Productivity Growth Determinants of Differently Developed Countries: Comparative Capital Input Results

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Abstract

The article aims to apply the growth accounting methodology to the Baltic countries in order to obtain detailed productivity growth determinants in the aggregated market economy with a particular focus to capital input. To this end, a new database following the KLEMS methodology for tangible and intangible capital indicators is constructed. The paper analyses determinants' genesis and growth tendencies in the context of more developed countries and uncovers the productivity gains associated with different types of capital assets. First, an overview of the economies during the period researched is presented. Second, a methodology is developed to derive new intangibles and EU KLEMS data for the Baltic countries. Third, statistical data are constructed for all economies and the growth accounting method is applied in order to obtain comparable results. Finally, economic analysis is conducted to detect certain aspects of the growth determinants for differently developed and structured economies.

Keywords

Productivity growth, KLEMS methodology, growth accounting, tangible capital, intangible capital, national accounts

JEL code

O47, E22

INTRODUCTION

Productivity is the ratio of output to all inputs. Determinants of labour productivity growth appear to be at the centre of both the European Union's (EU) current research and the political agenda. Moreover, labour productivity has constituted a key variable for economic growth and development theories dating back to R. Solow (1957), as well as in contemporary approaches to sustainable development.

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The growth accounting method is one of the best-known approaches to determining the proximate sources of productivity growth. The EU KLEMS and WORLD KLEMS databases provide information for economic analyses of different developed and developing countries. However, the EU KLEMS and WORLD KLEMS projects lack detailed information for detailed capital input and research results regarding the application of the growth accounting method for some less developed EU countries (e.g. Lithuania, Latvia, Estonia). Hence, the preparation of growth and productivity accounts, is advised and listed among nine specific satellite accounts (in the European Parliament and Council Regulation (No. 549/2013, p. 506, 525). However, not all National Statistics Departments have done so.

The goal of this research paper is to apply the growth accounting methodology to the Baltic countries in order to obtain detailed productivity growth determinants in the aggregated market economy with a particular focus to capital input (as these countries are missing this information).

In summary, it is essential to draw back the curtains of the Baltic states (Lithuania, Estonia and Latvia) and construct a database for them following the initial KLEMS methodology in order to attain in-depth and internationally comparable results. Such information is already available for more developed countries, but the Baltic countries are missing complete results. This information will thus fill an important research gap. Moreover, it will facilitate comparative economic analysis for a set of more developed countries within the EU for which information is already available from the determinants of the productivity growth perspective.

Furthermore, new intangible assets are deemed important for productivity growth, as indicated by the research of many scientists today (Mas and Quesada, 2014; Corrado et al., 2017; Haskel, 2018), including in reports (e.g. World Intellectual Property Report, 2017) and forecasts (e.g. European Forecast, 2016). Nevertheless, many intangible assets have not been fully estimated owing to a lack of necessary data (Corrado et al., 2006). One of the more novel aspects of this particular research is the incorporation of new intangibles, which are yet to be accounted for by national statistics, in the traditional growth accounting model. The statistical data for more developed economies can be found in INTAN invest database, but data for the Baltic countries are currently absent. Hence, brand estimates for detailed new intangible assets for the Baltic countries will be derived here. This will enable the Baltic countries' platforms to be clarified and their performance in the context of others in this contemporary research topic to be comprehended.

The article is structured as follows: Overview of the economies; Methodology and practical implementation; Results; Conclusions.

