# Productivity determinants and their contributions to productivity growth in the Baltic countries before and after their entry into the European Union: a comparative industrial perspective

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**Abstract**

*The article aims to apply the EU KLEMS methodology to obtain labour productivity growth determinants for the Baltic countries for two periods of time: before and after their entry into the European Union. The study's novelty lies in its detection of new statistical data that are unavailable in official databases for the Baltic countries. First, the countries' economic structures are examined during the two periods. Following the derivation of new statistical data, data were prepared according to strict methodological rules and the growth accounting method was applied to detect productivity growth determinants and the main industries that stimulate aggregated labour productivity growth. Subsequently, a comparative economic analysis is conducted for the Baltic countries. Productivity determinants are scrutinised for the aggregated market economy and the specific industries that contribute most to aggregated labour productivity growth. Some consistent patterns are detected for certain groups of tangible and intangible capital.*

*Keywords***:** productivity determinants, productivity growth, intangible capital, tangible capital, growth accounting

## Introduction

Numerous scientists have presented research results derived through the growth accounting method (Jorgenson, 1987; Mas *et al.*, 1998; Corrado *et al.*, 2005; Inklaar and Timmer, 2008), as it is considered to be the best method to derive productivity growth determinants (Lankauskiene, 2015; Lankauskiene, 2014). This method facilitates the detection of particular productivity growth determinants at the aggregated or industrial level. However, it has yet to be applied to the Baltic

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countries because these countries have no cultivation of research ability in this particular area. Furthermore, the importance of intangible capital to economic growth has been demonstrated in previous research (Haskel, 2008; Mas *et al.*, 2017; Corrado *et al.*, 2016; 2017), reports (e.g. World Intellectual Property Report 2017) and forecasts (e. g. European Economic Forecast 2016[1]). Hence, the incorporation of new intangibles to traditional growth accounting is of vital importance for the Baltic countries.

Given that the Baltic states currently lack results from the growth accounting method, share very similar economic structures and face congruent economic obstacles (Latvian Competitiveness Report, 2011; Kajaks, 2013; Smidova, 2015; Westmore, 2016; Benkovskis *et al.*, 2017; Koutsogeorgopoulou and Guzzardi, 2018; Lithuanian Bank, 2019), it is important to conduct a comprehensive economic analysis of their detailed labour productivity growth determinants. To this end, it is first necessary to derive new statistical information as required for the growth accounting method; data that cannot be found in official databases for the Baltic countries. Next, it is essential to apply the EU KLEMS methodology and growth accounting method and hence derive comparable results. Finally, it is important to conduct a comparative economic analysis of certain capital groups, focusing on two periods of time: before and after the countries' entry to the European Union (EU).

There are ongoing discussions on structural changes, multi-factor productivity, participation in global value chains, convergence aspects in the members of the European Union; consequently, the researched topic ideally contributes to the scope of the Eastern Journal of European Studies (Kirankabes and Erkul, 2019; Durkalic and Mihailo, 2019; Siljak and Nagy, 2018; Orosz, 2018; Mihaylova and Bratoeva-Manoleva, 2018; Kersan-Skabic, 2017).

## 1. Overview of the Baltic economies

The Baltic economies are similar in terms of their historical, geographical and economic structure, growth and development (Organisation for Economic Co-operation and Development, OECD, Economic Survey 2017; 2018; 2019). Indeed, from the end of the Second World War, they were part of the Soviet Union, before creating the Baltic Way of Freedom on 23 August 1989, a peaceful political demonstration that involved a chain of people connecting the three Baltic capitals of Tallinn, Riga and Vilnius. Approximately two million people joined their hands across the three states, which were republics of the Soviet Union at that time. Later, Lithuania gained its independence on 11 March 1990, Estonia on 20 August 1991, and Latvia on 6 September 1991. They all also entered the EU on the same date: 1 May 2004.

[1] European Economic Forecast (2016), Institutional paper.

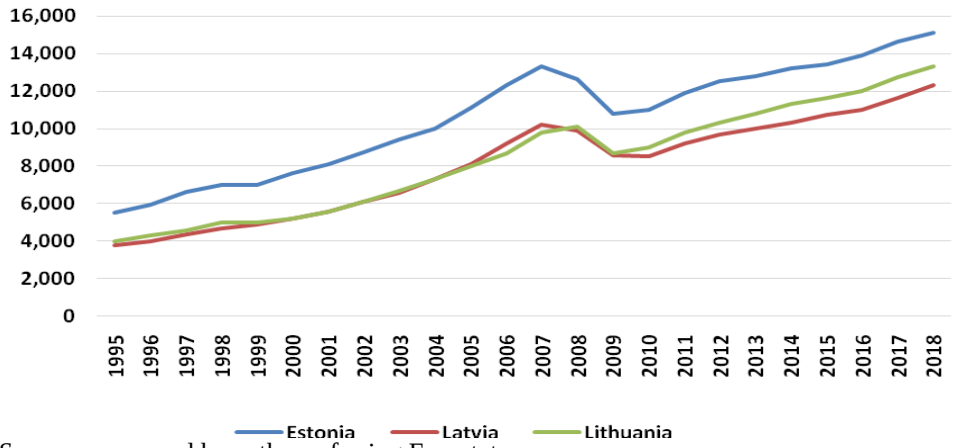
**Table 1. Gross domestic product per capita at market prices in euros**

| | GDP per capita, current prices | | | Annual average real growth rates% | |
|---|---|---|---|---|---|
| **Year** | 1995 | 2004 | 2018 | 1995-2004 | 2004-2018 |
| **Estonia** | 2,000 | 7,100 | 19,500 | 6.6 | 2.9 |
| **Latvia** | 1,700 | 5,200 | 15,300 | 7.3 | 3.7 |
| **Lithuania** | 1,400 | 5,400 | 16,100 | 6.7 | 4.3 |

*Source*: composed by author referring Eurostat data

Table 1 presents the gross domestic product (GDP) per capita of the Baltic states before and following their entry to the EU. In 1995, the greatest GDP per capita was held by Estonia, followed by Latvia and Lithuania. After joining the EU in 2004, and still by 2018, the top position was held by Estonia, the second position by Lithuania and the third one by Latvia. However, their real annual average GDP growth rates were all approximately twice as high in the period before entering the EU as afterwards.

**Figure 1. Gross domestic product per capital at market prices in euros, chain-linked volumes (2010), 1995-2018**




*Source*: composed by author referring Eurostat

Figure 1 provides the real GDP per capita for the three researched economies during the period 1995-2018. It may be acknowledged from the table that, in terms of GDP, the first position was held by Estonia. After 2009, Latvia lagged behind Lithuania, which remained on the second position.

From Table 2, it can be seen that the Baltic economies presented very similar economic structures in 2015 (Skribane and Jekabsone, 2013, 2014; Dudzeviciute *et al*., 2014). The highest shares in value added were held by the following industries

in 2015: manufacturing (C); wholesale and retail trade, repair of motor vehicles and motorcycles (G); transportation and storage (H); and professional, scientific, technical, administrative and support service activities (M-N).

