the 1998 Russian financial crisis, which had an adverse effect also on the development of European countries. Between 2000 and 2004, the speed of convergence was 3.4% per annum. It remained almost unchanged, rising only slightly to 3.6%, throughout 2005–2008 as well.

As to σ-convergence, it emerged in the EU27 countries only after 2000, thereafter improving consistently until 2008 (see Chart 13). The negative effects on the economic growth in Europe coming from the global financial crisis of 2008 caused σ-convergence to stop.

Chart 13
σ-convergence among EU27 countries
(NUTS 0 level)
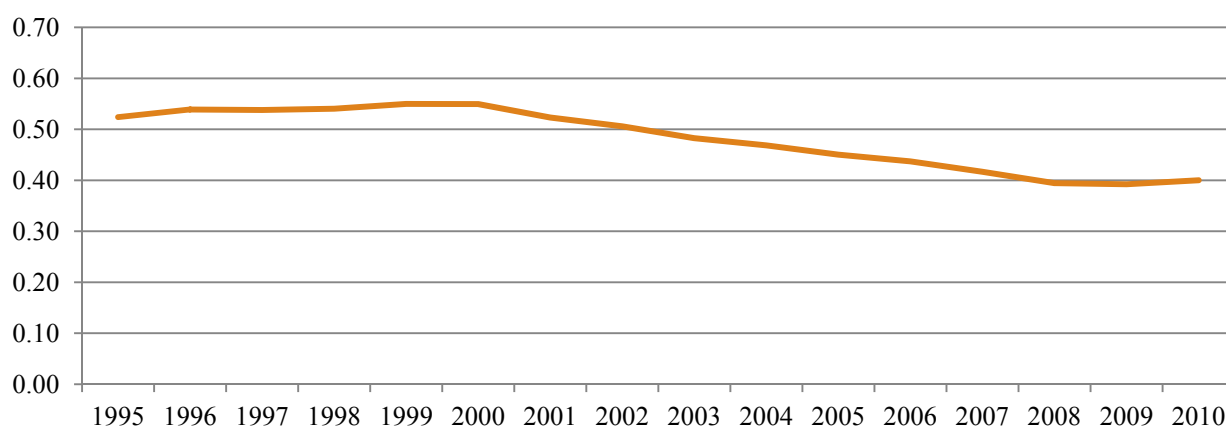
Sources: Eurostat and authors' calculations.

Accounting for the estimation results, which show that both β-convergence and σ-convergence accelerated in the EU prior and after the enlargement, it is interesting to explore whether the EU27 convergence processes primarily took place in the EU15 countries[5], or else relied on the growth dynamics in the EU12 countries[6]. The answer to this question lies within the estimation results for each country group.

These results show that in 1995–2008 the speed of β-convergence in the EU12 was high, 4.3% on average annually (see Table 2). At the same time, β-convergence in the EU15 was not observed. It should be noted that none of the EU15 countries recorded β-convergence in any of the observed periods.

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[5] The EU15 countries (including the group of the given countries prior to their accession to the EU) are the Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and UK.
[6] The EU12 countries (including the group of the given countries prior to their accession to the EU) are the Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

Table 2
β-convergence among EU15 countries and among EU12 countries
(NUTS 0 level)

Period	EU15 countries		EU12 countries	
	β	*p*- value	*β*	*p*- value
1995–2008	0.001	0.939	0.043	0.001
1995–2010	−0.002	0.847	0.032	0.001
1995–1999	0.007	0.655	0.003	0.904
2000–2004	0.002	0.881	0.048	0.001
2005–2008	−0.016	0.144	0.058	0.002
2005–2010	−0.012	0.209	0.034	0.011

Sources: Eurostat and authors' calculations.

Meanwhile, starting with 2000, the EU12 countries recorded a very buoyant process of β-convergence. Between 2000 and 2004, the EU12 countries were converging at an average annual speed of 4.8%. As β-convergence was practically non-existent in the EU12 in 1995–1999 but started to emerge as with 2000, it can be concluded that some pre-accession instruments (e.g. PHARE programmes) must have positively impacted the process of β-convergence. Overall, the EU enlargement facilitated converging, with its speed accelerating even to 5.8% on an annual basis in 2005–2008. The global financial crisis, in turn, had a negative effect on convergence within the EU12, and the speed of β-convergence in 2005–2010 was almost two times slower than in 2005–2008.

Chart 14
σ-convergence within EU15 and EU12 and among EU15 and EU12
(NUTS 0 level)
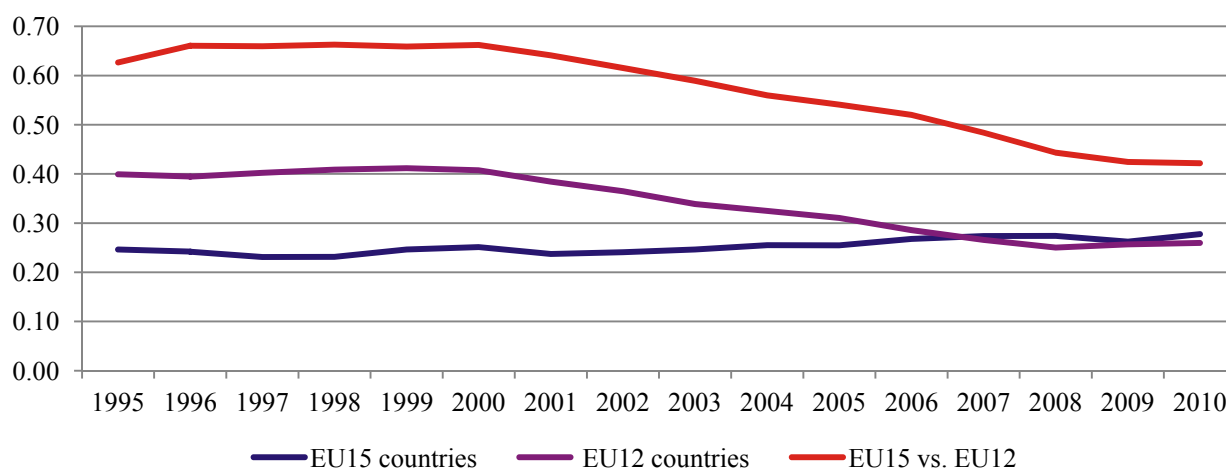
Sources: Eurostat and authors' calculations.

In the EU27, σ-convergence took place solely at the expense of the EU12 countries (see Chart 14). In the EU15 in 1995–2010, σ-convergence was not recorded, and, in fact, even divergence processes occurred. Other researchers investigating the European σ-convergence processes have arrived at similar findings (Marelli and Signorelli (2010)). Thus, in the EU15 some σ-convergence was observed in terms of employment, while in terms of per capita income it was very weak. In the EU12 countries, on the other hand, σ-convergence improved substantially in between 2000

and 2008: in 2007, the level of σ-convergence broke even with the EU15 σ-convergence level. As a result in 2000–2008, both β-convergence and σ-convergence took place among the EU12 countries, while in the EU15 both were absent. This is confirmed also by Marelli and Signorelli (2010), who argued that within the EU12 σ-convergence, accompanied by structural divergence in the manufacturing sector, has been stronger. Moreover, σ-convergence took place not only among the EU12 countries but also between the EU15 and EU12 country groups, and the process dynamics suggests that it is the convergence of EU12 countries towards the EU15 country group that was the driver of this σ-convergence process.

3.3.2 The EU: inter-regional estimation

In order to expand and enrich the research process of convergence in European countries, β-convergence is estimated for the EU countries at NUTS 2 level (see Table 3), thus providing policy makers with quantified information about the efficiency of EU regional policy. The Baltic States are represented in NUTS 2 as whole countries. The assessment of convergence process in the Baltic Region at the NUTS 3 level is given separately in Subsection 3.3.3.