1 OVERVIEW OF THE ECONOMIES

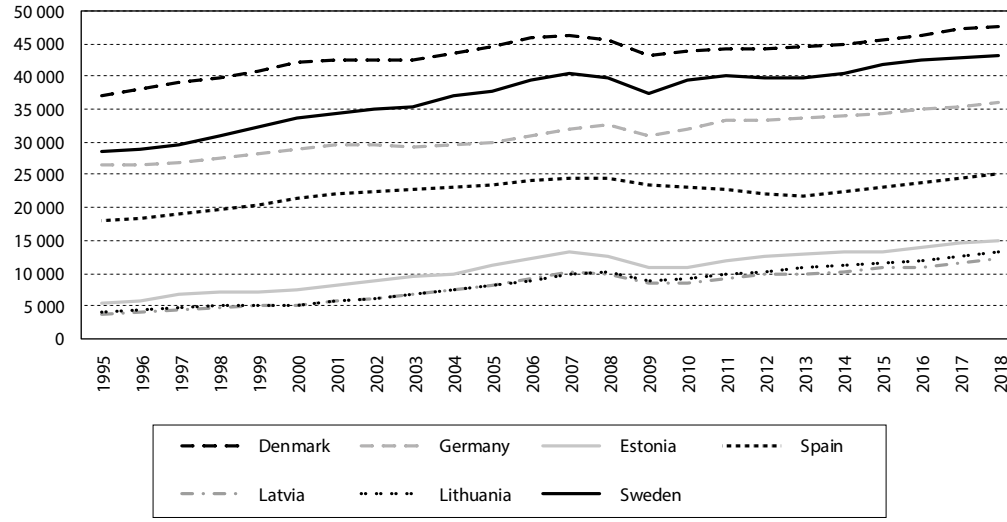
The selected countries are: Denmark, Germany, Spain, Sweden (hereinafter deemed more developed countries in terms of their gross domestic product, GDP), followed by the Baltic states of Estonia, Latvia and Lithuania.

Germany is the oldest EU member in the sample, having helped found it on 1 January 1958, followed by the accessions of Denmark (1 January 1973), Spain (1 January 1986) and Sweden (1 January 1995). In contrast, Lithuania, Latvia and Estonia all joined the EU on 1 May 2005. Moreover, not only are the Baltic states young members of the EU, but they previously belonged to the Soviet Union, only gaining their independence in 1991. The economies of the three Baltic countries are quite similar in terms of historical perspective, geography, size, economic structure, growth and development (Poissonnier, 2017).

Figure 1 provides the real GDP per capita for the seven countries during the period 1995–2018. Table 1 indicates the following sequence of countries in terms of GDP per capita in 1995 in nominal terms: Denmark, Germany, Sweden, Spain, Estonia, Latvia, Lithuania. In 2018 the following sequence could be distinguished: Denmark, Sweden, Germany, Spain, Estonia, Lithuania, Latvia. In terms of GDP

per capita real growth rates, the highest values were for the Baltic countries (from 3.9% to 4.1%). The annual growth rates of these countries are high compared with other countries, as is usually the case with so-called emerging economies. Indeed, their GDPs grew significantly from 1995 to 2018. These indicators highlight the importance of this research: to reveal the determinants of the growth of these emerging economies and to compare them in the context of more advanced counterparts.

Figure 1 GDP per capita at market prices, Euro, chain-linked volumes (2010) 1995–2018



Source: Own elaboration, upon the Eurostat data

Table 1 Gross domestic product, Euro per capita

Country	1995, current prices	2018, current prices	Real annual average growth rates
Estonia	2 000	19 500	4.0%
Latvia	1 700	15 300	3.9%
Lithuania	1 400	16 100	4.1%
Denmark	27 000	51 400	1.5%
Germany	24 400	40 800	1.4%
Spain	11 800	25 900	2.2%
Sweden	22 900	45 900	2.4%

Source: Own elaboration, upon the Eurostat data

From Table 2 it can be noticed that the agriculture, forestry and fishing (A) and manufacturing (C) (except Germany) industries shrunk in all of the economies. The consistent patterns of structural change explained by Todaro and Smith (2015) can be observed in that the economies are moving towards the expansion of service-based economies through the process of economic growth (Lankauskiene and Tvaronaviciene, 2012; Tvaronaviciene and Lankauskiene, 2013).

Table 2 Structure of nominal value added 1995–2015

	Estonia			Latvia			Lithuania			Denmark		
	1995	2017	Gr rate* %	1995	2017	Gr rate* %	1995	2017	Gr rate* %	1995	2017	Gr rate* %
Total**	100	100	4.6	100	100	4.4	100	100	4.6	100	100	1.6
A	8	4	4.7	12	5	2.1	13	5	0.9	5	1	0.3
B	3	2	3.7	0	1	10.5	0	0	3.1	1	2	–1.6
C	26	21	5.4	26	17	2.9	25	23	6.0	25	21	0.9
D, E	5	5	1.1	7	5	0.2	7	4	0.8	4	3	–0.5
F	9	9	4.1	6	9	4.9	9	9	4.7	8	8	1.0
G	17	16	4.1	12	20	6.4	20	23	5.4	19	20	2.1
H	11	10	2.5	18	13	3.8	10	14	4.2	9	9	1.5
I	2	2	4.5	1	3	5.8	2	2	2.9	2	2	–0.3
J	6	8	7.0	4	7	5.6	4	6	4.5	5	7	8.0
K	4	5	7.6	5	7	8.1	3	3	3.6	8	9	3.2
M, N	6	13	5.8	6	10	5.2	3	10	7.6	9	13	1.8
R, S	3	4	2.0	3	4	3.7	3	2	2.8	5	5	–0.3