**Table 2. Structure of nominal value-added growth rates, 1995–2015**

| | Estonia | | | Latvia | | | Lithuania | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1995 | 2015 | Gr rate%* | 1995 | 2015 | Gr rate%* | 1995 | 2015 | Gr rate%* |
| **Total*** | 100 | 100 | 4.6 | 100 | 100 | 4.4 | 100 | 100 | 4.6 |
| **A** | 8 | 4 | 4.7 | 12 | 5 | 2.1 | 13 | 5 | 0.9 |
| **B** | 3 | 2 | 3.7 | 0 | 1 | 10.5 | 0 | 0 | 3.1 |
| **C** | 26 | 21 | 5.4 | 26 | 17 | 2.9 | 25 | 23 | 6.0 |
| **D, E** | 5 | 5 | 1.1 | 7 | 5 | 0.2 | 7 | 4 | 0.8 |
| **F** | 9 | 9 | 4.1 | 6 | 9 | 4.9 | 9 | 9 | 4.7 |
| **G** | 17 | 16 | 4.1 | 12 | 20 | 6.4 | 20 | 23 | 5.4 |
| **H** | 11 | 10 | 2.5 | 18 | 13 | 3.8 | 10 | 14 | 4.2 |
| **I** | 2 | 2 | 4.5 | 1 | 3 | 5.8 | 2 | 2 | 2.9 |
| **J** | 6 | 8 | 7.0 | 4 | 7 | 5.6 | 4 | 6 | 4.5 |
| **K** | 4 | 5 | 7.6 | 5 | 7 | 8.1 | 3 | 3 | 3.6 |
| **M,N** | 6 | 13 | 5.8 | 6 | 10 | 5.2 | 3 | 10 | 7.6 |
| **R, S** | 3 | 4 | 2.0 | 3 | 4 | 3.7 | 3 | 2 | 2.8 |

* Real annual average growth rates 1995-2015

*Total (Market economy) , A - Agriculture, forestry and fishing, B - Mining and quarrying, C - Manufacturing, D-E - Electricity, gas and water supply, F - Construction, G - Wholesale and retail trade, repair of motor vehicles, H - Transportation and storage , I - Accommodation and food service activities, J - Information and communication, K - Financial and insurance activities, M-N - Professional, scientific, technical, administrative and support service activities, R-S - Arts, entertainment, recreation, and other service activities

*Source*: composed by author referring EU KLEMS data[2]

In relation to the industrial annual average real value-added growth rates, the highest figures were in the information and communication industry (J), financial and insurance activities (K), and professional, scientific, technical, administrative and support service activities (M-N). Furthermore, high industrial real value-added growth rates were seen in wholesale and retail trade, repair of motor vehicles and motorcycles (G), manufacturing (C), accommodation and food service activities (I), construction (F), and transportation and storage (H). In Latvia, mining and quarrying (B) was also especially significant.

[2] Data retrieved from EU KLEMS database (retrieved from http://www.euklems.net).

## 2. Methodology and practical implementation

The results derived from the application of the growth accounting method provide numerous research benefits (Lankauskiene, 2014, 2015, 2016). With roots in the work of the famous neoclassical economist Robert Solow (1956), Jorgenson, Gollop and Fraumeni (1987) published their seminal study outlining the growth accounting approach based on the KLEMS methodology.

EU KLEMS methodology uses the growth accounting method, where measures of value added growth can be decomposed into contributions of inputs and productivity within a consistent framework (Timmer *et al.*, 2010). It allows for an assessment of the relative importance of labour, capital, and measures of multi-factor productivity (MFP) growth to be derived. MFP growth is measured as the difference between the volume growth of outputs and the volume growth of inputs. As such, it captures increases in the amount of value added that can be created by a given quantity of inputs. To put it in another way, it captures the reduction in input costs to create a given amount of value added. Under strict neo-classical assumptions MFP growth measures disembodied technological changes (Timmer *et al*., 2007; Inklaar and Timmer, 2008).

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

$$V_j = g_j(K_j, L_j, T), \quad (1)$$

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

$$P^V{}_j V_j = P^K{}_j K_j + P^L{}_j L_j, \quad (2)$$

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

$$\Delta ln\, V_{jt} = w^K{}_{jt} \Delta ln\, K_{jt} + w^L{}_{jt} \Delta lnL_{jt} + \Delta lnA^V{}_{jt}, \quad (3)$$

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

$$w^L{}_{jt} = (P^V{}_{jt} V_{jt})^{-1} P^L{}_{jt} L_{jt}; \quad w^K{}_{jt} = (P^V{}_{jt} V_{jt})^{-1} P^K{}_{jt} K_{jt}. \quad (4)$$

Accordingly, capital and labour accounts must be prepared, followed by productivity accounts (Timmer *et al*., 2010).

Hereinafter the traditional growth accounting method and EU KLEMS methodology is expanded via the incorporation of the new intangibles (Corrado *et al*., 2005, 2006, 2009).
Relevant information on practical implementation is provided in Tables 3, 4, 5, 6.

**Table 3. Research implementation details**

| |
|---|
| Country coverage: Estonia, Latvia, Lithuania |
| *Research period: 1995-2015 |
| Method: Growth accounting |
| Methodology: EU KLEMS supplemented by new intangibles |
| Data: Capital, Labour, Capital and labour compensation, Value added |
| Capital data: different types of capital assets (in more detail in Table 5) |
| Labour data: labour composition according to the educational attainment |
| Databases: EU KLEMS, INTAN Invest, National statistics departments, WIOD, Eurostat, for labour data - EU KLEMS and WIOD |

* The research period refers to the latest period available in the statistical databases.
*Source*: own calculations

**Table 4. Industrial aggregation**

| **Industrial aggregation** |
|---|
| Total (Market economy) |
| A - Agriculture, forestry and fishing |
| B - Mining and quarrying |
| C - Manufacturing |
| D-E - Electricity, gas and water supply |
| F - Construction |
| G - Wholesale and retail trade, repair of motor vehicles |
| H - Transportation and storage |
| I - Accommodation and food service activities |
| J - Information and communication |
| K - Financial and insurance activities |
| M-N - Professional, scientific, technical, administrative and support service activities |
| R-S - Arts, entertainment, recreation and other service activities |

*Source*: own calculations

**Table 5. Capital data**

| | |
|---|---|
| EU KLEMS data | IT - Computing equipment<br>CT - Communications equipment<br>SoftwDB - Computer software and databases<br>TR - Transport equipment<br>OtherMash - Other machinery and equipment<br>NonResid - Non-residential equipment<br>Resid - Residential structures<br>Cult - Cultivated assets<br>RD - Research and development |
| INTAN Invest data - here referred as New Intangibles | Minart - Entertainment artistic and literary originals + mineral explorations<br>Design - Design<br>Brand - Brand<br>OrgCap - Organisational capital<br>Train - Training<br>NPD - New product development in the financial sector |

*Source*: own calculations

**Table 6. Details on research novelty and author's contribution**

| **Countries** | **Data availability in EU KLEMS database** | **Data availability in INTAN Invest database** | **Research contribution** |
|---|---|---|---|
| **Baltic countries** | Only for some indicators; major gaps | NO | New statistical EU KLEMS and INTAN Invest data created;<br>To the traditional EU KLEMS methodology (INTAN invest intangibles have been included). |

*Source*: own calculations

Newly derived data had to be prepared under strict methodological rules before the growth accounting method was applied (Timmer, 2007; Jäger, 2018):

1. Capital input files, in order to obtain capital volumes;
2. Labour input files, in order to derive labour services;
3. Productivity accounts.

## 2.1. Capital data: Baltic countries

### Contribution to EU KLEMS database

The first initial available indicators were taken from the EU KLEMS database (Table 7), and in the cases where the data were not available, they were supplemented with data from National Statistics departments or Eurostat databases. Once the real values of GFCF were obtained for each type of asset, the Harberger method (1978) was used to derive the initial 1995 capital stocks. Subsequently, by using the perpetual inventory method (PIM) (OECD 2009), the indicators were constructed for the entire period (1995–2015) researched.

**Table 7. Contribution to EU KLEMS database**

| Countries | **Available indicators in EU KLEMS database, 2017 release** | **Non-available indicators in EU KLEMS database, 2017 release** |
|---|---|---|
| Estonia | SoftwDB, TR, OtherMash, NResid, Resid, RD, Minart, Cult | IT, CT |
| Latvia | IT, CT, SoftwDB, TR, OtherMash, NResid, Resid, Cult | Minart, RD |
| Lithuania | IT, CT, TR, OtherMash, NResid, Resid, Cult | SoftwDB, RD, Minart |

*Source*: own calculations

Lithuania lacked indicators for the 2000–2015 period, hence the backwards PIM was used to derive values from 1995 to 2000.

### Contribution to INTAN Invest database[3]

The new intangibles (Table 8) are not provided in the INTAN invest database for the Baltic countries. Consequently, new estimates were prepared by using the methodology described by Corrado *et al*., (2012) and Mas and Quesada (2014). The same sequence was applied for all Baltic countries.