Table 3
β-convergence among EU27 basic regions
(NUTS 2 level)

Period	β	*p*-value
1995–2008	0.017	0.000
1995–1999	0.005	0.031
2000–2004	0.025	0.000
2005–2008	0.025	0.000

Sources: Eurostat and authors' calculations.

The pace of β-convergence among the EU27 basic regions for the full sample period is slower than in the case of estimating it at the country level. The average pace of income per capita convergence was 1.7% in 1995–2008 (2.7% at NUTS 0 level for the respective period). β-convergence estimated for the period from 1995 to 1999 points to slow pace in the region (around 0.5% per annum on average), while in the upcoming periods the convergence process proceeded much more dynamically (at around 2.5% per annum on average).

The σ-convergence process in the EU27 basic regions at NUTS 2 level has a similar albeit less pronounced trend, yet, with the number of observations increasing, σ-convergence declined, pointing to a higher convergence level attained among the EU27 basic regions (see Chart 15).

When estimating β-convergence tendencies for the EU15 basic regions at NUTS 2 level, it is useful to note that in a more detailed breakdown convergence was in place, and its average pace in the reviewed period from 1995 to 2008 was 1.2% (see Tables 2 and 4). In addition, β-convergence in the EU15 basic regions (at NUTS 2 level) was observed only in 2000–2004.

The analysis of findings in respect to the EU15 basic regions (NUTS 2 level) suggests that during 1995–1999 the annual rate of β-convergence in the basic regions of the EU15 countries was around 0.9%. The cross-country analysis testifies, on the other hand, that β-convergence statistically did not differ from zero. In the

following five-year period, the respective pace of β-convergence was even more dynamic, at 1.4%. However, from 2005 to 2008, a halt in β-convergence among the basic regions of the EU15 countries (NUTS 2 level) was observed.

Chart 15
σ-convergence among EU27 countries and among their basic regions
(NUTS 0 and NUTS 2 levels)
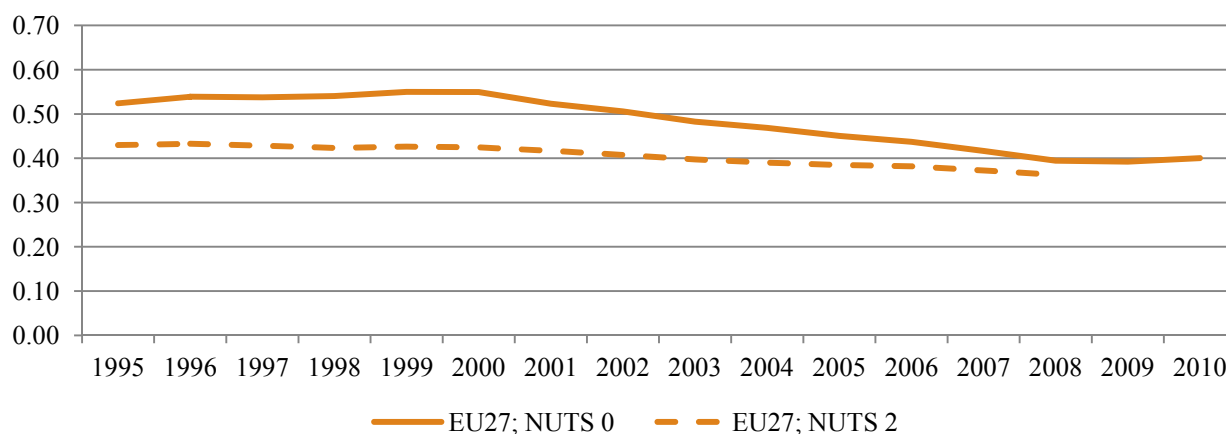
Sources: Eurostat and authors' calculations.

Table 4
β-convergence among basic regions of EU15 and among basic regions of EU12
(NUTS 2 level)

Period	EU15		EU12	
	β	*p*-value	*β*	*p*-value
1995–2008	0.012	0.000	0.005	0.367
1995–1999	0.009	0.004	−0.006	0.507
2000–2004	0.014	0.000	0.022	0.000
2005–2008	0.000	0.976	0.016	0.042

Sources: Eurostat and authors' calculations.

A more detailed basic-region-based analysis of the EU12 countries did not point to as significant β-convergence as in the estimation of inter-state regression. The pace of β-convergence of the EU12 basic regions (NUTS 2 level) was estimated at 2.2% on average in 2000–2004 (4.8% at NUTS 0 level). In the period between 1995 and 1999, statistically significant β-convergence among the EU12 countries was not observed. In 2005–2008, the pace of β-convergence in the basic regions of the EU12 countries (NUTS 2 level) dropped to 1.6%.

The estimation of σ-convergenc among the basic regions of the EU15 and EU12 countries (NUTS 2 level) leads to a cardinally different situation (see Chart 16). It shows that over the entire period under review, σ-convergence among the basic regions of the EU12 and EU15 countries (NUTS 2 level) was not observed at all.

These findings are in line with the results obtained through similar research. Thus, B. Funck and L. Pizzati (2003) acknowledged that the regional instruments did not warrant real convergence of living standards in the fund-recipient region. The outcomes herein also confirm that β-convergence at inter-state level was stronger

than at inter-regional level; hence the regional policy instruments currently employed under the EU regional policy framework are not trustworthy. Such authors as Stierle-von Schutz and Stierle (2008), and Pelkmans (2006) have arrived at similar conclusions when arguing about the impact of the EU structural funds: in regard to real regional convergence, their impact is minor or does not exist at all.

Chart 16
σ-convergence among EU27 countries, EU15 countries and their basic regions
(NUTS 0 and NUTS 2 levels)
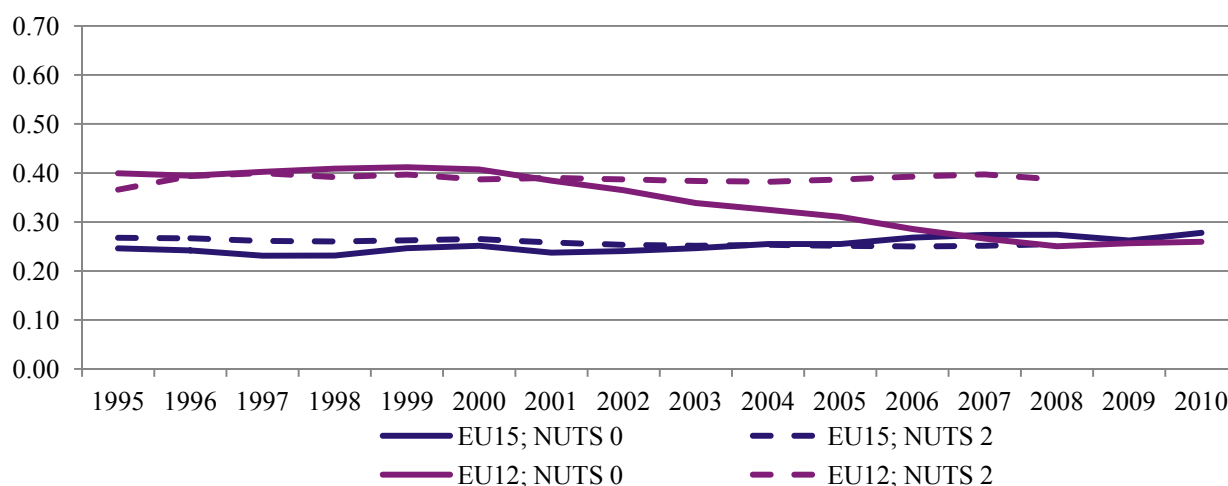
Sources: Eurostat and authors' calculations.

