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Labour Productivity Growth Determinants in the Manufacturing Sector in the Baltic States

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ABSTRACT: This article seeks to derive the determinants of labour productivity growth in the Baltic states' manufacturing sector and comparatively analyse the results. To achieve this, first, the growth rate of value added and its main contributors, namely hours worked and the growth rate of labour productivity, have been determined. Second, the main contributors to the growth rate of labour productivity, namely the contributions of labour composition, capital, and total factor productivity (TFP), have been established. Last, following the results, the relevant comparative analysis of newly derived indicators in the manufacturing sector has been accomplished, and conclusions have been presented. This paper used the growth accounting research methodology. Research limitations: the research was performed through the primary sources of growth approach, that is, only those determinants that remain important are incorporated in the model. Practical implications: the newly derived contributors to the growth rate of labour productivity reveal actual growth sources targeted to derive conclusions. The latter could be relevant for policy recommendations at both the national (e. g. guidelines for governmental policies for the selected economies) and the international (e.g., guidelines for EU policy and acts) levels. Originality and value: the novelty of the present study lies in the fact that the growth accounting method had not previously been applied in the manufacturing sector for the Baltic states.

KEYWORDS: growth rate, value-added, labour productivity, hours worked, labour composition, capital

Introduction

The advantages that the growth accounting method can provide for the accurate measurement of the primary sources of the growth rate of value-added and labour productivity is perceived and provided by scholars (Corrado, Hulten, and Sichel 2005, 15; Jorgenson and Schreyer 2012, 2). There has, however, been inadequate attention paid by Lithuanian researchers to applying the growth accounting method for the Baltic States and a lack of results concerning this issue (Lankauskiene 2015, 2; Lankauskiene 2016, 430). This method has therefore been applied here to consider the manufacturing sector in the Baltic countries and to provide the present research results. The selection of the Baltic countries for comparative analysis is well grounded, because these countries are quite comparable, as they share similar historical, economic (structure, growth, development), political and geographical backgrounds. The manufacturing sector was selected because it remains important for the Baltic economies according to its share in gross value added and its applicable annual growth rates in those countries.

The article seeks to derive labour productivity growth determinants in the manufacturing sector of the Baltic states and compare derived results. First the growth rate of value added and its main contributors, namely hours worked and the growth rate of labour productivity, were estimated. Second, the main contributors to the growth rate of labour productivity – namely the contributions of labour composition, capital, and total factor productivity (TFP) – were determined. Last, following the results derived, a relevant comparative analysis of the new indicators was made and adequate conclusions drawn.

Research methodology – the growth accounting methodology.

Research limitations – the research was performed using the primary sources of growth approach; other factors except for the main determinants of growth value added and productivity incorporated in the model remain distanced.

Practical implications – the newly derived contributors to the growth rate of labour productivity reveal actual growth sources targeted to derive conclusions. The latter could be relevant for policy recommendations at both the national (e.g. in shaping governmental policies and guidelines for actions in the Baltic countries) and the international (e.g. EU policy and acts) levels.

Originality and value – the novelty of the present study lies in the fact that the growth accounting method has not previously been applied in the manufacturing sector for the Baltic states.

1. Methods

Economic growth consists of capital, labour and product contributions. The growth accounting method has long been used by well-known researchers (Solow 1956, 14). Later, the modified version appeared – that is, the growth accounting approach of Jorgenson, Gollop and Fraumeni (1987, 20). The latter is applied here to derive the results desired.

Suppose one unit of capital and labour (K and L, respectively) produces (value-added) output Vj in industry j. For each industry, there is the following value added defined as ΔlnTFPj (Haskel et al. 2012, 14).

$$\Delta \ln TFP_j = \Delta \ln V_j - v_{K,j} \Delta \ln K_j - v_{L,j} \Delta \ln L_j \quad (1)$$

Here, TFP is the total factor productivity, "v" and "j" are shares of K (capital) and L (labour) remuneration in nominal value added.

The relationship between industry value added and market sector value added, reflected in changes in aggregate real value added, is a weighted sum of changes in industry real value added:

$$\Delta \ln V = \sum_j w_j \Delta \ln V_j,\ w_j = P_{V,j} V_j / \sum_j (P_{V,j} V_j),\ w_j = 0.5\,(w_{j,t} + w_{j,t-1}) \quad (2)$$

The estimates of the economy-wide real value-added growth and the industrial contributions are as follows:

$$\Delta \ln V = (\sum_j w_j v_{K,j} \Delta \ln K_j) + (\sum_j w_j v_{L,j} \Delta \ln L_j) + \sum_j w_j + \ln \Delta TFP_j \quad (3)$$

The contributions of Kj and Lj to whole-economy value-added growth depend upon the share of Vj in total V (wj) and the shares of K and L in industry value added. That is, the contributions of Kj and Lj depend on their share in aggregate value added. The contribution of ΔlnTFPj also depends on the share of Vj in total V (wj) (Haskel et al. 2012, 14).