**Table 8. Contribution to INTAN Invest database**

| **Countries** | **Data availability for new intangibles in INTAN Invest database** |
|---|---|
| Estonia | No |
| Latvia | No |
| Lithuania | No |

*Source*: own calculations

[3] Intan Invest database (data retrieved from http://www.intaninvest.net).

Organisational capital (OrgCap) was composed of two parts: own account and purchased. For the former, the data indicators were taken from the Eurostat database: employment by occupation and economic activity (Nace Rev. 2) OC1 occupation - managers; total employment; annual earnings of managers; total annual earnings. For the data gaps, the interpolation method was used. Next, following Corrado *et al*., (2012), nominal GFCF was obtained. For the purchased component, turnover data from Eurostat for industries M7022 and M70 were used to derive the output of M7022, and then with the assistance of USE tables in the WIOD database[4], the nominal GFCF of purchased component was attained (Corrado *et al*., 2012).

Vocational training (Train). Vocational training data were derived from Eurostat's Continuing Vocational Training Survey (CVTS). The variable was the cost of CVT courses as a percentage of total labour costs (all enterprises) for the years 2000, 2008 and 2012. For the information gaps, the interpolation method or backwards exponential function of the growth rates was used. This percentage was multiplied by the compensation of employees and was assumed to be 100 per cent of spending as GFCF. The values of apprenticeships were either very low or not provided at all, and so these values were not considered significant.

New product development costs in the financial services industry (Nfp). The labour compensation of high-skilled workers in the financial services (K) industry was calculated. To this end, the share in total compensation of high-skilled workers in financial services (K) was multiplied by the total labour compensation in financial services (K), and a 0.08 coefficient for the derivation of nominal investment values was applied.

Design - following the methodological explanations by Corrado *et al.* (2012), turnover data from Eurostat M711 (architectural activities) and M71 (architectural and engineering activities; technical testing and analysis) were derived, followed by the output. The shares were applied for the approximated values of USE tables from WIOD. These calculated shares were considered as nominal GFCF. Brand. This indicator consisted of two variables: advertising and market research. The industries of interest for their derivation comprised M731 (advertising), M732 (market research and public opinion polling) and M73 (advertising and market research). The shares of turnover and output were calculated. The proportions were applied for the intermediate consumption indicators from USE tables in the WIOD database. These shares were deemed nominal GFCF (Corrado *et al.*, 2012; Mas and Quesada, 2014).

The above provided newly derived nominal GFCF intangible asset types, which were converted to real ones by using the price levels for each type of asset. Once the real values of GFCF were obtained for each asset type, the Harberger method was used to derive the initial capital stocks for 1995. Once the initial real capital stocks for each type of capital were derived, they were constructed by using the PIM for the entire period 1995–2015.

[4] WIOD database (data retrieved from http://www.wiod.org/home).

## 2.2 Labour data

Labour data for all countries were taken from EU KLEMS labour input files; where unavailable, they were supplemented from the WIOD database release 2016 Socio Economic accounts. The indicators were hours worked and compensation shares of highly-, medium- and low-skilled workers. Once the complete capital and labour data were derived and constructed, the same calculation steps were performed for all of the countries to attain their productivity accounts.

## 2.3 Productivity accounts

For the productivity accounts, value added and labour compensation were taken from the EU KLEMS database. Given that the traditional growth accounting method had been expanded with the new intangibles, new intangible capital components were added to the traditional growth accounting model. The methodological steps were as follows:

- The nominal GVA was adjusted by adding the gross fixed capital formation (GFCF) nominal values of new intangible capital;
- The capital compensation part was derived through subtracting labour compensation from GVA, adjusted to new intangible capital.

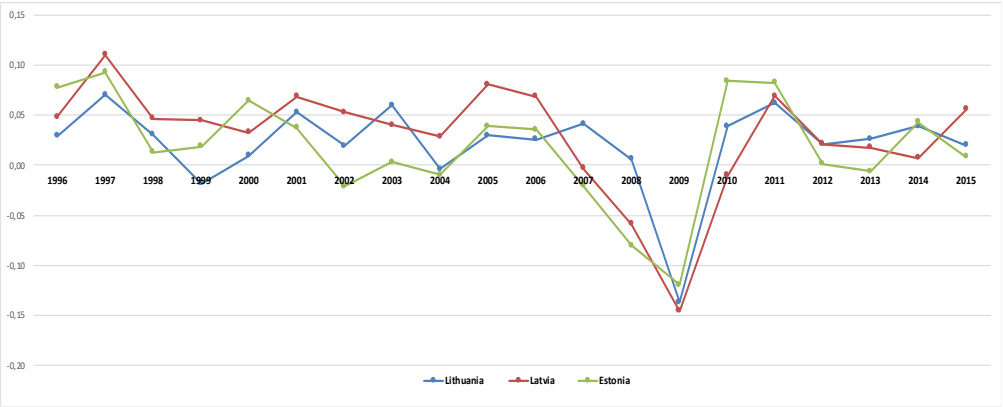
## 3. Results

The results will be presented as follows: at the aggregated level and for the industries that mostly contributed to aggregated labour productivity growth. First, the productivity determinants will be provided for aggregated labour productivity growth, and comparative economic analysis will be conducted. Second, the industries that contributed most to aggregated labour productivity growth will be distinguished. Third, the growth determinants will be presented for the industries that contributed most to aggregated labour productivity growth, and comparative economic analysis will be undertaken.

## 3.1. Aggregated level

Figure 2 demonstrates how before entering the EU in 2004, Latvia had led in terms of labour productivity growth. It retained its leading position following this historic moment, although its labour productivity declined during the financial crisis. Subsequently, no clear country leader could be distinguished in terms of labour productivity growth.

**Figure 2. Aggregated labour productivity growth rates in Lithuania, Latvia, Estonia, percentage points, 1995-2015**




*Source*: own representation

**Table 9. Contributors to annual average aggregated labour productivity growth (productivity total), percentage points**

| | | | Estonia 1995-2015 | Latvia 1995-2015 | Lithuania 1995-2015 | Estonia 1995-2004 | Latvia 1995-2004 | Lithuania 1995-2004 | Estonia 2004-2015 | Latvia 2004-2015 | Lithuania 2004-2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **AB = A + B** | AB | Productivity total | 4.96 | 4.95 | 4.81 | 7.72 | 7.63 | 5.76 | 2.70 | 2.75 | 4.04 |
| **A = f + g + h** | A | Productivity sectorial | 4.64 | 3.99 | 4.41 | 7.54 | 6.73 | 5.55 | 2.27 | 1.75 | 3.47 |
| | B | Reallocation effect | 0.32 | 0.96 | 0.41 | 0.19 | 0.90 | 0.21 | 0.43 | 1.00 | 0.57 |
| | f | Contribution labour composition | 0.19 | -0.14 | -0.13 | 0.58 | 0.16 | -0.06 | -0.13 | -0.39 | -0.18 |
| | g | Capital contribution | 2.74 | 1.28 | 2.44 | 3.90 | 1.35 | 2.86 | 1.80 | 1.23 | 2.09 |
| | h | MFP | 1.70 | 2.85 | 2.10 | 3.06 | 5.22 | 2.76 | 0.60 | 0.91 | 1.56 |

*Source*: own calculations

Table 9 presents detailed contributors to average aggregated labour productivity growth. In terms of average annual labour productivity growth in the 1995-2015 period, the leading position was held by Estonia (4.96%), followed by

Latvia (4.95%) and Lithuania (4.81%). Before entering the EU (1995-2004), the greatest labour productivity growth was in Estonia (7.72%), followed by Latvia (7.63%) and Lithuania (5.76%). Afterwards (2004-2015), the highest average annual labour productivity growth was in Lithuania (4.04%), followed by Latvia (2.75%) and Estonia (2.70%). The reallocation effect contributed positively to total productivity during all periods for all countries, and was especially high in Latvia. Before entering the EU, the contribution of labour composition to annual average labour productivity growth was highest in Estonia (0.58%) and lowest in Lithuania (-0.06%). After entering the EU, it decreased and became negative in all countries, being lowest in Latvia (-0.39%), followed by Lithuania (-0.18%) and Estonia (-0.13%).