Also in F. Canova's study (2001) it is concluded that at the current pace of convergence in per capita income it is impossible to achieve notable improvements in the situation at NUTS 2 basic regions' level via transfers (e.g. financing from the EU funds). The outcomes of the said research suggest that convergence has been slow or non-existent at NUTS 2 level and can be attained only under the condition of free movement of labour and other production factors within a common economic space. While capital movement in Europe is actually unhampered, labour migration remains restricted.

3.3.3 The Baltic States: regional estimation

The territorial breakdown at NUTS 3 level allows for the estimation of β-convergence also in the Baltic States (see Table 5).

Table 5
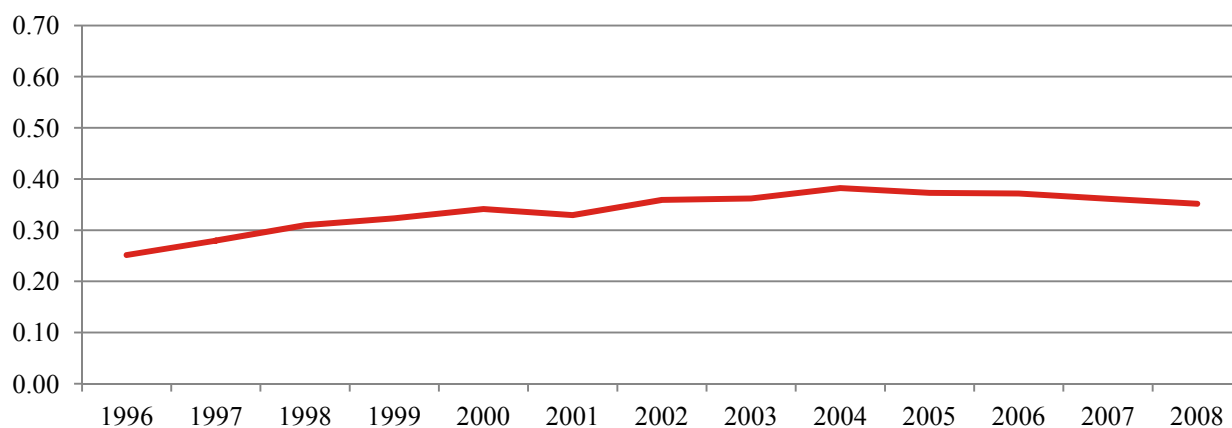**β-convergence among regions of the Baltic States**
(NUTS 3 level)

Period	β	*p*-value
1996–2008	−0.016	0.126
1996–1999	−0.053	0.006
2000–2004	−0.019	0.033
2005–2008	0.019	0.072

Sources: Eurostat and authors' calculations.

In general, β-convergence among the regions of the Baltic States was not observed in the period under review. Up to 2005, the Baltic States had even recorded

divergence: −5.3% in 1996–1999 and −1.9% in 2000–2004 per annum on average. The process of positive β-convergence at an average annual pace of 1.9% was recorded only after the accession to the EU, i.e. in 2005–2008.
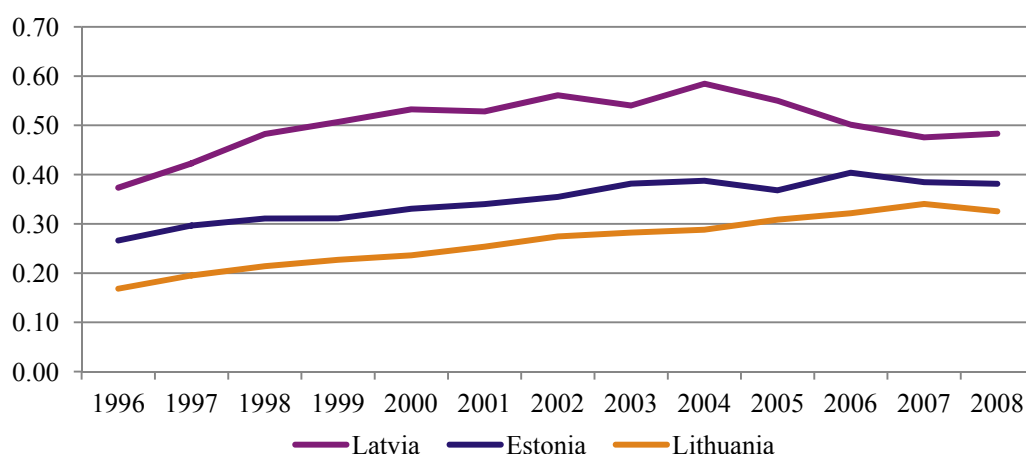
Chart 17
σ-convergence among regions of the Baltic States
(NUTS 3 level)

Sources: Eurostat and authors' calculations.

Some σ-convergence among the regions of the Baltic States was observed only in 2005–2008 (see Chart 17), with σ-divergence in place in the remaining part of the period. It can be thus concluded that the said σ-convergence resulted primarily from σ-convergence among the regions of Latvia (see Chart 18).

Chart 18
σ-convergence among regions of Latvia, Lithuania and Estonia
(NUTS 3 level)

Latvia   Estonia   Lithuania

Sources: Eurostat and authors' calculations.

The summing up of the findings for regional analysis at NUTS 0 and NUTS 2 levels confirms that convergence among the EU countries materialised only in respect of richer regions of the countries becoming increasingly richer (characteristic of the EU12 countries in particular); in addition, the process was faster in relatively poorer

countries. This is to indicate that the gap in regional wealth within a country has increased over time as is the case of the Baltic States (in Latvia to a lesser extent).

3.4 Estimation of structural convergence

In this research, the estimation of structural convergence among countries is carried out by cluster analysis. It is a statistical technique with the help of which it is possible to classify different territorial units into groups based on their characteristics (for more detailed information about clustering, see, e.g. Everitt, Landau and Leese (2011)). With the aim to extend the sample, this analysis uses not only the EU27 country data but also those of the other European countries (see Appendix A.1) in the breakdown by sector of the economy[7] (see Appendix A.2).

Chart 19
Grouping of European countries by structural similarities
(cluster analysis; rescaled distance cluster combine is 15)