The contributions of capital (both tangible and intangible) and labour (different types and separations) can differ, and they are aggregated according to their impact on growth (Haskel et al. 2012, 15):

$$\Delta \ln K = \sum_k w_k \, \Delta \ln K_k, \text{ capital type k} \quad (4)$$

$$\Delta \ln L = \sum_l w_l \, \Delta \ln L_l, \text{ labour type l} \quad (5)$$

$$w_k = P_{K,k} K_k / \sum_k (P_{K,k} K_k), \; w_l = P_{L,l} L_l / \sum_l P_{L,l} L_l, \; K_j = \sum_j K_{k,j} \forall k, \; L_j = \sum_j L_{l,j} \forall l, \quad (6)$$

$$w_t = 0.5(w_t + w_{t-1}) \quad (7)$$

The growth accounting method provided above is applied here. After employing this technique, the growth rate of value added can be decomposed into the contributions of hours worked and labour productivity determinants within a consistent pattern. The labour productivity growth rate is further decomposed into labour, capital, and TFP input measures. Under the strict neoclassical assumptions, TFP embodies technology improvements (Goodridge 2007, 42; Oulton 2016, 68). It is derived as a residual between the volume growth of output and the volume growth of inputs. As a result, it measures the increase in value added by specific given quantities of inputs (Haskel et al. 2012, 15).

The foundation of the growth accounting method is production possibility frontiers. Industry gross output is the function of capital, labour, intermediate inputs and total factor productivity, all indexed by time. The value added consists of capital and labour inputs. Under strict neoclassical assumptions, the growth of industrial value added is broken into labour, capital, and TFP contributions. Capital and labour inputs are weighted by their parts of the remuneration in all gross value added.

The data for the growth accounting method had be prepared following strict methodological rules before application (Timmer et al. 2007, 24–44):

- Capital accounts for input measures to obtain capital volumes;
- Labour accounts for input measures to obtain labour services; and
- Productivity accounts.

Labour services reflect the labour input. The labour input measure is derived according to educational attainment. This measurement is most beneficial from a labour productivity perspective. Labour services are calculated by Formula 5 and expressed as the Tornqvist quantity index. The weights reflect the average shares of labour types according to the educational attainment in the value of labour compensation (LAB; Formula 6 and 7; Timmer et al. 2007, 24–44).

Capital services reflect capital input. The capital services measure is derived according to the detailed capital stock indicators, and the weights were the shares of its remuneration in the total output value. Capital services were calculated according to Formula 6 (Timmer et al. 2007, 24–44) and are expressed as the Tornqvist quantity index. The weights were derived as the average value of shares of each detailed asset in the value of capital compensation (CAP; Formula 6 and 7); the compensation is expressed as the user cost; and the return rate is calculated following the endogenous approach (Timmer et al. 2007, 24–44).

For the productivity accounts, capital and labour weights were derived from two indicators from the national statistics departments: compensation of employees (COMP) and gross operating surplus (GOS). GOS is adapted to self-employed income (which is forwarded to the COMP indicator). Thus, the prominent figures for capital and labour weights were derived from the remuneration values (Timmer et al. 2007, 24–44).

Growth accounting needs the preceding variables that capture the contributions of inputs and TFP to value-added growth (Timmer et al. 2007, 24–44). A new set of intangibles expands the traditional EU KLEMS methodology.

2. Research implementation

Research implementation details are presented in Table 1.

Table 1. Research implementation details

Country coverage:	Lithuania, Latvia, Estonia
Industry coverage:	Manufacturing
Method:	Growth Accounting
Methodology:	EU KLEMS approach supplemented by new intangibles
Period of research:*	1995–2017
Data:	Capital, Labour and labour compensation, value-added
Capital data:	Different types of capital assets (in more detail in Table 2)
Labour data:	Labour composition according to the educational attainment
Databases:	EU KLEMS (http://www.euklems.net), INTAN Invest (http://www.intaninvest.net), national statistics departments (Latvia: https://www.stat.gov.lt/en; Lithuania: https://www.csb.gov.lv/en/sakums, Estonia: https://www.stat.ee/en), WIOD (http://www.wiod.org/home), Eurostat (https://ec.europa.eu/eurostat)

Source: own elaboration

*The research period refers to the latest period available in the statistical databases

Table 2. Types of capital assets

EU KLEMS data	IT – Computing equipment CT – Communications equipment SoftwDB – Computer software and databases TR – Transport equipment OtherMach – Other machinery and equipment NonResid – Non-residential equipment Resid – Residential structures Cult – Cultivated assets RD – Research and development
INTAN Invest data (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