Given that the particular focus of this research is capital and different capital groups' contributions to LP growth, the average annual labour productivity growth results will be presented hereinafter. Before entering the EU, capital contributions to annual average labour productivity growth were highest in Estonia (3.90%) (see Table 10), followed by Lithuania (2.86%) and Latvia (1.35%). Thereafter, the highest position was held by Lithuania (2.09%), followed by Estonia (1.80%) and Latvia (1.23%).

**Table 10. Capital contributions in detail, 1995-2015**

| | | **Capital contribution = 1+2+3+4+5+6+7+8+9+10+11+12+13+14+15** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Estonia 1995-2015** | **Latvia 1995-2015** | **Lithuania 1995-2015** | **Estonia 1995-2004** | **Latvia 1995-2004** | **Lithuania 1995-2004** | **Estonia 2004-2015** | **Latvia 2004-2015** | **Lithuania 2004-2015** |
| | Capital contribution | 2.74 | 1.28 | 2.44 | 3.90 | 1.35 | 2.86 | 1.80 | 1.23 | 2.09 |
| 1 | IT | 0.15 | 0.06 | 0.22 | 0.27 | 0.12 | 0.40 | 0.05 | 0.00 | 0.06 |
| 2 | CT | 0.20 | 0.02 | 0.15 | 0.27 | 0.10 | 0.18 | 0.15 | -0.04 | 0.13 |
| 3 | TR | 0.60 | 0.20 | 0.37 | 0.98 | 0.47 | 0.34 | 0.28 | -0.03 | 0.40 |
| 4 | OtherMash | 0.99 | 0.58 | 0.75 | 1.10 | 0.41 | 1.12 | 0.90 | 0.72 | 0.45 |
| 5 | NonResid | 0.41 | 0.07 | 0.47 | 0.54 | -0.11 | 0.29 | 0.29 | 0.22 | 0.63 |
| 6 | Resid | -0.09 | 0.05 | 0.00 | 0.08 | 0.01 | 0.00 | -0.23 | 0.08 | 0.00 |
| 7 | Cult | 0.01 | 0.01 | -0.02 | 0.00 | 0.01 | -0.02 | 0.01 | 0.01 | -0.02 |
| 8 | SoftwDB | 0.08 | 0.07 | 0.15 | 0.10 | 0.05 | 0.14 | 0.07 | 0.09 | 0.16 |
| 9 | Minart | -0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.02 | -0.01 | 0.00 | 0.00 |
| 10 | Design | 0.09 | 0.04 | 0.07 | 0.15 | 0.02 | 0.07 | 0.04 | 0.05 | 0.07 |
| 11 | Nfp | 0.02 | 0.04 | 0.00 | 0.02 | 0.02 | 0.00 | 0.02 | 0.05 | 0.00 |
| 12 | RD | 0.08 | 0.00 | 0.03 | 0.04 | 0.04 | 0.02 | 0.12 | -0.04 | 0.04 |
| 13 | Brand | 0.07 | 0.09 | 0.09 | 0.14 | 0.14 | 0.16 | 0.01 | 0.05 | 0.03 |
| 14 | OrgCap | 0.10 | 0.05 | 0.10 | 0.14 | 0.06 | 0.11 | 0.07 | 0.04 | 0.10 |
| 15 | Train | 0.04 | 0.03 | 0.03 | 0.06 | 0.03 | 0.03 | 0.02 | 0.02 | 0.03 |

*Source*: own calculations

In Table 11, capital contributions according to their shares of tangible and intangible capital are presented. In the 1995-2015 period, intangible capital was greatest in Latvia (24%), followed by Lithuania (20%) and lastly Estonia (18%).

Before entering the EU, the share of intangible capital was highest in Latvia (27%), followed by Lithuania (19%) and Estonia (17%). After entering the EU, the share of intangible capital decreased significantly (6%) in Latvia, but increased in Estonia and Lithuania. The shares are as follows: Latvia and Lithuania (21%); Estonia (19%).

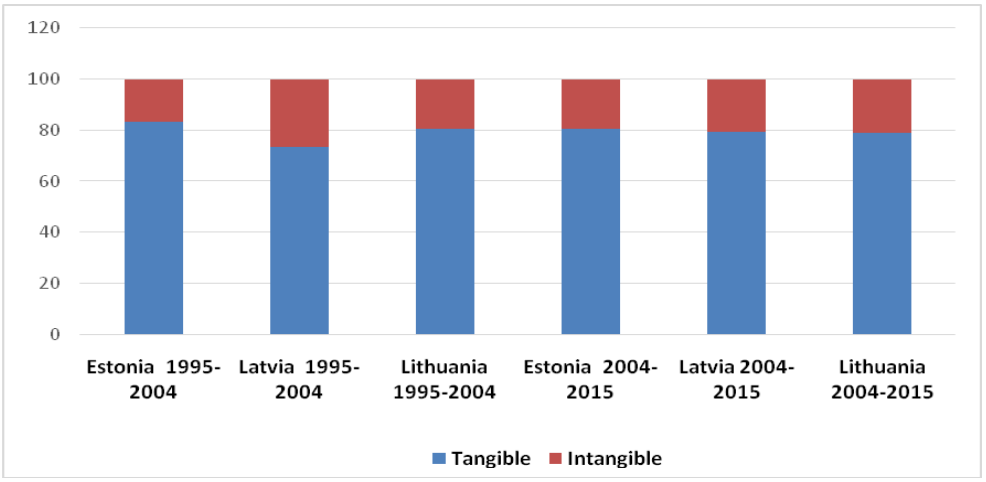
**Table 11. Contributions of tangible and intangible capital to aggregated annual average labour productivity growth 1995-2015**

| | | *** = (Refer to Table 12) 1+2+3+4+5+6+7** | **** = (Refer to Table 12) 8+9+10+11+12+13+14+15** | |
|---|---|---|---|---|
| | **Capital contribution** | **Share of tangible capital*** | **Share of intangible capital**** | *** + ** = 100 %** |
| Estonia 1995-2015 | 2.74 | 2.26 (82%) | 0.49 (18%) | 100% |
| Latvia 1995-2015 | 1.28 | 0.98 (76%) | 0.30 (24%) | 100% |
| Lithuania 1995-2015 | 2.44 | 1.94 (80%) | 0.49 (20%) | 100% |
| Estonia 1995-2004 | 3.90 | 3.24 (83%) | 0.65 (17%) | 100% |
| Latvia 1995-2004 | 1.35 | 0.99 (73%) | 0.36 (27%) | 100% |
| Lithuania 1995-2004 | 2.86 | 2.30 (81%) | 0.55 (19%) | 100% |
| Estonia 2004-2015 | 1.80 | 1.45 (81%) | 0.35 (19%) | 100% |
| Latvia 2004-2015 | 1.23 | 0.97 (79%) | 0.25 (21%) | 100% |
| Lithuania 2004-2015 | 2.09 | 1.65 (79%) | 0.44 (21%) | 100% |

*Source*: own calculations

Figure 3 demonstrates how the share of intangible capital was significantly higher in Latvia before entering the EU, diminishing significantly thereafter. Moreover, following this time, the shares of intangible capital became similar for all Baltic states at the aggregated level.