1995

2000

2005

2010
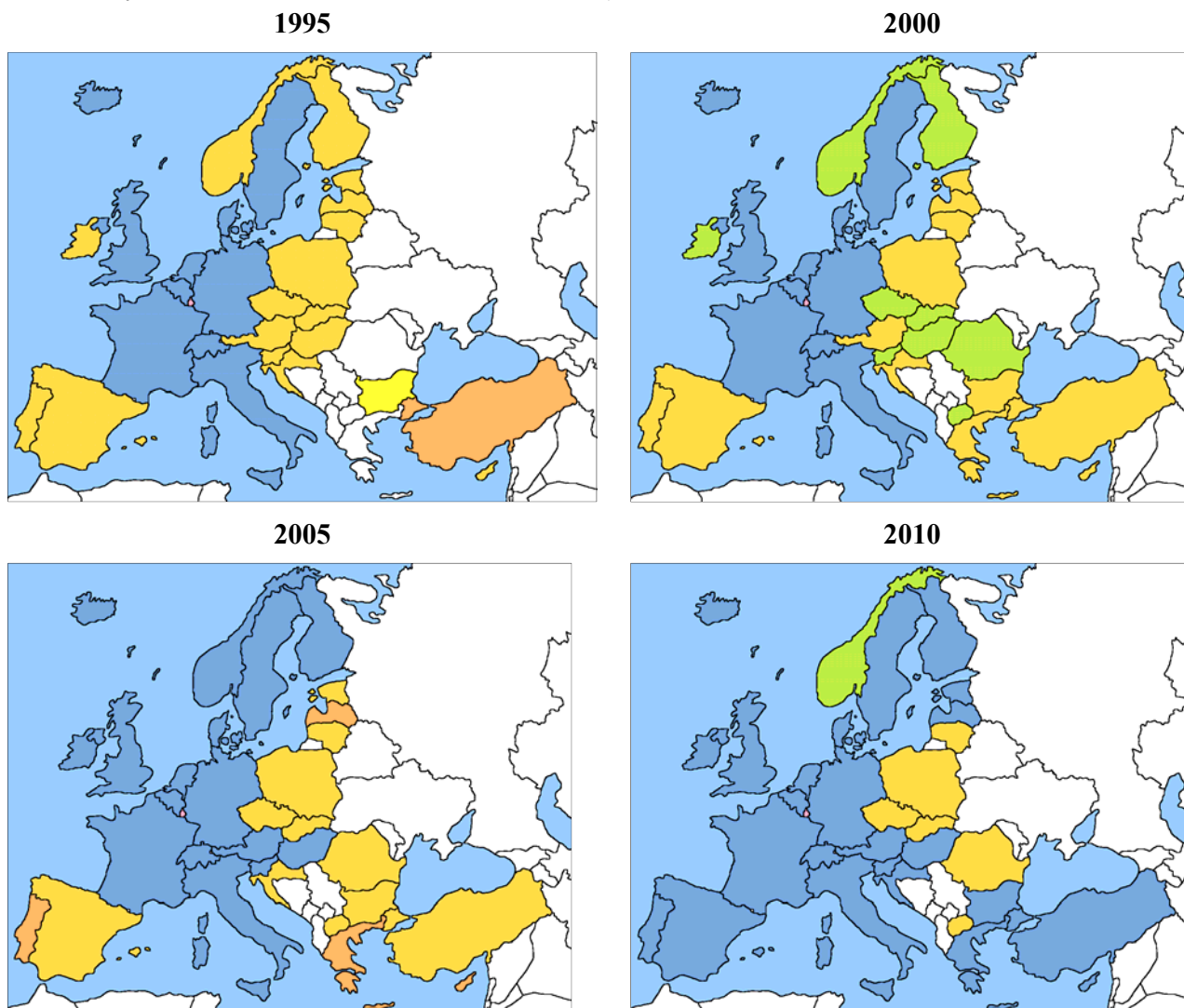
Sources: Eurostat and authors' chart.

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[7] The selection of European countries and sector breakdowns depended on the availability of statistical data.

The analysis of the 1995 data suggests that two large clusters with mutually similar economic structures existed in Europe (see Chart 19 and Appendix A.4). The largest was made up of Norway, Finland, Estonia, Latvia, Lithuania, Poland, the Czech Republic, Slovakia, Slovenia, Hungary, Austria, Croatia, Malta, Cyprus, Spain, Portugal and Ireland. The second bloc contained Iceland, the UK, Sweden, Denmark, the Netherlands, Belgium, France, Germany, Switzerland and Italy. Thus, from the point of view of structure, the economic division of Europe into the Western bloc and Eastern bloc countries followed the pattern of socio-political developments. Some countries which nowadays are classified into the Western country bloc, e.g. Austria, Spain, Portugal, Ireland, Finland and Norway, according to the cluster analysis fall into the Eastern bloc. As is known, Austria (1995), Spain (1986), Portugal (1986) and Finland (1995) were relatively recent EU accession countries, which is likely to explain their weakly-converged economic structures towards the Western country bloc. As the economic structures of Luxembourg, Bulgaria and Turkey were quite different these three countries did not form a cluster with any of the countries under review.

In 5 years certain changes surfaced in Europe (see Appendix A.5). In 2000, the Eastern country bloc formed two new clusters, with the Baltic States, Poland, Austria, Croatia, Bulgaria, Turkey, Greece, Cyprus, Portugal and Spain forming one of them, and Norway, Finland, Ireland, the Czech Republic, Slovenia, Slovakia, Hungary, Romania and the FYR of Macedonia composing the other. Luxembourg with its specific economic structure remained outside the given three clusters.

The situation continued to evolve in 2005 when the Western bloc was joined by Ireland, Norway, Finland, Austria, Hungary and Slovenia (see Appendix A.6). The second major cluster incorporated Estonia, Lithuania, Poland, the Czech Republic, Slovakia, Hungary, Croatia, Macedonia, Bulgaria, Turkey and Spain. The third cluster included Latvia, Portugal, Greece, Cyprus and Malta, i.e. the countries with relatively large shares of trade and, at the same time, small shares of manufacturing in their gross value added.

In 2010, following the severe effects from the global crisis, the countries in Europe became more homogenous in terms of their economic structure, in part resembling Europe in the mid-1990s (see Appendix A.7). Two clusters still existed in Europe, yet the Western country bloc had accumulated a part of the Eastern bloc countries. As a result, the latter comprised only six countries: Lithuania, Poland, the Czech Republic, Slovakia, Romania and Macedonia. Norway and Luxembourg were the only countries to form separate clusters, thus mirroring the essential structural distinctions of their economies from those of other European countries. It can thus be concluded that the moderation of real convergence triggered the process of structural convergence also in Europe and, as a result, the countries became mutually more homogeneous.

If the European countries are grouped with a stronger focus on structural disparities of their economies (reducing rescaled distance cluster combine from 15 to 10), the picture changed substantially. In this case, by applying cluster analysis the countries were classified into smaller but more specific groups, hence those within one cluster were mutually more similar by their characteristics. In 1995, the composition of the Western country bloc cluster remained broadly unchanged. The only difference consisted in the fact that the cluster of Eastern bloc countries had broken down into

two, with Hungary, Slovenia, Slovakia, the Czech Republic, Finland and Sweden now forming a separate cluster. Cyprus, Luxembourg and Turkey all boasted of quite distinctive economic structures.

In 2000, Latvia's economic structure became similar with that of Greece and Cyprus (see Chart 20 and Appendix A.5) under the impact of a significant share of trade, tourism and transport in the structure of value added in these countries. Meanwhile, elsewhere in Europe the situation remained similar to the one in 1995, except one innovation, i.e. the splitting of the Eastern country bloc into two, with the Czech Republic, Slovakia, the FYR of Macedonia and Romania united into a separate cluster. Turkey is seen to have joined the cluster with Spain, Portugal and some Eastern bloc countries.