	Germany			Spain			Sweden		
	1995	2017	Gr rate*%	1995	2017	Gr rate* %	1995	2017	Gr rate* %
Total**	100	100	1.4	100	100	1.8	100	100	3.3
A	1	1	–1.2	5	4	2.1	4	2	1.3
B	1	0	–4.3	1	0	–1.8	0	1	–1.9
C	32	33	1.8	23	21	1.4	33	22	2.9
D, E	4	4	0.5	4	5	2.3	5	4	1.0
F	9	6	–1.6	12	8	–1.1	8	9	1.4
G	14	14	1.9	16	17	2.6	15	15	3.9
H	6	6	1.9	7	7	1.2	9	7	1.5
I	2	2	–0.2	9	9	0.3	2	2	2.6
J	5	7	5.3	5	6	4.6	5	11	7.4
K	7	6	–0.9	7	6	3.1	6	7	3.7
M, N	13	16	1.7	7	12	3.3	9	16	4.2
R, S	5	5	0.3	4	4	3.2	4	4	1.8

Notes: * 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: Own elaboration, upon the EU KLEMS data

In 2015, the transportation and storage (I) industry had comparatively higher shares in the total market economy in the Baltic states relative to other more developed economies. Financial and insurance (K) (except Latvia) and professional, scientific, technical, administrative and support service activities' (M, N) industrial shares in total value added of the market economy were lower for the Baltic states compared with other more developed economies (except Spain and Denmark).

Regarding the industrial real value-added growth rates, the highest growth rates were for the the Baltic countries. Moreover, these were positive for all industries, in contrast to the more developed economies. The highest industrial real value-added growth rates were for the information and communication industry (J) for all economies. Furthermore, high values were maintained in financial and insurance activities (K) (except Germany) and professional, scientific, technical, administrative and support service activities (M-N), and the highest values for these industries were in the Baltic countries. High industrial real value-added growth rates in the Baltic countries were also seen in the following industries: 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).

2 METHODOLOGY AND PRACTICAL IMPLEMENTATION

Numerous methods can be found in relevant scientific literature to account for productivity growth (Lankauskiene, 2014; Lankauskiene and Tvaronaviciene, 2014), but the best method is growth accounting for the research benefits it can provide (Lankauskiene, 2015; 2016). With roots in the work of Nobel Prize winner neoclassical economist Solow (1956), Jorgenson, Gollop and Fraumeni (1987) published their seminal study outlining the growth accounting approach based on the KLEMS methodology, which is today widely used by researchers (Timmer et al., 2007; Jäger, 2018).

Through the growth accounting method, value-added growth can be decompiled into contributions of hours worked and labour productivity inputs within a consistent framework (Timmer et al., 2010). Labour productivity inputs are composed of labour, capital and multi-factor productivity (MFP). 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. Stated another way, it captures the reduction in input costs to create a given amount of value added. Under strict neoclassical assumptions, MFP growth measures disembodied technological changes and innovation (Timmer et al., 2007; Inklaar and Timmer, 2008).

Hereinafter the traditional growth accounting method and EU KLEMS methodology are expanded through the incorporation of the new intangibles (Corrado et al., 2005; 2006; 2009).

Relevant information on practical implementation is provided in Tables 3, 4, 5 and 6.