**Figure 3. Shares of tangible and intangible capital in aggregated annual average labour productivity growth, percentage points**




*Source: own representation*

**Table 12. Contributions of capital groups to aggregated annual average labour productivity growth, 1995-2015**

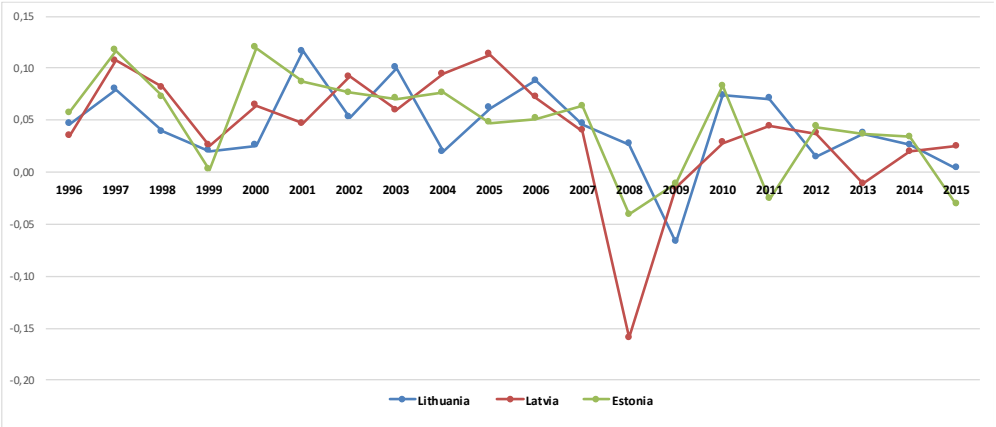
| | | Estonia 1995-2015 | Latvia 1995-2015 | Lithuania 1995-2015 | Estonia 1995-2004 | Latvia 1995-2004 | Lithuania 1995-2004 | Estonia 2004-2015 | Latvia 2004-2015 | Lithuania 2004-2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| SUM from I to VII = 100 % | Capital contribution | **2.74** | **1.28** | **2.44** | **3.90** | **1.35** | **2.86** | **1.80** | **1.23** | **2.09** |
| I = 1+2* | IT&CT | 13 | 6 | 15 | 14 | 16 | 20 | 11 | -3 | 9 |
| II = 3+4* | Machinery-based | 58 | 61 | 46 | 53 | 65 | 51 | 65 | 57 | 40 |
| III = 5+6* | Buildings | 12 | 9 | 19 | 16 | -8 | 10 | 4 | 25 | 30 |
| IV = 8* | SoftwDB | 3 | 5 | 6 | 3 | 4 | 5 | 4 | 7 | 8 |
| V = 9+10+11+12* | Innovative property | 7 | 6 | 5 | 5 | 7 | 4 | 9 | 5 | 5 |
| VI = 13+14+15* | Economic competencies | 8 | 12 | 9 | 9 | 16 | 10 | 6 | 9 | 8 |
| VII = 7* | Cultivated assets | 0 | 1 | -1 | 0 | 0 | -1 | 1 | 1 | -1 |

*For explanations 1, 2, 3 … etc. refer to Table 10
*Source*: own calculations

Table 12 demonstrates that during the 1995-2015 period the greatest share of IT&CT capital was in Lithuania (15%), followed by Estonia (13%) and Latvia (6%). The share of IT&CT capital declined in all countries after entering the EU: 11% in Lithuania (from 20% to 9%), 3% in Estonia (from 14% to 11%) and 19% in Latvia (from 16% to -3%). The machinery-based capital share was largest in Latvia (61%), followed by Estonia (58%) and Lithuania (46%). The share of machinery-based capital declined in Latvia by 8% (from 65% to 57%) and in Lithuania by 11% (from 51% to 40%), but, by contrast, it grew in Estonia by 12 points (from 53% to 65%) after entering the EU. The highest share of buildings was in Lithuania (19%), then in Estonia (12%) and Latvia (9%) during the 1995-2015 period. It increased in Lithuania by 20% (from 10% to 30%) and in Latvia by 33% (from -8% to 25%), but diminished in Estonia by 12% (from 16% to 4%) after entering the EU. The share of SoftDB capital was largest in Lithuania (6%), followed by Latvia (5%) and Estonia (3%) through the 1995-2015 period, and increased in all Baltic countries after entering the EU. The share of innovative property capital during this period was 7% in Estonia, 6% in Latvia and 5% in Lithuania, increasing in Estonia and Lithuania but declining in Latvia. Economic competencies through this period were 12% in Latvia, 9% in Lithuania and 8% in Estonia, diminishing in all three Baltic states following their entry to the EU.

MFP (Table 9) in the 1995-2015 period was greatest in Latvia (2.85%), followed by Lithuania (2.10%) and Estonia (1.70%). Before entering the EU, it was highest in Latvia (5.22%), followed by Estonia (3.06%) and finally Lithuania (2.76%). In the 2004-2015 period (after the EU entry), MFP was highest in Lithuania (1.56%), followed by Latvia (0.91%) and Estonia (0.60%).

**Figure 4. MFP contributions to aggregated labour productivity growth rates in Lithuania, Latvia and Estonia, percentage points, 1995–2015**




*Source:* own representation

Figure 4 indicates that no country could be distinguished as the leader in terms of its MFP contribution to labour productivity growth. Indeed, the highest positions were held by different countries for different years. During the period of the financial crisis, MFP decreased most in Latvia.

**Table 13. Industrial contributions to aggregated MFP growth, percentage points, 1995-2015**

| | Estonia 1995-2015 | Latvia 1995-2015 | Lithuania 1995-2015 | Estonia 1995-2004 | Latvia 1995-2004 | Lithuania 1995-2004 | Estonia 2004-2015 | Latvia 2004-2015 | Lithuania 2004-2015 |
|---|---|---|---|---|---|---|---|---|---|
| Total, market economy* | **1.70** | **2.85** | **2.10** | **3.06** | **5.22** | **2.76** | **0.60** | **0.91** | **1.56** |
| Agriculture, forestry and fishing | 0.17 | 0.19 | 0.20 | 0.11 | 0.17 | 0.13 | 0.23 | 0.22 | 0.25 |
| Mining and quarrying | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 | 0.05 | 0.03 | 0.01 | -0.03 |
| Manufacturing | 0.67 | 0.54 | 1.09 | 0.85 | 1.10 | 1.36 | 0.52 | 0.08 | 0.86 |
| Electricity, gas and water supply | 0.02 | -0.04 | 0.02 | -0.04 | 0.07 | 0.25 | 0.06 | -0.14 | -0.16 |
| Construction | 0.00 | 0.32 | 0.20 | 0.07 | 0.60 | 0.26 | -0.05 | 0.10 | 0.15 |
| Wholesale and retail trade; repair of motor vehicles and motorcycles | 0.41 | 0.86 | 0.36 | 0.85 | 1.28 | 0.29 | 0.04 | 0.52 | 0.41 |
| Transportation and storage | 0.00 | 0.39 | 0.08 | 0.43 | 0.86 | 0.02 | -0.35 | 0.01 | 0.14 |
| Accommodation and food service activities | 0.06 | 0.08 | -0.01 | 0.09 | 0.09 | -0.02 | 0.03 | 0.08 | -0.01 |
| Information and communication | -0.01 | 0.10 | 0.02 | -0.05 | 0.39 | 0.02 | 0.02 | -0.13 | 0.02 |
| Financial and insurance activities | 0.27 | 0.33 | 0.06 | 0.46 | 0.29 | 0.05 | 0.11 | 0.37 | 0.06 |
| Professional, scientific, technical, administrative and support service activities | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Arts, entertainment, recreation and other service activities | 0.08 | 0.04 | 0.08 | 0.34 | 0.33 | 0.28 | -0.24 | -0.25 | -0.09 |

*****All industrial MFP contributions sums to aggregate MFP
*Source*: own calculations

From Table 13, it can be observed that the biggest contributors to aggregated labour productivity growth were manufacturing, wholesale and retail trade and the repair of motor vehicles and motorcycles.

### 3.2. Industries that contributed most to aggregated labour productivity growth

From Table 14, it can be discerned that industries which contributed most to labour productivity growth were congruent across Baltic countries, comprising

manufacturing, wholesale and retail trade and repair of motor vehicles and motorcycles, and transportation and storage.