Chart 20
Grouping of European countries by economic structural similarities
(cluster analysis, rescaled distance cluster combine is 10)
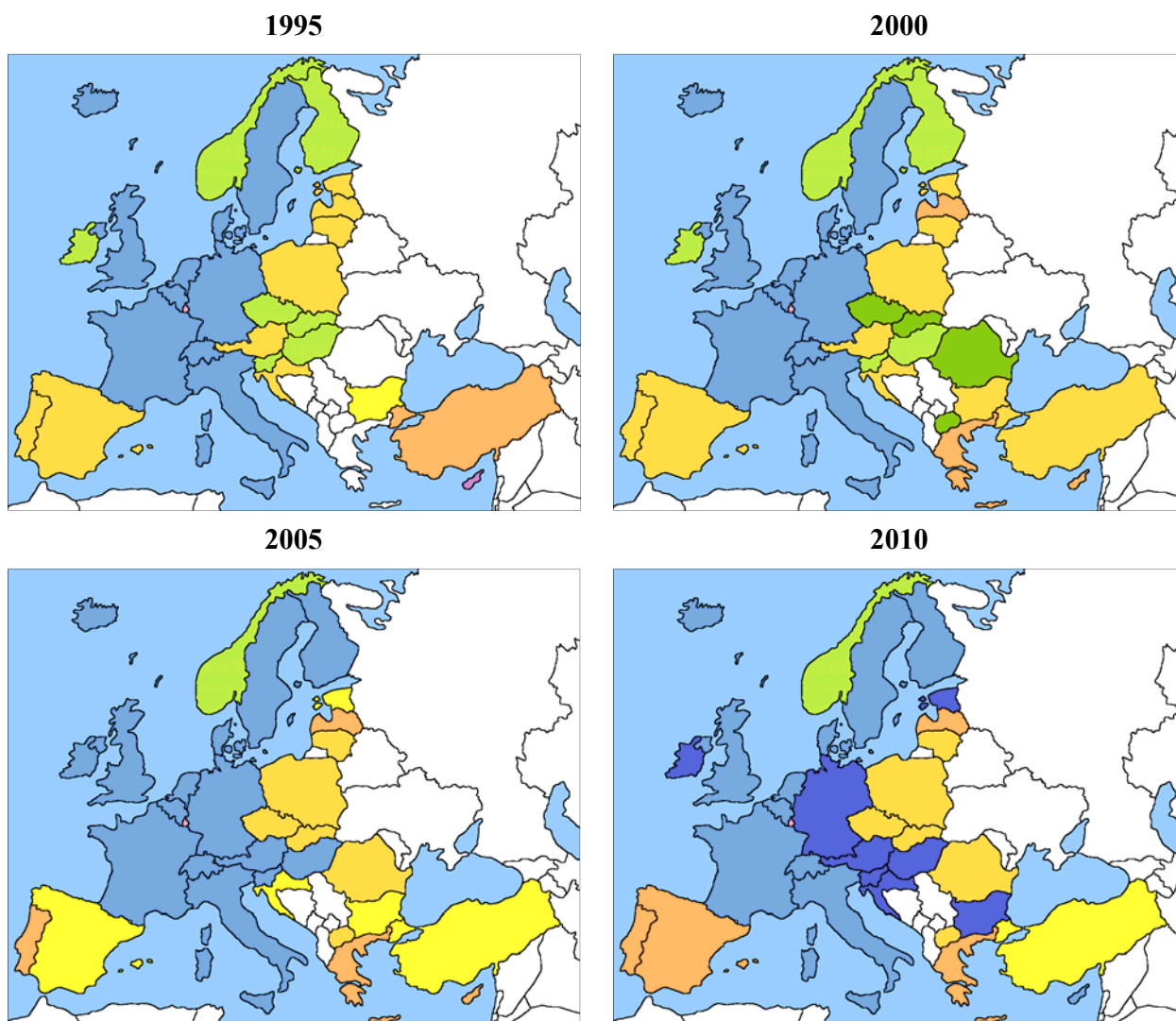
Sources: Eurostat and authors' chart.

However in 2005, the situation sharply shifted, and the three Baltic States found themselves in different clusters for the first time (see Appendix A.6). Estonia joined the cluster of Spain and Turkey. Lithuania, Poland, the Czech Republic, Slovakia, Romania and the FYR of Macedonia together formed a separate cluster, while Latvia remained in the cluster with Greece and Cyprus, which later was joined also by Spain.

In 2010, following the global financial crisis, the situation in Europe changed notably. As of 2010, there were four clusters in Europe but Turkey, Luxembourg and Norway did not belong to any of them (see Appendix A.7). The countries hit hard by the global financial crisis and suffering from the sovereign debt crisis (Latvia, Greece, Spain and Portugal) formed a single cluster. Poland, which sustained growth throughout the crisis, forms a single cluster with its neighbours Lithuania, the Czech Republic, Slovakia and Romania. Meanwhile, the largest cluster, i.e. that of the Western countries, broke into two, with Germany, Austria, Ireland, Slovenia, Croatia, Hungary, Bulgaria and Estonia forming one cluster, and Denmark, the UK, Sweden, Finland, Iceland, Belgium, the Netherlands, France, Italy and Switzerland composing the other.

The results of cluster analysis disclose several relationships. First, the UK, France, Italy, Switzerland, the Netherlands, Belgium, Sweden and Denmark display a very strong structural connection. In the reference period, these countries never changed clusters. In addition, the economic structure of some countries depended on their bigger neighbours. Thus, for instance, the economies of Lithuania, the Czech Republic and Slovakia were primarily related to Poland, whereas those of Austria and Hungary had links with Germany. However, there were exceptions as well, and some countries (Latvia among them) rather often shifted from one cluster to another.

It can also be inferred that the countries in Europe had more homogeneous economic structures in 2010 than in 2005, 2000 or 1995 (at distance 15). Nevertheless, a deeper insight into their economic structural disparities (reducing the distance to 10) leads to the conclusion that substantial differences among them still existed. It is interesting to point out that the countries that had suffered most severely from the adverse effects of the global financial crisis (e.g. Latvia, Greece, Portugal and Spain but excluding Iceland and Ireland characterised by serious banking problems) formed a single cluster.

CONCLUSIONS

In this research, Latvia's structural convergence using the Krugman index was estimated. The results obtained confirm that in the period of fast real convergence the economy of Latvia gradually diverged from that of the European economies (in terms of structure). It was mainly driven by a particular increase in the shares of individual branches in the composition of Latvia's gross value added. In the period of buoyant growth, the shares of trade, transport and communication, and construction in Latvia were above those in the EU27 and euro area, while, on the other hand, those of real estate and other business activities as well as manufacturing were below the respective levels. When the global financial crisis broke out, the process of Latvia's real convergence halted and, in fact, the process of real divergence set in, which, in turn, gave impetus to the process of structural convergence and reduced imbalances that had surfaced during the period of buoyant growth. The computations conducted in this study demonstrate a link between real and structural convergence; in the case of Latvia, excessively fast real convergence caused some imbalances to emerge and translate into structural disparities. Nevertheless in a longer perspective, both real and structural convergence evolved in one and the same direction.

Structural homogeneity of countries is of particular importance for countries within a single currency area; prior to entering the euro area, it is essential for the economy of Latvia not only to meet the nominal criteria (the Maastricht criteria), but also to attain higher structural similarity with other euro area economies. True, structural distinctions among the Member States determined, say, by geographical advantages for the development of certain sectors (transport and communication, agriculture, mining, tourism, etc.) will always exist. Within this study, an in-depth analysis of how the structure of value added in Latvia's manufacturing differs from that in the EU27 has been conducted. The Krugman index value is primarily dependent on the large shares of wood and wood products (DD), basic metals and fabricated metals (DJ), and food products, beverages and tobacco (DA) in Latvia's gross value added, and also on the fact that the manufacture of electrical and optical equipment (DL), transport equipment (DM) and machinery and equipment n.e.c. (DK) in Latvia vis-á-vis the EU27 and the euro area is less developed. Weak diversification of manufacturing in comparison with the euro area average is Latvia's disadvantage, which may amplify the exposure of Latvia's economy to adverse effects of eventual external shocks. That is why today, prior to joining the euro area, reinforced focus should be placed on industrialisation policy. High specialisation of manufacturing relies on certain comparative advantages of individual industries, which are likely to retain their larger output shares also in the future, while the build-up of the potential of some low-output-capacity industries (or branches) should not be neglected either.

The findings related to β-convergence estimations show that it was in place in the EU27 at both national and regional levels in 1995–2010, with the speed of convergence at the national level outpacing that at the regional one. The breakdown of β-convergence period shows that up to 2000 β-convergence was practically non-existent among the countries in Europe. The breakdown of β-convergence process by country group (EU15 and EU12) demonstrates, on the other hand, that the β-convergence process, which started in 2000, was driven by the group of the new Member States or the EU12 countries and most likely was due to the access these countries gained to pre-accession financial instruments and economic expectations

associated with the accession to the EU. The research also reveals that the pace of β-convergence in the EU12 countries gained momentum after the accession to the EU, which confirms that the latter was a strong driver behind the real convergence processes. Speaking about the regional level, however, β-convergence in the EU15 and EU12 took place only at the national level, and β-convergence at the regional level was not observed.