Table 3 Research implementation details

Country coverage: Estonia, Latvia, Lithuania, Denmark, Germany, Spain, Sweden
* 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 (further detail in Table 5)
Labour data: Labour composition according to educational attainment
Databases: For capital data – EU KLEMS and INTAN Invest (for more developed economies); EU KLEMS, INTAN Invest, National statistics departments, WIOD, Eurostat (for the Baltic states), for labour data – EU KLEMS and WIOD

Note: * The research period refers to the latest period available in the statistical databases.
Source: Own elaboration

Table 4 Industrial aggregation

Industrial aggregation
Total Economy (A, B, C, D-E, F, G, H, I, J, K, L, M-N, O, P, Q, R-S) **Total Market economy (A, B, C, D-E, F, G, H, I, J, K, M-N, R-S)**
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
L – Real estate activities
M-N – Professional, scientific, technical, administrative and support service activities
O – Public administration and defence; compulsory social security
P – Education
Q – Health and social work
R-S – Arts, entertainment, recreation and other service activities

Source: Own elaboration

Table 5 Capital data

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

Source: Own elaboration

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
More developed countries	YES	YES	• To the traditional EU KLEMS methodology (INTAN invest intangibles have been included).
Baltic countries	**Only for some indicators; major gaps**	NO	• New statistical EU KLEMS and INTAN Invest data created. • To the traditional EU KLEMS methodology (INTAN invest intangibles have been included).

Source: Own elaboration

Data for the Baltic and other selected countries were prepared following strict methodological rules and the growth accounting method applied (Timmer, 2007; Jäger, 2018). For the application of the growth accounting method, capital input files had to be constructed in order to obtain the capital volumes. Labour input files were constructed in order to derive labour services. To construct the productivity accounts' value added, labour compensation data were taken from the EU KLEMS database. Given that the traditional growth accounting method was expanded using the new intangibles, intangible capital components were added to the traditional growth accounting model. Hence, the following methodological steps were followed for the final estimation of productivity accounts: the nominal gross value added (GVA) was adjusted by adding the gross fixed capital formation (GFCF) nominal values of new intangible capital, and the capital compensation part was derived from subtracting the labour compensation from GVA adjusted to new intangible capital. These data were later used to derive the contributors of aggregated value added and productivity.

3 CAPITAL DATA: BALTIC COUNTRIES

3.1 Contribution to EU KLEMS database

The first available indicators were taken from the EU KLEMS database (Table 7), and in cases where the data were unavailable they were supplemented with data from the 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, using the perpetual inventory method (PIM) (Organisation for Economic Co-operation and Development – OECD, 2009), the capital stocks 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	Unavailable 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 elaboration

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

3.2 Contribution to INTAN Invest database

The new intangibles (Table 8) are not provided in the INTAN invest database for the Baltic countries. Consequently, new estimates were prepared using the methodology described by Corrado et al. (2012). The same sequence was applied for all of the 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**
Other more developed economies	Yes

Source: Own elaboration

Organisational Capital (OrgCap)

Organisational capital was compiled from 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; annual earnings total. For the data gaps, the interpolation method was used. Next, following Corrado et al. (2012), nominal GFCF was obtained. For the purchased component – using turnover data from Eurostat for industries M7022 (business and other management consultancy activities) and M70 (activities of head offices; management consultancy activities) – the output of M7022 was derived, and then with the assistance of USE tables in the WIOD database, the nominal GFCF of purchased component was attained (Corrado et al., 2012). The sum of the purchased and own account components was deemed the nominal GFCF of organisational capital (OrgCap).

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 very low or were 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 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 using the price levels for each type of asset. Once the real values of GFCF had been obtained for each asset type, the Harberger method was used to derive the initial capital stocks for the year 1995 (Berlemann et al., 2014). Once the initial real capital stocks for each type of capital had been derived, they were constructed using the PIM for the entire period 1995–2015.

3.3 Capital data: other selected countries

All EU KLEMS indicators of real stocks and price levels were taken from EU KLEMS databases for the selected countries regarding the following types of capital assets: IT, CT, SoftwDB, TR, OtherMash, NResid, Resid, RD, Minart, Cult namely. For the new intangibles (Minart, Design, Brand, OrgCap, Train, NPD), GFCF values were taken from the INTAN invest database, although they needed to be constructed to obtain the price levels and capital stocks required to accomplish growth accounting. In the INTAN Invest database, the GFCF nominal and GFCF chain-linked volumes are provided.

