Productivity and economic structure: some empirical lessons of the relationship[1]

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Abstract

The paper aims to offer some empirical insights into the relationship between the indicators of the aggregated productivity and economic structure examining this relationship on the level of the EU-27 countries and of the regions (counties) of Estonia – a small member country of the EU. In order to elaborate on the aggregated indicators of the countries' and regions' economic structure, the method of principal component in combination with regression analysis is applied in the paper. The estimated regression models describe more than two thirds of the variability of the aggregated productivity in the EU-27 countries. The results of the empirical analysis show that productivity of the EU new member states is below-average, in ceteris paribus terms, while the productivity of small countries is somewhat higher than average. The results of the empirical analysis on the level of the regions of Estonia confirm the validity of the hypothesis that regional disparities in productivity are remarkably affected by the sectoral structure of the regions' economy. There is a core-periphery structure with high income levels in the capital region and low income levels in peripheral regions. The divergence in regional aggregated productivity levels within a small country like Estonia indicates that the concentration of production inputs is mainly in the comparatively large regions, where economies are functioning more efficiently. Regional and national policies having target leading to regional income convergence should definitely serve measures both to alleviate poverty and support structural changes improving efficiency of economies.

Keywords: economic structure, productivity, regional disparities, EU-27, Estonia

1. Introduction

The issue of regional disparities and convergence has been the subject of a large body of empirical research since 1990s (e.g., Barro and Sala-i-Martin 1995, Armstrong 1995, Tondl 2001, Cuadrado Roura 2001, Baumont et al. 2003, Arbia and Piras 2005, Meliciani and Peracchi 2006, Anagnostou *et al* 2008, Paas and Schlitte 2008). Despite the great interest in this matter, information on regional convergence in the enlarged EU is still relatively scarce and the role of sectoral structure in convergence processes has been largely ignored. However, considering the objective of enhancing economic and social cohesion, this constitutes a challenging task in the context of developing proper regional policy measures helping to alleviate poverty and to improve efficiency of an economy. Information on disparities and factors that may have impact on regional economic development is therefore of utmost importance for regional policy. Sectoral structure of an economy, which can be analysed on

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the basis of a wide range of indicators (employment, added value, GDP, etc.) and at different levels and structure of economic sectors, is playing a significant role in the economic performance and regional development of a country; its improvement is vital for enhancing both economic efficiency and wealth.

The relationship between sectoral structure and economic development of a country has received considerable attention in recent decades (see Gemmell, 1987). According to the three-sector hypothesis, which was first introduced by Fisher (1935) and Clark (1940), a gradual shift in employment and value added from the primary to the tertiary sector is inherent in the process of economic development. Hence, structural change could be characterized as a demand phenomenon: with increasing income levels, the demand for inferior goods will unavoidably decrease, while the demand for superior services will continue to grow (Breitenfellner & Hildebrandt, 2006). Also regional aspects of structural change have gained remarkable attention in recent economic literature (e.g. Cunado, J.; Sanches-Robles, B., 2000; Arcelus, F.J.; Dovan, P., 2003; Marelli, E., 2004; Osterhaven, J; Broersma, C. 2007).

The paper aims to offer some empirical insights into the relationship between the indicators of aggregated productivity and economic structure examining this relationship on the level of the EU-27 countries and the regions (counties) of Estonia, the small country with post-socialist path-dependence. Estonia like the other two Baltic States, Latvia and Lithuania are the only former Soviet Republics that are the members of the enlarged EU. Therefore this country provides an interesting case for generalizing the post-socialist transition and the European (re)integration processes also in the global context.

The analysis bases on Eurostat sectoral data of the EU-27 economies and the data of the Statistics Estonia about sectoral structure of the counties of Estonia. The data are examined using the combination of several statistical methods in order to elaborate on the aggregated indicators (latent variables) of the EU-27 and Estonian counties' sectoral structure and to examine the relationship between the aggregated indicators of sectoral structure and GDP per capita.