σ-convergence is also estimated in this paper. The findings confirm that σ-convergence took place in Europe in 2000–2008, i.e. in the same period as did β-convergence. Much like β-convergence, σ-convergence was primarily observed at the country level while being weaker at the regional one. In addition, the findings suggest that from 2000 to 2008, σ-convergence took place only in the EU12 countries at the country level.

Regarding the Baltic States, β-convergence at NUTS 3 regional level among them was observed only in 2005–2008. In 1995–1999 and 2000–2004, in turn, β-divergence was recorded. Insignificant σ-convergence among the regions of the Baltic States was observed only in 2005–2008, whereas for the rest of the period σ-divergence was reported. In addition, the convergence process took place due to converging among the regions of Latvia.

Summing up the findings about β-convergence and σ-convergence, it can be concluded that convergence among the EU Member States was possible due to higher-income regions of these countries becoming ever richer, which was particularly characteristic of the EU12 countries, and, in addition, was faster in lower-income countries. This apparently means that within a country, disparities between richer and poorer regions increased over time (similar to the developments in the Baltic States). Therefore, it can be concluded that the European regional policy which aims to remove income level disparities across regions, was not effective in the reviewed period.

The conducted cluster analysis suggests that over time Europe became more homogeneous: in 2010, there were two clusters in Europe, the largest of which comprised also Latvia. Consequently in 2010, Latvia's economic structure was similar to that of most European countries. It was a result of structural adjustments in the economy after the period of overheating and during the global financial crisis, because in 2005, 2000 and 1995 Latvia's economic structure had been more similar to that of the Eastern bloc countries. The cluster analysis and its findings suggest that in terms of the country economic structure Europe was more homogenous in 2010 than in 2005, 2000 or 1995. It was so due to the economic structure of East European countries approaching closer to that of Western Europe in the last decade, which, in turn, proves that not only real convergence but also structural convergence took place in the EU12 countries. However, if the focus is on disparities of inter-state economic structures, homogeneity among European countries was less pronounced. The breakdown of countries in smaller but more specific clusters produces a picture of relatively higher fragmentation in Europe in 2010. Thus, Latvia entered into one cluster with the countries (Greece, Portugal and Spain), which had suffered most from the negative effects of the global financial crisis (excluding Iceland and Ireland experiencing severe banking sector problems). Moreover, this cluster had been in a step-by-step making since 2000. Also, some clusters were forming around those major economies, which have more successfully

coped with the aftermath of the crisis, e.g. Poland and Germany. Judging more generally, the situation in 2010 overall was not uniform. The estimated σ-convergence and β-convergence demonstrate that real convergence processes decelerated substantially during the financial crisis, while structural convergence points to structural agglomerations of the EU countries around those economies that are successfully coping with the crisis.

APPENDICES

A.1 List of countries used in cluster analysis

No.	Code	Name
1	BE	Belgium
2	BG	Bulgaria
3	CZ	Czech Republic
4	DK	Denmark
5	DE	Germany
6	EE	Estonia
7	IE	Ireland
8	GR	Greece
9	ES	Spain
10	FR	France
11	IT	Italy
12	CY	Cyprus
13	LV	Latvia
14	LT	Lithuania
15	LU	Luxembourg (Grand-Duché)
16	HU	Hungary
17	MT	Malta
18	NL	Netherlands
19	AT	Austria
20	PL	Poland
21	PT	Portugal
22	RO	Romania
23	SI	Slovenia
24	SK	Slovakia
25	FI	Finland
26	SE	Sweden
27	UK	United Kingdom
28	IS	Iceland
29	NO	Norway
30	CH	Switzerland
31	MK	Former Yugoslav Republic of Macedonia, the
32	TR	Turkey

A.2 Branches characterising economic structure of countries
(six-branch breakdown)

Code	Name (short name)
A + B	Agriculture, hunting and forestry; fishing (agriculture)
C + D + E	Mining and quarrying; manufacturing; electricity, gas and water supply (industry)
F	Construction
G + H + I	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods; hotels and restaurants; transport, storage and communication (trade, tourism and transport)
J + K	Financial intermediation; real estate, renting and business activities (financial intermediation and real estate)
L + M + N + O	Public administration and defence; compulsory social security; education; health and social work; other community, social and personal service activities (public services)

A.3 Branches characterising economic structure of countries
(15-branch breakdown)

Code	Name (short name)
A	Agriculture, hunting and forestry (agriculture)
B	Fishing
C	Mining and quarrying (mining)
D	Manufacturing
E	Electricity, gas and water supply (energy)
F	Construction
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods (trade)
H	Hotels and restaurants (tourism)
I	Transport, storage and communication (transport and communication)
J	Financial intermediation
K	Real estate, renting and business activities (real estate and other business activities)
L	Public administration and defence; compulsory social security (public administration)
M	Education
N	Health and social work
O	Other community, social and personal service activities (social services)