First, the price levels for certain types of capital assets for each of the selected countries were derived by dividing the GFCF nominal by the GFCF chain-linked volumes. Next the GFCF real values were derived by dividing the GFCF nominal dividing by price levels. Once the real values of GFCF had been obtained for each capital asset, the Harberger was used to derive initial capital stocks for the year 1995. Once the initial real capital stocks for each type of asset had been derived, they were constructed using PIM for the whole period 1995–2015.

Labour data for all of the 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 high-, medium- and low-skilled workers.

4 RESULTS

First, industrial contributions to aggregated labour productivity growth were considered. The results are provided in Table 9 (the highest values are marked in bold). For the more developed economies, the highest industry contributors to aggregate labour productivity growth were: manufacturing; wholesale trade, hotels and restaurants; and information and communication or financial and insurance activities. While for the Baltic countries the first two positions remained the same, i.e. manufacturing and wholesale trade, hotels and restaurants, in third place was the transportation and storage industry.

Table 9 Industrial growth contributions to aggregate LP growth, percentage points, 1995–2015

	Estonia	Latvia	Lithuania	Denmark	Germany	Spain	Sweden
Total industries	4.6	4.0	4.4	1.4	1.3	0.7	2.7
Agriculture, forestry and fishing	0.5	0.3	0.2	0.1	0.0	0.2	0.1
Mining and quarrying	0.2	0.0	0.0	–0.2	0.0	0.0	0.0
Manufacturing	**1.4**	**1.1**	**1.7**	**0.6**	**0.8**	**0.4**	**1.3**
Electricity, gas and water supply	0.2	0.0	0.2	0.0	0.1	0.0	0.0
Construction	0.2	0.4	0.3	0.0	0.0	0.0	0.0
Wholesale and retail trade; Repair of motor vehicles and motorcycles	**0.8**	**1.5**	**1.1**	**0.3**	**0.3**	**0.2**	**0.5**
Transportation and storage	**0.5**	**0.6**	**0.4**	0.1	0.1	0.0	0.1
Accommodation and food service activities	0.1	0.1	0.0	0.0	0.0	–0.2	0.0
Information and communication	0.1	0.0	0.1	**0.4**	**0.2**	0.1	**0.5**
Financial and insurance activities	0.3	0.5	0.1	0.2	0.0	**0.2**	0.2
Professional, scientific, technical, administrative and support service activities	0.3	0.0	0.0	–0.1	–0.2	–0.1	0.2
Arts, entertainment, recreation and other service activities	0.0	–0.4	0.2	0.0	0.0	0.0	0.0

Note: Highest rates are marked in bold.
Source: Own elaboration

Table 9 displays how the labour productivity growth rates and the contributions to labour productivity growth of manufacturing, wholesale, retail and repair of motor vehicles and motorcycles, transportation and storage and construction were much higher in the Baltic states than in the more advanced economies.

Table 10 presents the results of the contributors to aggregated labour productivity growth. The highest aggregated LP growth values were as follows: Estonia (5.0%), Latvia (4.9%), Lithuania (4.8%), Sweden (2.7%), Denmark and Germany (1.4%), Spain (0.6%). The reallocation effect was the highest for the Baltic countries – Lithuania (0.4%), Estonia (0.3%) and Latvia (0.1%) – positively contributing to their high values of aggregated labour productivity growth. The highest contributions of labour composition to aggregated LP growth were for Estonia and Germany (0.2%), followed by Sweden (0.1%), whilethe least negative values belonged to Latvia, Lithuania, Denmark and Spain (–0.1%).

Table 10 Contributions to annual average aggregated labour productivity growth (productivity total), percentage points, 1995–2015

			Estonia	Latvia	Lithuania	Denmark	Germany	Spain	Sweden
AB = A + B	AB	Productivity total	5.0	4.9	4.8	1.4	1.4	0.6	2.7
	A	Productivity sectorial	4.6	4.0	4.4	1.4	1.3	0.7	2.7
	B	Reallocation effect	0.3	1.0	0.4	0.0	0.1	–0.1	–0.1
A = f + g + h	f	Contribution labour composition	0.2	–0.1	–0.1	–0.1	0.2	–0.1	0.1
	g	Capital contribution	2.7	1.3	2.4	0.7	0.7	1.0	1.2
	h	MFP	1.7	2.9	2.1	0.8	0.4	–0.3	1.4