**Table 14. Industrial growth contributions to aggregate LP growth, 1995–2015**

| | **Estonia** | **Latvia** | **Lithuania** |
|---|---|---|---|
| Total industries | 4.6 | 4.0 | 4.4 |
| Agriculture, forestry and fishing | 0.5 | 0.3 | 0.2 |
| Mining and quarrying | 0.2 | 0.0 | 0.0 |
| Manufacturing | 1.4 | 1.1 | 1.7 |
| Electricity, gas and water supply | 0.2 | 0.0 | 0.2 |
| Construction | 0.2 | 0.4 | 0.3 |
| Wholesale and retail trade; repair of motor vehicles and motorcycles | 0.8 | 1.5 | 1.1 |
| Transportation and storage | 0.5 | 0.6 | 0.4 |
| Accommodation and food service activities | 0.1 | 0.1 | 0.0 |
| Information and communication | 0.1 | 0.0 | 0.1 |
| Financial and insurance activities | 0.3 | 0.5 | 0.1 |
| Professional, scientific, technical, administrative and support service activities | 0.3 | 0.0 | 0.0 |
| Arts, entertainment, recreation and other service activities | 0.0 | -0.4 | 0.2 |

*Source*: own calculations

The first positions were retained by manufacturing in Lithuania and Estonia, and by wholesale and retail trade and repair of motor vehicles and motorcycles in Latvia. The second position was held by wholesale and retail trade and repair of motor vehicles and motorcycles in Lithuania and Estonia, and by manufacturing in Latvia. The third position was consistent in all three Baltic countries: transportation and storage industry, the greatest contribution being in Latvia, followed by Estonia and Lithuania.

## Manufacturing

The shares of IT&CT capital (Table 15) were equal in Estonia and Lithuania (9%), and lower in Latvia (2%) during the 1995-2015 period. They diminished in all Baltic countries following their admission to the EU. The share of machinery-based capital was greatest in Latvia (79%), followed by Estonia (50%) and Lithuania 46 (%) during this time. After entering the EU, this decreased in all three countries. The share of buildings was largest in Estonia (28%), followed by Lithuania (22%) and Latvia (7%). It increased in all countries after entering the EU. SoftwDB capital contribution's share was largest in Lithuania (5%), followed by Latvia (2%) and Estonia (1%), and increased in all of the countries after their entrance to the EU. Innovative capital contribution's share was greatest in Lithuania (8%), followed by Latvia (4%) and Estonia (3%), and increased in Estonia and Lithuania after they

entered the EU, but decreased in Latvia. Economic competencies' share was highest in Lithuania (11%), followed by Estonia (9%) and Latvia (6%). It decreased in Estonia and Latvia, but increased in Lithuania.

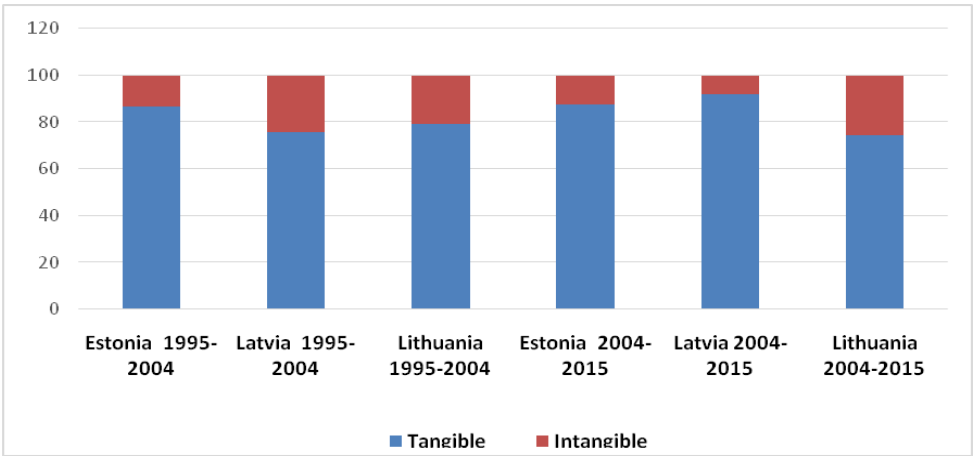
**Table 15. Contributions of capital groups to annual average labour productivity growth in the manufacturing industry, percentage points**

| For explanations 1, 2, 3 … etc. refer to Table 11 | | Estonia 1995-2015 | Latvia 1995-2015 | Lithuania 1995-2015 | Estonia 1995-2004 | Latvia 1995-2004 | Lithuania 1995-2004 | Estonia 2004-2015 | Latvia 2004-2015 | Lithuania 2004-2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| SUM from I to VII = 100 % | Capital contribution | **0.03** | **0.02** | **0.02** | **0.04** | **0.01** | **0.02** | **0.03** | **0.03** | **0.03** |
| I = 1+2* | IT&CT | 9 | 2 | 9 | 11 | 5 | 15 | 6 | 0 | 4 |
| II = 3+4* | Machinery-based | 50 | 79 | 46 | 52 | 81 | 65 | 49 | 79 | 31 |
| III = 5+6* | Buildings | 28 | 7 | 22 | 24 | -10 | -2 | 33 | 13 | 39 |
| IV = 8* | SoftwDB | 1 | 2 | 5 | 0 | 2 | 4 | 1 | 2 | 6 |
| V = 9+10+11+12* | Innovative property | 3 | 4 | 8 | 2 | 4 | 7 | 4 | 3 | 9 |
| VI = 13+14+15* | Economic competencies | 9 | 6 | 11 | 11 | 17 | 10 | 8 | 2 | 11 |
| VII = 7* | Cultivated assets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*For explanations 1, 2, 3 … etc. refer to Table 10
*Source*: own calculations

Figure 5 indicates that before entering the EU, the share of intangible capital was relatively higher in Latvia. Thereafter, the share of intangible capital decreased significantly in Latvia, but increased in Lithuania.

**Figure 5. Shares of tangible and intangible capital of labour productivity growth in the manufacturing industry, percentage points**




*Source:* own representation

**Wholesale and retail trade, repair of motor vehicles**

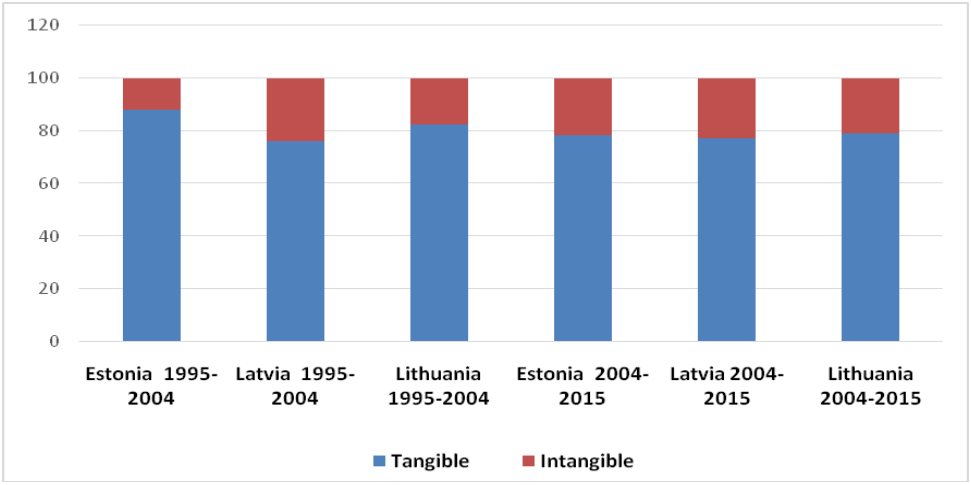
In the wholesale and retail trade (Table 16) and motor vehicle repair industry, the share of IT&CT capital was greatest in Estonia (16%), followed by Lithuania (15%) and Latvia (4%) during the 1995-2015 period. After entering the EU, it increased in Estonia, but decreased in Latvia and Lithuania. The contribution share of machinery-based capital was highest in Estonia (53%), followed by Latvia and Lithuania (43%). The share of this capital subsequently increased in Estonia, decreased in Lithuania and maintained the same position in Latvia. The share of buildings was highest in Latvia (30%), followed by Lithuania (24%) and Estonia (16%). Constructions decreased in Estonia, but increased in Latvia and Lithuania. SoftwDB's contribution share was greatest in Lithuania (5%), followed by Estonia and Latvia (2%). The share of SoftwDB capital increased in all Baltic states following their entry to the EU. Innovative property capital's share was the same across the Baltic states (1%), and increased or maintained the same position in each country. Economic competencies' share was highest in Latvia (20%), followed by Estonia and Latvia (12%). It increased in Estonia, but diminished in Latvia and Lithuania after they entered the EU.