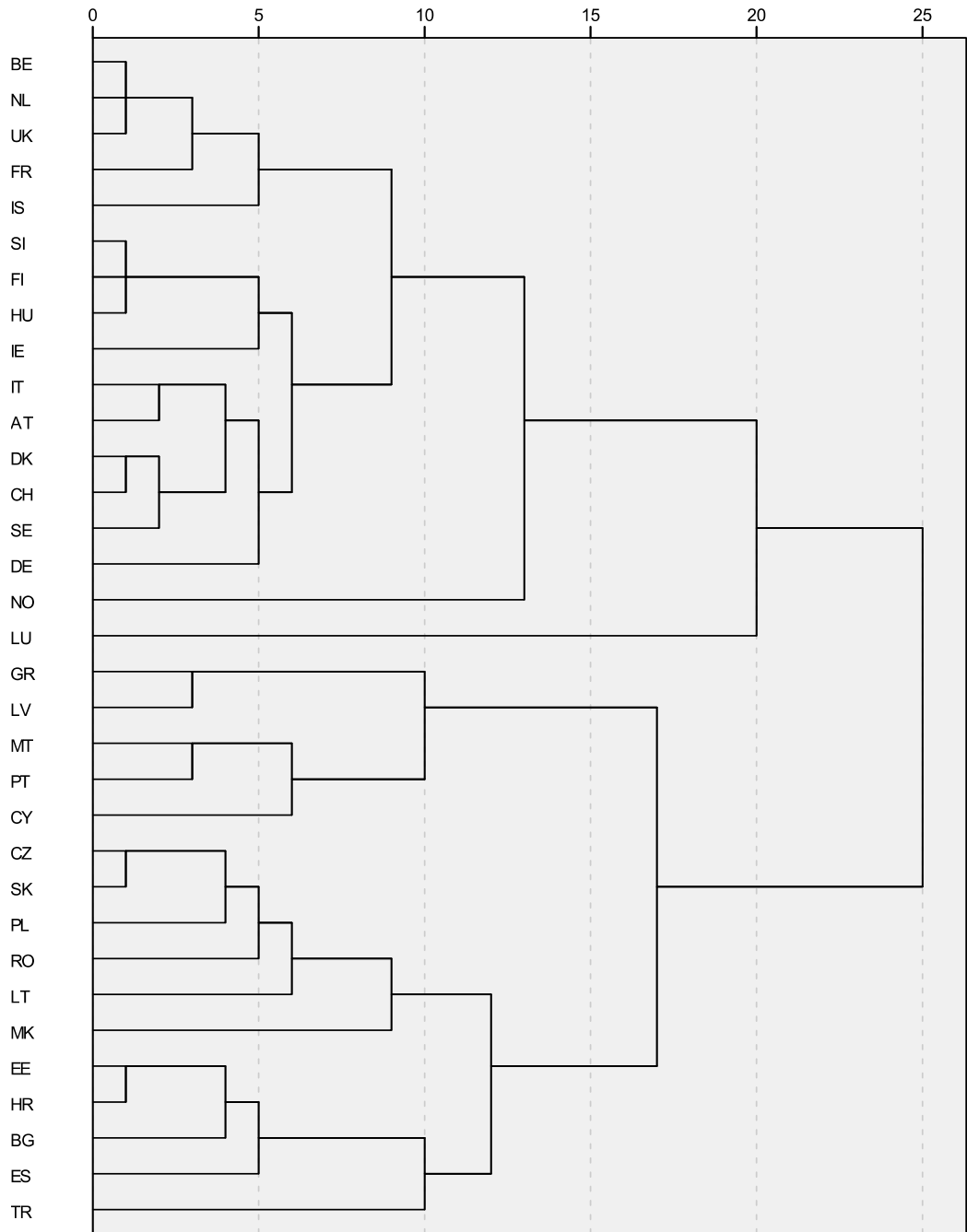**A.4 Dendrogram**
(cluster analysis; 1995)
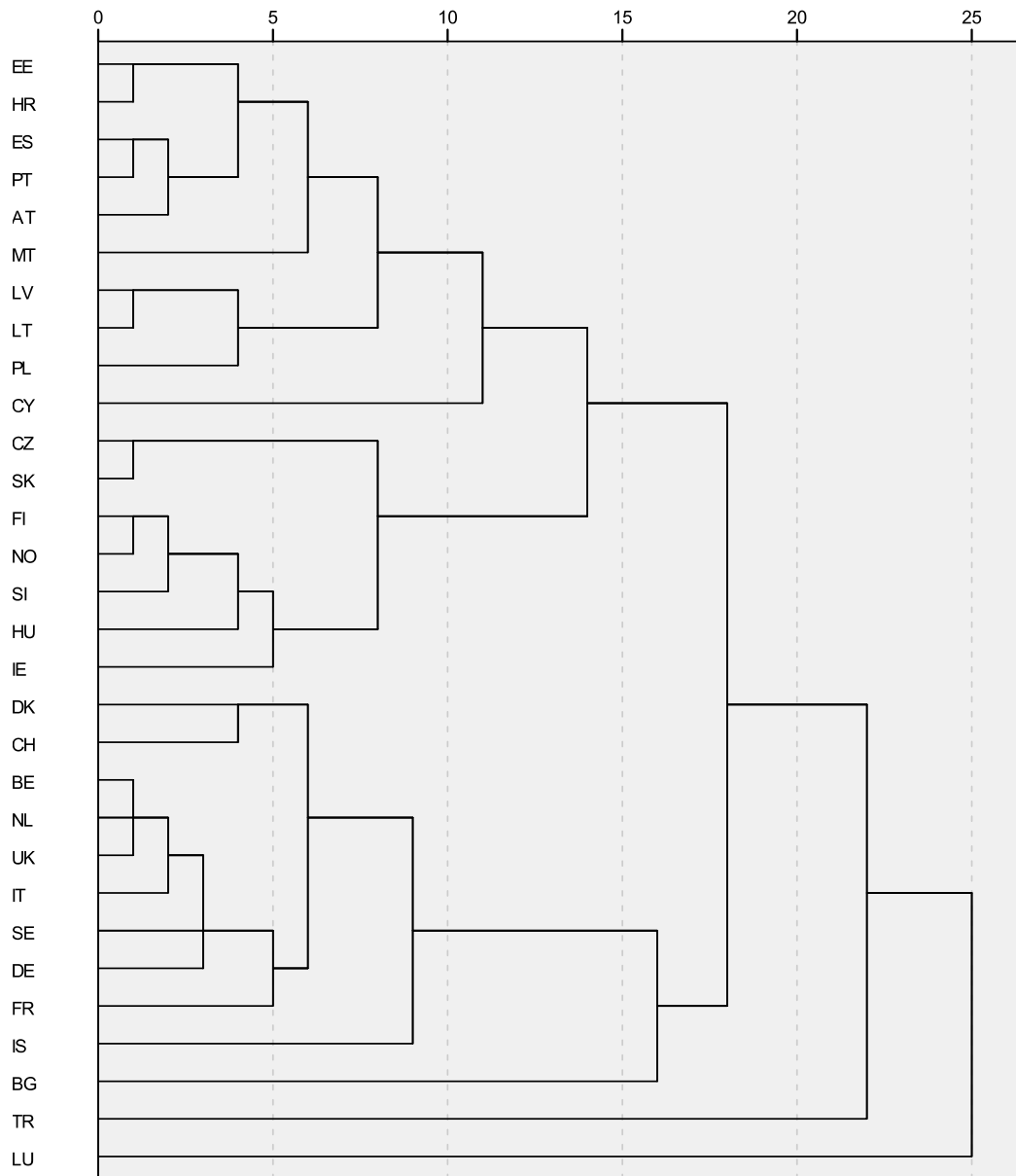
Sources: Eurostat and authors' calculations.
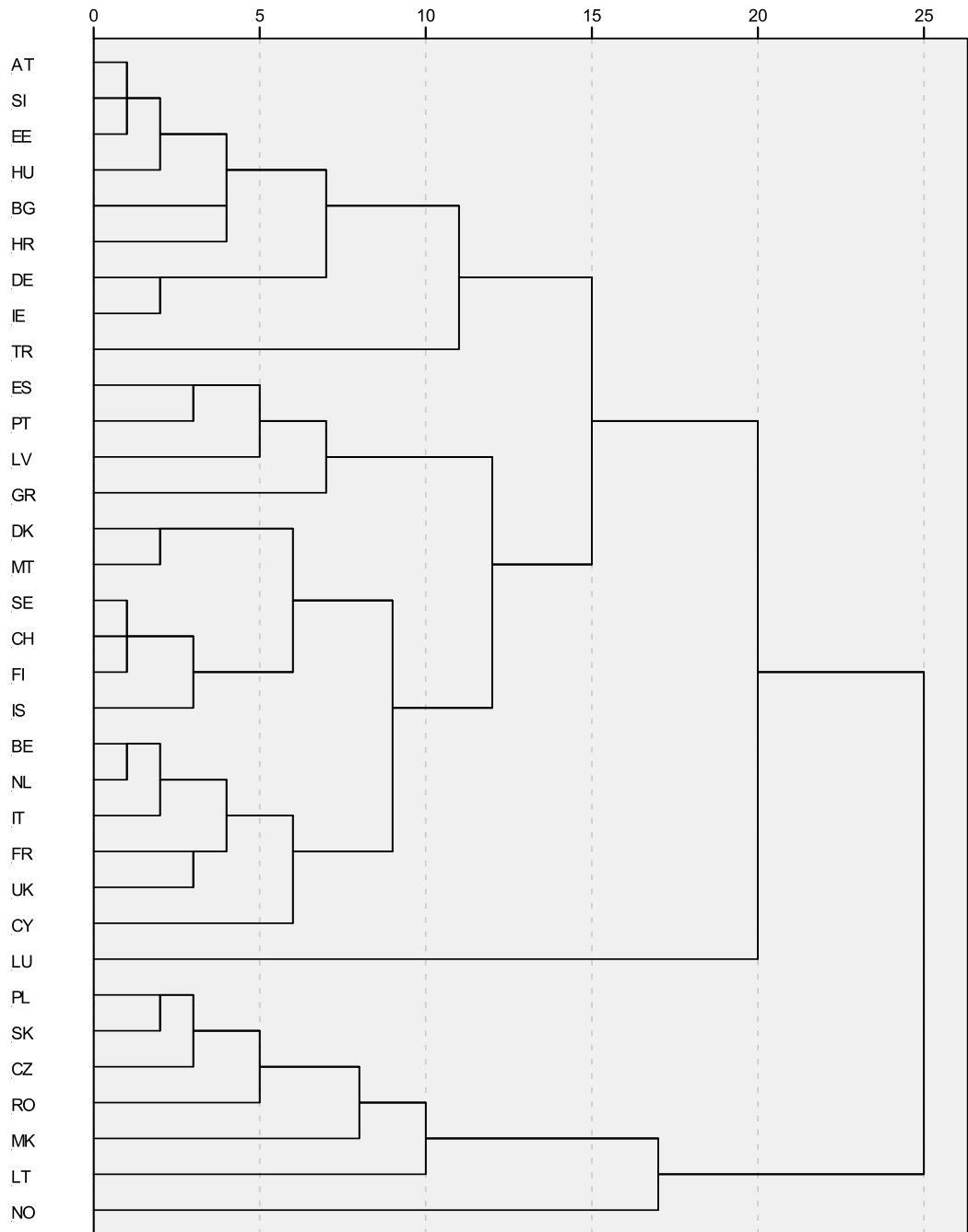
A.5 Dendrogram
(cluster analysis; 2000)
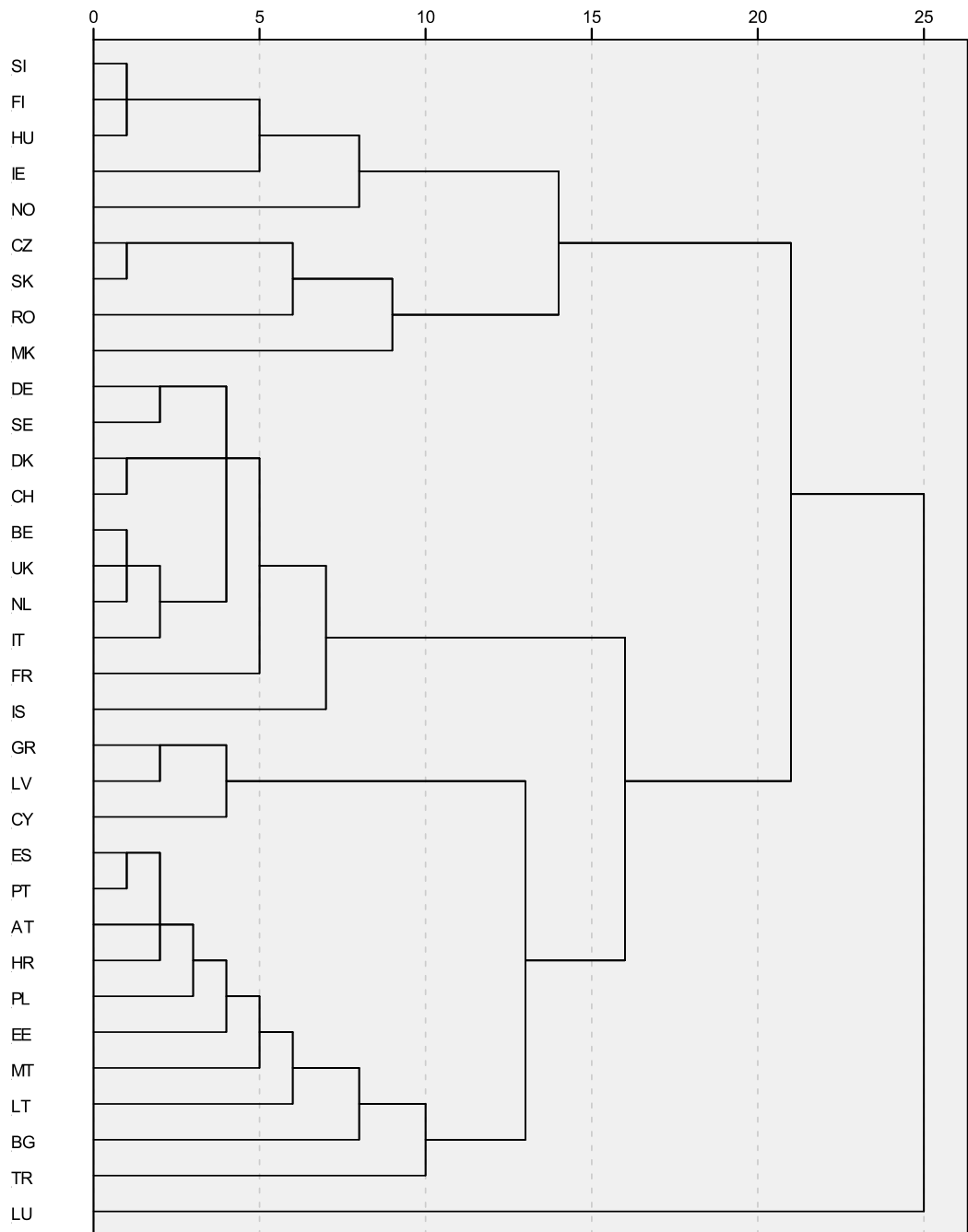
Sources: Eurostat and authors' calculations.