Source: Own elaboration

Table 11 Capital contributions in detail, percentage points, 1995–2015

Capital contribution = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 + 12 + 13 + 14 + 15

		Estonia	Latvia	Lithuania	Denmark	Germany	Spain	Sweden
	Capital contribution	**2.74**	**1.28**	**2.44**	**0.66**	**0.73**	**1.04**	**1.20**
1	IT	0.15	0.06	0.22	0.08	0.40	0.10	0.12
2	CT	0.20	0.02	0.15	0.02	0.01	0.09	0.10
3	TR	0.60	0.20	0.37	0.16	0.06	0.08	0.12
4	OtherMash	0.99	0.58	0.75	0.04	0.10	0.14	0.33
5	NonResid	0.41	0.07	0.47	0.02	–0.03	0.23	0.07
6	Resid	–0.09	0.05	0.00	0.00	0.00	0.16	–0.01
7	Cult	0.01	0.01	–0.02	0.04	0.00	0.03	–0.01
8	SoftwDB	0.08	0.07	0.15	0.15	0.06	0.07	0.09
9	Minart	–0.01	0.01	0.01	0.02	0.00	0.01	0.00
10	Design	0.09	0.04	0.07	–0.01	0.02	0.03	0.03
11	Nfp	0.02	0.04	0.00	0.01	0.00	0.01	0.01
12	RD	0.08	0.00	0.03	0.17	0.08	0.06	0.28
13	Brand	0.07	0.09	0.09	0.02	–0.01	0.02	–0.02
14	OrgCap	0.10	0.05	0.10	0.02	0.04	0.01	0.10
15	Train	0.04	0.03	0.03	–0.07	0.00	0.01	–0.02

Source: Own elaboration

Table 12 Ranked capital contributors to aggregated annual average labour productivity growth, 1995–2015

	Estonia	Latvia	Lithuania	Denmark	Germany	Spain	Sweden
Capital contribution	**2.74**	**1.28**	**2.44**	**0.66**	**0.73**	**1.04**	**1.20**
IT*	5	6	4	4	4	4	3
CT*	4	12	6	9	5	5	6
TR*	2	2	3	2	0	6	4
OtherMash*	1	1	1	5	6	3	1
NonResid*	3	5	2	11	0	1	8
Resid*	0	7	0	0	0	2	0
Cult*	13	13	0	6	0	10	0
SoftwDB*	8	4	5	3	2	7	7
Minart*	0	14	12	8	0	15	11
Design*	7	9	9	0	7	9	9
Nfp*	12	10	13	12	8	13	10
RD*	9	0	11	1	1	8	2
Brand*	10	3	8	10	0	11	0
OrgCap*	6	8	7	7	3	12	5
Train*	11	11	10	0	0	14	0

Note: * The largest contributor value = 1; the least = 14. Accordingly, negative values were not considered to have any significant impact on growth, hence their contributions were not considered as significant and were not included.
Source: Own elaboration

The largest capital contributions to aggregated labour productivity growth were for the Baltic countries (Table 11: from 1.28 % to 2.74%). When capital contributors were ranked (Table 12), the following results could be observed. Hereinafter attention will be paid to the first five ranks of each country that most significantly contributed to aggregated market economy labour productivity growth. Estonia: OtherMash, TR, NonResid, CT, IT (two from five were intangible). Latvia: OtherMash, TR, Brand, SoftwDB, NResid (two from five were intangible). Lithuania: OtherMash, NResid, TR, IT, SoftwDB (two from five were intangible). In Denmark the results were as follows: RD, TR, SofwtDB, IT, OtherMash (three from five were intangible). Germany: RD, SoftwDB, OrgCap, IT, CT (all intangible). Spain: Nresid, Resid, OtherMash, IT, CT (two from five were intangible). Sweden: OtherMash, RD, IT, TR, OrgCap (three from five were intangible).