3. Data

The initial indicators (where available) were taken from the EU KLEMS database (Table 2). To fill remaining gaps, data were drawn from national statistics departments or from Eurostat databases. The needed values included the real values of GFCF for each type of asset. In cases when the data for the previous years were required, the Harberger method (1978) was used to get estimations for the initial 1995 capital stocks. With the help of the perpetual inventory method (PIM; OECD 2009, 87), the indicators were estimated for the whole period (1995–2017) needed. Lithuania lacked estimations from 1995 to 2000, so the backwards PIM calculation method was used to derive values for the missing period.

There were no data for the new intangibles (Table 2) for the Baltic countries in the INTAN invest database. For this reason, the indicators were derived with the help of the methodology of Corrado et al. (2012) and Mas and Quesada (2014, 117). The same sequence of steps needed to provide the full set of indicators were composed and applied for the Baltic countries.

4. Results

The results of the research are provided in Table 3.

Table 3. Research results

1995–2017	VAQ 1	H 2	LP 3	Contr LC 4	Contr C 5	TFP 6
	1=2+3		3=4+5+6			
Lithuania	0.06	-0.01	0.07 (0.068)	0.00 (-0.001)	0.02 (0.025)	0.04 (0.044)
Latvia	0.03	-0.02	0.05 (0.053)	0.01 (0.007)	0.02 (0.023)	0.02 (0.023)
Estonia	0.05	-0.01	0.06 (0.062)	0.00 (-0.002)	0.03 (0.035)	0.03 (0.029)

Source: own calculations

*VAQ – the growth rate of value added (%)
H – contribution of hours
LP – the growth rate of labour productivity (%)
Contr LC – contribution of labour composition (according to educational attainment)
Contr C – contribution capital
TFP – total factor productivity

During the period researched, the growth rate of value added was highest in Lithuania's manufacturing sector (0.06%). The second place goes to Estonia (0.05%), followed by Latvia (0.03%). The hours worked contributed negatively to the growth rate of value added in the manufacturing sector in all Baltic countries, but most negatively in Latvia (−0.02%). Labour productivity was the highest in Lithuania (0.07%), followed by Estonia (0.06%) and Latvia (0.05%). The real interest is the driving forces of labour productivity growth, as this is the most critical indicator for wealth, beginning in the research of Solow (1956, 14) and Jorgenson, Landefeld, and Shreyer (2014, 3) and ending in contemporary research (Goodridge, Haskel, and Edquist 2019, 867; Castellani et al. 2018, 75; Goodridge, Haskel, and Wallis 2018, 1; Jona-Lasinio and Meliciani 2018, 58; Oulton 2018, 63; Van Ark, de Vries, and Jäger 2018, 53; Goodridge and Haskel 2015a, 2015b, 2; Veugelers 2015, 4; Dal Borgo et al. 2013, 806;

Jorgenson, Ho, and Stiroh 2005, 2) and the EU policy agenda (Van Ark 2015, 6). The TFP indicator is of real interest because it embodies technological change; the highest contributor is in Lithuania (0.04%), followed by Estonia (0.03%) and then Latvia (0.02%). Regarding contribution of capital, the highest is in Estonia (0.03%), followed by equal positions shared in Lithuania and Latvia (0.02%). The contribution of labour composition to the growth rate of labour productivity is more or less similar in all countries, and it does not take a leading role in any of them: Latvia (0.01%) and Lithuania and Estonia (0.00%).

5. Conclusions

The manufacturing sector is significant for the economies of the Baltic countries. It was necessary to distinguish the main contributors to labour productivity growth in the manufacturing industry for the researched economies because results related to Baltic economies were lacking. The highest positions in the growth rate of value added and, most importantly – labour productivity, Lithuania's remains. A more in-depth analysis of the results derived revealed an exciting tendency – the contribution of TFP also remains the highest in Lithuania. This indicator is a significant one, because it embodies technological change. Capital, more or less, remains an equal contributor, and labour composition, according to educational attainment, does not play a vital role for any of the three researched economies. The following indicators – value added, labour productivity growth and TFP – the first place goes to Lithuania, followed by Estonia and Latvia.

The results obtained are impressive. A more in-depth analysis is needed, particularly for the main detailed contributions of the different types of capital assets to the growth rate of labour productivity and their separation according to tangible and intangible capital deepening (Corrado et al. 2012, 13; Corrado et al. 2013, 261; Haskel et al. 2010, 17; Haskel et al. 2014, 2; Guido and Bodmer 2017, 211; Jona-Lasinio, Manzocchi, and Meliciani 2019, 1).

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