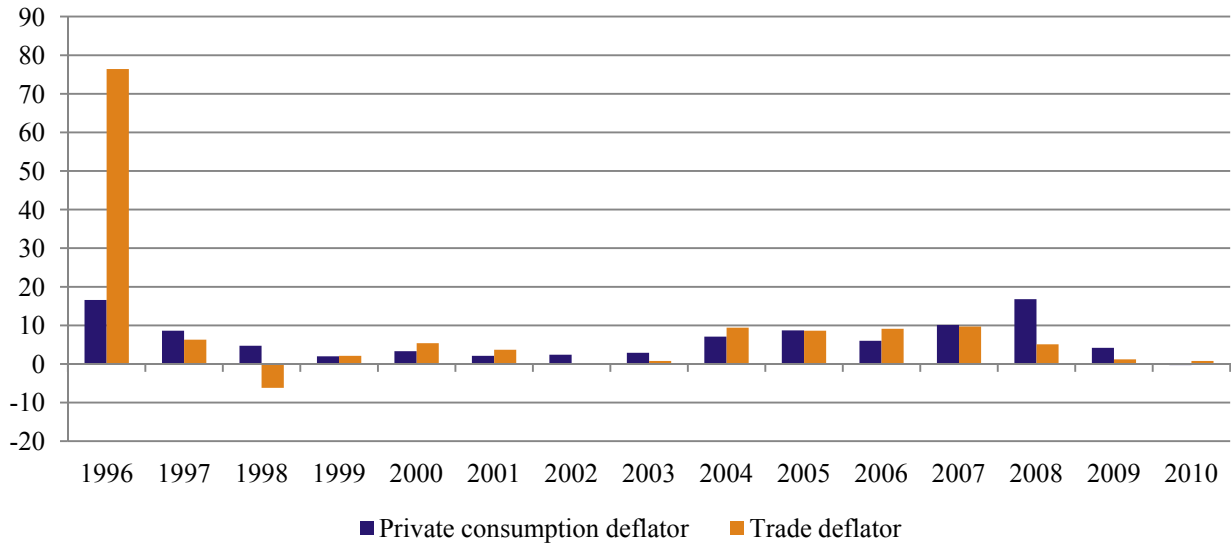
A.6 Dendrogram
(cluster analysis; 2005)

Sources: Eurostat and authors' calculations.

A.7 Dendrogram
(cluster analysis; 2010)

Sources: Eurostat and authors' calculations.

A.8 Latvia's trade and private consumption deflator dynamics
(1996–2010; year-on-year; %)

Source: CSB.

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