Table 13 Contributions of tangible and intangible capital to aggregated annual average labour productivity growth, 1995–2015

	Capital contribution	Share of tangible capital*	Share of intangible capital**
Estonia	2.74	2.25 (82%)	0.49 (18%)
Latvia	1.28	0.97 (76%)	0.31 (24%)
Lithuania	2.44	0.8 (80%)	1.64 (20%)
Denmark	0.66	0.36 (55%)	0.3 (45%)
Germany	0.73	0.53 (73%)	0.2 (27%)
Spain	1.04	0.82 (79%)	0.22 (21%)
Sweden	1.20	0.73 (61%)	0.47 (39%)

Notes: * = (refer to Table 11) 1 + 2 + 3 + 4 + 5 + 6 + 7.
** = (refer to Table 11) 8 + 9 + 10 + 11 + 12 + 13 + 14 + 15.
Source: Own elaboration

The highest shares of tangible capital in total (Table 13) corresponded to Estonia (82%), Lithuania (80%), Spain (79%) and Latvia (76%).

If we consider that all capital equals 100 (Table 14), from IT and CT capital the highest share was provided by Germany (55%). The highest shares of machinery-based capital (transport equipment and other machinery) were made by Latvia (61%), Estonia (58%) and Lithuania (46%). For buildings, the highest share was provided by Spain (37%), while for SofwDB (23%) and innovative property (28%) the leader was Denmark. In terms of economic competencies, the highest values were provided by Latvia (12%).

Table 14 Contributions of capital groups to aggregated annual average labour productivity growth, 1995–2015

For explanations 1, 2, 3 … etc. refer to Table 11		Estonia	Latvia	Lithuania	Denmark	Germany	Spain	Sweden
SUM from I to VII = 100 %	**Capital contribution**	**2.74**	**1.28**	**2.44**	**0.66**	**0.73**	**1.04**	**1.20**
I = 1 + 2	ItandCT	13%	6%	15%	15%	55%	19%	19%
II = 3 + 4	Machinery-based	58%	61%	46%	31%	22%	20%	38%
III = 5 + 6	Buildings	12%	9%	19%	2%	–4%	37%	5%
IV = 8	SoftwDB	3%	5%	6%	23%	8%	6%	7%
V = 9 + 10 + 11 + 12	Innovative property	7%	6%	5%	28%	15%	11%	26%
VI = 13 + 14 + 15	Economic competencies	8%	12%	9%	–5%	4%	4%	5%
VII = 7	Cultivated assets	0%	1%	–1%	6%	0%	3%	–1%

Source: Own elaboration

Table 14 represents the capital structure, with a total of 100. Apparent are different structures of productivity determinants for the Baltic countries compared to their more developed counterparts: machinery-based capital dominates for the Baltic countries and economic competencies constitute a greater contribution of shares relative to more developed economies. Indeed, a far bigger part of IT and CT shares make up the capital contribution in Germany.

MFP (Table 10) accordingly presents the highest values: Latvia (2.9%), Lithuania (2.1%), Estonia (1.7%), Sweden (1.4%), Denmark (0.8%), Germany (0.4%), Spain (–0.3%). Table 15 presents the industries that contribute most to MFP growth. In more developed economies, these comprise manufacturing; wholesale and retail trade, repair of motor vehicles and motorcycles; information and communication for all of the countries; and financial and insurance activities (with the exception of Spain). For the Baltic countries, the first two positions are the same, but big contributions are also made by financial and insurance activities (except for in Lithuania), agriculture, forestry and fishing, transportation and storage (except for in Estonia) and construction (again, with the exception of Estonia).

Table 15 Industry contributions to aggregated MFP growth; percentage points, 1995–2015

	Estonia	Latvia	Lithuania	Denmark	Germany	Spain	Sweden
Total, market economy*	1.70	2.85	2.11	0.85	0.42	–0.28	1.44
Agriculture, forestry and fishing	0.17	0.19	0.20	0.04	0.02	0.11	0.04
Mining and quarrying	0.02	0.02	0.01	–0.22	0.00	–0.01	–0.05

Table 15 (continuation)