**Table 16. Contributions of capital groups to annual average labour productivity growth in the wholesale and retail trade and the motor vehicle repair industry, percentage points**

| For explanations 1, 2, 3 … etc. refer to Table 11 | | Estonia 1995-2015 | Latvia 1995-2015 | Lithuania 1995-2015 | Estonia 1995-2004 | Latvia 1995-2004 | Lithuania 1995-2004 | Estonia 2004-2015 | Latvia 2004-2015 | Lithuania 2004-2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| SUM from I to VII = 100 % | Capital contribution | **0.02** | **0.02** | **0.04** | **0.04** | **0.02** | **0.05** | **0.01** | **0.02** | **0.02** |
| I = 1+2* | IT&CT | 16 | 4 | 15 | 14 | 9 | 16 | 24 | 0 | 12 |
| II = 3+4* | Machinery-based | 53 | 43 | 43 | 46 | 43 | 48 | 76 | 43 | 33 |
| III = 5+6* | Buildings | 16 | 30 | 24 | 28 | 25 | 19 | -21 | 34 | 33 |
| IV = 8* | SoftwDB | 2 | 2 | 5 | 1 | 1 | 4 | 6 | 3 | 8 |
| V = 9+10+11+12* | Innovative property | 1 | 1 | 1 | 0 | 1 | 1 | 2 | 1 | 1 |
| VI = 13+14+15* | Economic competencies | 12 | 20 | 12 | 11 | 21 | 13 | 13 | 19 | 12 |
| VII = 7* | Cultivated assets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*For explanations 1, 2, 3 … etc. refer to Table 10
*Source*: own calculations

**Figure 6. Shares of tangible and intangible capital of labour productivity growth in wholesale and retail trade and motor vehicle repair industry, percentage points**




*Source:* own representation

Figure 6 demonstrates that the share of intangible capital in the wholesale and retail trade and motor vehicle repair industry was relatively greater in Latvia but that, after entering the EU, it decreased while in Estonia and Lithuania it increased. All Baltic countries maintained similar shares of intangible capital after entering the EU.

**Transportation and storage**

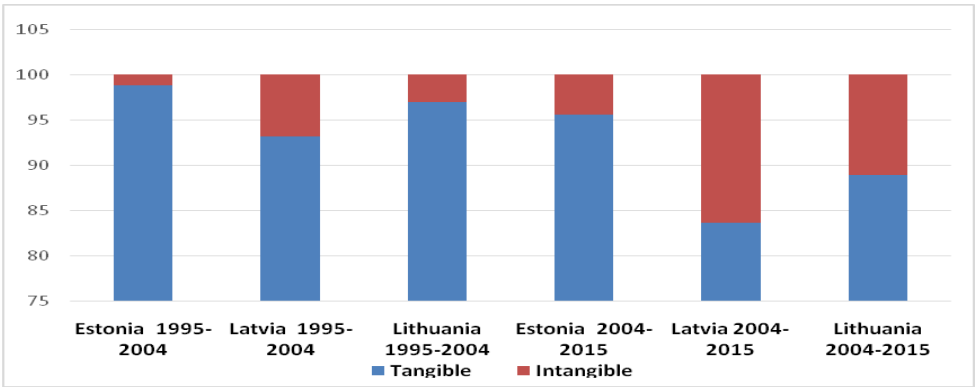
In the transportation and storage industry (Table 17), the share of IT&CT capital was highest in Lithuania (12%), followed by Latvia and Estonia (7%) during the 1995-2015 period. After entering the EU, the contribution share of this capital increased in Estonia, but decreased in Latvia and Lithuania. During that period, Machinery-based capital had the highest share in Estonia (86%), followed by Lithuania (62%) and Latvia (50%). Machinery-based capital increased in Lithuania, decreased in Latvia and maintained the same position in Estonia. Buildings' highest share was in Latvia (32%), followed by Lithuania (20%) and Estonia (4%). It decreased in Estonia and Lithuania, but increased in Latvia. SoftwDB had the largest shares in Latvia and Lithuania (4%), with Estonia (1%) on the last position. SoftwDB capital increased in all Baltic countries. Innovative property was highest in Latvia (2%), and increased here and in Estonia, but decreased in Lithuania. Economic competencies were highest in Latvia (5%), followed by Lithuania (3%) and Estonia (1%), and increased in all three countries after entering the EU.

**Table 17. Contributions of capital groups to annual average labour productivity growth in the transportation and storage industry, percentage points**

| **For explanations 1, 2, 3 … etc. refer to Table 11** | | **Estonia 1995-2015** | **Latvia 1995-2015** | **Lithuania 1995-2015** | **Estonia 1995-2004** | **Latvia 1995-2004** | **Lithuania 1995-2004** | **Estonia 2004-2015** | **Latvia 2004-2015** | **Lithuania 2004-2015** |
|---|---|---|---|---|---|---|---|---|---|---|
| SUM from I to VII = 100 % | Capital contribution | **0.03** | **0.01** | **0.03** | **0.05** | **0.01** | **0.04** | **0.02** | **0.01** | **0.02** |
| I = 1+2* | IT&CT | 7 | 7 | 12 | 6 | 12 | 22 | 9 | 2 | -2 |
| II = 3+4* | Machinery-based | 86 | 50 | 62 | 86 | 89 | 55 | 86 | -1 | 72 |
| III = 5+6* | Buildings | 4 | 32 | 20 | 7 | -8 | 20 | 1 | 83 | 19 |
| IV = 8* | SoftwDB | 1 | 4 | 4 | 0 | 3 | 1 | 2 | 5 | 6 |
| V = 9+10+11+12* | Innovative property | 0 | 2 | 0 | 0 | 2 | 1 | 1 | 3 | 0 |
| VI = 13+14+15* | Economic competencies | 1 | 5 | 3 | 1 | 2 | 1 | 2 | 9 | 5 |
| VII = 7* | Cultivated assets | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Source*: own calculations

**Figure 7. Shares of tangible and intangible capital of labour productivity growth in transportation and storage industry, percentage points**




*Source:* own representation

Figure 7 indicates that in the transportation and storage industry, the share of intangible capital was significantly higher in Latvia than in Estonia and Lithuania. After entering the EU, the share of intangible capital increased in all three countries, especially in Latvia.

## Conclusions

Labour productivity growth and its main contributors, labour composition and capital, have decreased in all three Baltic countries. Moreover, MFP, the measure of technological change and innovation, declined in all these countries after they entered the EU.

Before entering the EU, Estonia led in terms of the following indicators: productivity growth, contribution of labour and capital, and MFP. Thereafter, Lithuania came to lead in terms of labour productivity growth, capital and MFP contribution. Latvia experienced the greatest reallocation effect for all of the periods examined, significantly contributing to its total productivity growth. Moreover, the financial crisis affected the Latvian economy most negatively in terms of labour productivity growth and MFP, these indicators decreasing most significantly in comparison with the other Baltic states.

The industries that have most significantly boosted aggregated labour productivity growth across all three Baltic countries were manufacturing, wholesale and retail trade and the repair of motor vehicles and motorcycles and transportation and storage.

Insights from the aggregated level

IT&CT's capital contribution shares diminished in all three countries after entering the EU, especially in Lithuania. Economic competencies (brand, organisational and training) also decreased in all three economies, while SoftwDB increased across the board.

The share of intangible capital was greatest in Latvia during the researched period. Moreover, before entering the EU, it was especially high relative to the other Baltic states, but decreased thereafter. In contrast, the shares of intangible capital increased for Estonia and Lithuania after entering the EU.

Insights at the industrial level

*Manufacturing.* After entering the EU, IT&CT and machinery-based capital's shares decreased in all three economies, while buildings and SoftwDB consistently increased.

Before entering the EU, the biggest share of intangible capital was in Latvia. Thereafter, this share decreased significantly, while increasing in Lithuania.

*Wholesale and retail trade and repair of motor vehicles.* After entering the EU, SoftwDB and innovative property (Minart, Design, Nfp, RD) increased in all three researched economies. Given that SoftDB and innovative property belong to the group of intangible capital, this is a positive result because the industry is intangible capital-intensive.