	Estonia	Latvia	Lithuania	Denmark	Germany	Spain	Sweden
Manufacturing	0.67	0.54	1.09	0.35	0.50	0.24	0.70
Electricity, gas and water supply	0.02	–0.04	0.02	–0.04	0.02	–0.09	–0.05
Construction	0.00	0.32	0.20	0.08	–0.01	–0.20	–0.08
Wholesale and retail trade; repair of motor vehicles and motorcycles	0.41	0.86	0.36	0.31	0.21	0.01	0.32
Transportation and storage	0.00	0.39	0.08	0.07	0.07	–0.03	–0.02
Accommodation and food service activities	0.06	0.08	–0.01	–0.03	–0.02	–0.24	0.01
Information and communication	–0.01	0.10	0.02	0.29	0.17	0.00	0.37
Financial and insurance activities	0.27	0.33	0.06	0.14	–0.08	0.10	0.12
Professional, scientific, technical, administrative and support service activities	0.02	0.02	0.00	–0.11	–0.41	–0.14	0.07
Arts, entertainment, recreation and other service activities	0.08	0.04	0.08	–0.04	–0.04	–0.04	0.02

Note: * All industrial MFP contributions summed to aggregate MFP.
Source: Own elaboration

CONCLUSIONS

During the process of economic growth, the agriculture, forestry, mining and manufacturing sectors shrink, while the service sector grows and expands. The industrial structure of the service sector changes accordingly, while ICT and intangible capital-intensive industries tend to grow and dominate.

All of the more developed economies examined here present a similar economic structure, with the exception of Germany. This economy has a larger manufacturing sector, and moreover this grew throughout the period researched.

The Baltic countries share a distinctive economic structure. The rate of growth of GDP per capita has been the highest, as is usually the case for emerging economies, manifesting a tendency to economic convergence. The transportation and storage industry's shares in value added are higher, but financial and insurance (except Latvia) and professional, scientific, technical, administrative and support service activities' industrial shares are lower relative to more developed economies.

In relation to industrial real value-added growth rates, the highest values are for the information and communication industry for all economies. All of the economies have also maintained high values in financial and insurance activities (except Germany) and professional, scientific, technical, administrative and support service activities. Nevertheless, the highest growth rates are for the the Baltic countries and, in contrast with the more developed economies, they are all positive.

The real growth rates of GDP and aggregated labour productivity are also higher for the Baltic countries compared with the more developed economies. Furthermore, the contributors to aggregated labour productivity, namely MFP, capital and reallocation, are higher for these economies as well. The highest contributions in terms of labour composition are for Estonia and Germany, while the least negative values belong to Latvia, Lithuania, Denmark and Spain.

Insights from the results of the industrial contributions to the aggregated labour productivity growth perspective. For more developed economies, the highest industry contributors to aggregate labour productivity growth are: manufacturing; wholesale trade and repair of motorvehicles; information and communication and financial and insurance activities. For the Baltic countries the first two positions remain the same, but the third position goes to the transportation and storage industry.

Insights from the results of the capital growth determinants perspective. For the Baltic states and Spain – which is the least developed of the four developed countries considered – the share of tangible capital is greater when compared with the more developed economies. Moreover, machinery-based (transport and other machinery) capital predominates in the Baltic countries. From this perspective, the Baltic economies are similar to Spain, in which NResid, Resid and OtherMachinery capital dominates. However, in terms of economic competencies (brand, organisational and training), the Baltic countries maintain strong positions, Latvia being foremost. From IT and CT capital the highest share by far is made by Germany, while the SofwtDB and innovative property leader is Denmark.

The ranked contributors uncovered the following consistency: the first contributors to aggregated labour productivity growth for more developed economies are in intangible capital, and RD tends to maintain the leading positions in more developed economies. In contrast in the Baltic countries, other machinery and transport capital assets make the major contributions to aggregated labour productivity growth, while RD does not take primary positions. Nevertheless, as already stated above, the industrial real value-added growth rates for industries (intangible, IT and CT and particularly R and D capital intensive), namely professional, scientific, technical, administrative and support service activities, information and communications and financial and insurance activities are for all of the Baltic economies especially high. This may be related to the notion that the Baltic economies are only at the stage of development when machinery-based capital predominates for necessary infrastructure creation, whereas later in the growth of their economic structure, both the industrial and main productivity growth determinants will change accordingly. Much greater significance should be acknowledged for intangible capital, particularly RD capital.

Given the similarities in economic structure and productivity growth determinants between the Baltic countries, more detailed analysis of productivity growth determinants in the particular industries that contribute most to aggregated labour productivity growth is required.

Moreover, as the significance of intangible capital during the process of economic growth might be clearly distinguished, investments to intangible capital should play a significant role. Therefore, further accounting research of yet-to-be-measured intangible capital components is necessary.

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