The share of intangible capital in Latvia was higher than in Estonia and Lithuania before entering the EU, but subsequently decreased, while increasing in the other countries. All three Baltic countries maintained similar shares of intangible capital after entering the EU.

*Transportation and storage.* After entering the EU, SoftwDB and economic competencies (brand, organisational and training) increased in all three economies analysed. SoftwDB and economic competencies are examples of intangible capital and so this is a positive result for these economies.

The share of intangible capital was significantly higher in Latvia than in Estonia and Lithuania. After entering the EU, the share of intangible capital increased in all three countries, but especially in Latvia. During the referred period, in Latvia, the share of intangible capital was even higher than that of tangible capital, as usually happens in more developed economies.

The share of SoftwDB capital increased for all three countries, both at the aggregated and at selected industrial level during the examined period.

Following the main productivity growth determinants analysis at the aggregated and industrial level, a lack of intangible capital contributions to the labour productivity growth of the Baltic states can be observed. However, the highest industrial annual average real value-added growth rates are seen in the information and communication industry, financial and insurance activities and professional, scientific, technical, administrative and support service activities. Given that all these

industries are intangible and IT&CT capital-intensive, the main productivity determinants will change accordingly in the future. Indeed, the intangible capital group and its components will come to predominate, as has already happened in more developed economies.

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## References

Benkovskis, K., Masso, J., Tkacevs, O., Vahter, P. and Yashiro, N. (2017), *Export and productivity in global value chains*, OECD Economics Department Working Papers No. 1448 (retrieved from https://dx.doi.org/10.1787/cd5710c4-en).

Corrado, C., Haskel, J., Iommi, M., Jona-Lasinio, C., Mas, M. and O'Mahony, M. (2017), *Eurona, Eurostat Review on National Accounts and Macroeconomic Indicators*.

Corrado, C., Haskel, J., Jona-Lasinio, C. and Iommi, M. (2012), *Intangible Capital and growth in advanced economies: measurement methods and comparative results*, Discussion Paper no. 6733, Germany.

Corrado, C., Haskel, J., Jona-Lasinio, C. and Massimiliano, I. (2016), *Intangible investment in the EU an US before and since the Great Recession and its contribution to productivity growth*, EIB Working Papers 2016/08, European Investment Bank (EIB).

Corrado, C., Hulten, C. and Sichel, D. (2005), Measuring Capital and Technology: An Expanded Framework, in: *Measuring Capital in the New Economy*, Chicago University Press, pp. 11-46.

Corrado, C., Hulten, C. R. and Sichel, D. E. (2006), *Intangible Capital and Economic Growth*, NBER Working Paper No. 11948.

Corrado, C., Hulten, C. and Sichiel, D. (2009), Intangible capital and U.S. economic growth, *The review of income and wealth*, 55(3), pp. 661-685.

Dudzeviciute, G., Maciulis, A. and Tvaronaviciene, M. (2014), Structural changes of economies: Lithuania in the global context, *Technological and economic development of economy*, 20(2), pp. 353-370.

Durkalic, D. and Mihailo, C. (2019), Comparative analysis of debt sustainability of EU countries and EU candidates: the Promethee-Gaiaapproach, *Eastern Journal of European Studies*, 9(2), pp. 67-92.

Harberger, A. C. (1978), Perspectives on capital and technology in less developed countries, *Contemporary Economic Analysis*, pp. 42-72.

Haskel, J. (2018), *Capitalism without capital: the rise of intangible economy*, Princeton, N. J.: Princeton University Press.

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

Jäger, K. (2017), *EU KLEMS Growth and Productivity Accounts 2017 release, Description of Methodology and General Notes* (retrieved from http://www.euklems.net/TCB/ 2018/Metholology_EUKLEMS_2017_revised.pdf)

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

Kajaks, J. (2013), Economic and social situation in the Baltic states: Latvia Study, *European Economic*, Unit EESC-2013-26-EN.

Kersan-Skabic, I. (2017), Assessment of EU memberstates' positions in Global ValueChains, *Eastern Journal of European Studies*, 8(2), pp. 5-19.

Kirankabes, M.C. and Erkul, A. (2019), Regional knowledgeproduction in Central and East European countries: R&D factor productivity and changes in performances, *Eastern Journal of European Studies*, 10(1), pp. 25-44.

Koutsogeorgopoulou, V. and Guzzardi, D. (2018), *Boosting productivity and inclusiveness in Lithuania*, OECD Economics Department Working Papers, No. 1529, OECD Publishing, Paris (retrieved from https://doi.org/10.1787/1099017a-en).

Lankauskiene, T. (2014), Accounting productivity in the sectors of economy: methodological aspects, *Entrepreneurship and Sustainability*, 2(2), pp. 98-106.

Lankauskienė, T. (2015), *Economic structure and growth evaluation*, Doctoral dissertation, Vilnius Gediminas Technical University (retrieved from http://dspace.vgtu.lt/ bitstream/1/1827/1/2319_Lankauskiene_Dissertation_WEB.pd).

Lankauskiene, T. (2016), The application of the growth accounting model for the construction industry, *Journal of Business Economics and Management*, 17(3), pp. 430-443.

Mas, M. J. and Quesada. J. (2014), *Activos intangibles Una inversion necesaria para el crecimiento economico en Espana*, Fundacion Telefonica: Madrid.

Mas, M., Maudos, J., Perez, F. and Uriel, E. (1998), Public capital, productive efficiency and convergence in the Spanish regions, *Review of Income and Wealth*, 44(3), pp. 383-396.

Mas, M., Quesada, J., Uriel, E., Fernández de Guevara, J., Albert, C., Benages, E., Hernández, L., Mínguez, C. and Robledo, J.C. (2017), *Intangible economy in Spain: evolución, and distribution through territories and sectors*, Madrid; València: Cotec: Ivie.

Mihaylova, S.M. and Bratoeva-Manoleva, S. (2018), Structural changes and wage inequality in the Bulgarian economy, *Eastern Journal of European Studies*, 9(2), pp. 205-227.

OECD (2009), *The Perpetual Inventory Method - Overview, Measuring Capital - OECD Manual 2009*: Second edition, OECD Publishing, Paris.

OECD (2017), *OECD Economic Surveys: Estonia 2017*, OECD Publishing, Paris (retrieved from https://doi.org/10.1787/eco_surveys-est-2017-en).

OECD (2018), *OECD Economic Surveys: Lithuania 2018*, OECD Publishing, Paris (retrieved from https://doi.org/10.1787/eco_surveys-ltu-2018-en).

OECD (2019), *OECD Economic Surveys: Latvia 2019*, OECD Publishing, Paris (retrieved https://doi.org/10.1787/f8c2f493-en).

Orosz, A. (2018), The impact of the 2008 economic and financial crisis on the public spending devoted to social protection in the EU, *Eastern Journal of European Studies*, 9(2), pp. 187-203.

Siljak, D. and Nagy, S. G. (2018), Economic convergence of the Eastern Partnership, *Eastern Journal of European Studies*, 9(2), pp. 169-185.

Skribane, I. and Jekabsone, S. (2013), Structural changes in the economy of Latvia after it joined the European Union, *Intellectual economics*, 1(15), pp. 29-41.

Skribane, I. and Jekabsone, S. (2014), Structural weaknesses and challenges of the economic growth of Latvia, *Social research*, 1(34), pp. 74-85.

Smidova, Z. (2015), Policy areas for increasing productivity in Latvia Economics department working papers, No. 1255, Organisation for Economic Co-operation and Development.

Solow, R.M. (1957), Technical change and the Aggregate Production Function, *Review of Economics and Statistics*, 39(3), pp. 312-320.

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

Timmer, M.P., Inklaar, R., O'Mahony, M. and Van Ark, B. (2010), *Economic growth in Europe: a comparative industry perspective*, Cambridge: Cambridge University press.

Westmore, B. (2016), *Scaling New Heights: Achievements and Future Challenges for Productivity Convergence in Lithuania*, OECD Economics Department Working Papers, No. 1307, OECD Publishing, Paris (retrieved from https://doi.org/10.1787/5jlv2zcn3s8r-en).