The paper consists of six sections. In the next section, the framework for the analysis of sectoral structure including conceptualization and measurement of the observable phenomena is introduced and a short data description is presented. Section 3 gives an overview of the main shifts in the sectoral structure of the EU-27 economies. Section 4 introduces the procedure of finding aggregate indicators for analysis by means of the method of principal components, and presents the results of elaborating and analysing the aggregated indicators that describe sectoral structure of the EU-27 countries. Section 5 examines the relationship between the aggregated indicators of sectoral structure and GDP per capita in the case of the regions (counties) of Estonia. Section 6 concludes.

2. A framework for the analysis of sectoral structure: data and methodology

The general trends in sectoral evolution are summarized by the so-called "three-sector hypothesis" associated historically with Firsher (1935) and Clark (1940) works. "The three

sector hypothesis" describes the long-run evolution of economies from agricultural to industrial and then to service-based economic structure defined as the process of tertiarization (see also Bachman and Burda, 2008). These developments are associated with the changes in the shares of sectors by creating value added as well as in movement of labour between sectors that induce new challenges for development of human capital and educational system. Some of structural change has a short run nature reflecting temporary shifts of technological and innovative development, while others are more or less permanent having also different impact economic growth and GDP per capita across countries and their regions.

Nowadays the service sector is the most important sector in industrialized economies. According to the ILO data, the service sector's share of total employment in the European Union and other developed economies has grown from 66.1% in 1995 to 71.4% in 2005; the industry sector shrunk from 28.7% to 24.9% at the same time (ILO 2006). The sectoral shifts in employment and also in GVA structure describe the widening process of tertiarization of national as well as international economies and this tendency is also valid in the EU countries and their regions. The industrialized countries of the EU have already entered the stage of post-industrialised service economies which also generates certain effects of sectoral structure on the aggregated productivity of an economy. The new member states of the EU mainly passed the process of industrialisation and also entering into the post-industrialization stage. The economies with different sectoral structures have essentially different opportunities of growth.

The sectoral structure of an economy can be analysed on the basis of a wide range of indicators (employment, added value, GDP, etc.) and at different levels and structure of economic sectors. Table 1 presents the 3-level classification system of economic sectors which is used in the Eurostat database of sectoral data.

Table 1. Classification of the main economic sectors

Economic sectors	Classification code in the Eurostat database
Agriculture, hunting, forestry, fishing	A, B
Manufacturing, construction,	C, D, E, F
Wholesale and retail trade; repair of motor vehicles and household appliances, hotels and restaurants, transport, warehousing, communication, financial mediation, real estate, renting and business activities, public administration and civil defence; compulsory social insurance, education, health care and social welfare, etc.	G, H, I, J, K, L, M, N, O

Source: Eurostat

The empirical analysis of a sectoral structure of the counties of Estonia bases on the different indicators focusing on the role of three main economic sectors in employment and in creating GDP and value added (table 2). The data for the analysis are derived from the regional data base of the Statistics Estonia of the years 1997–2006, the period that mainly describes the post-socialist transition and EU assessment processes. As we see from the table 2, according to the different indicators describing sectoral structure there are significant disparities between the 15 counties

Tabel 2. The variability of the share of the main economic sectors in the counties of Estonia, 1997–2006 average (%)

		Minimum	Maximum	Average
Primary sector	The share in GDP	0.7	23.0	10.0
	The share in employment	1.1	32.0	13.1
	The share in added value	0.8	25.0	11.3
Secondary sector	The share in GDP	14.4	45.3	27.1
	The share in employment	19.1	53.9	33.2
	The share in added value	16.2	51.5	30.5
Tertiary sector	The share in GDP	40.5	68.3	51.3
	The share in employment	41.3	70.8	53.4
	The share in added value	46.4	76.0	57.9

Source: Author's calculations based on the data of Statistics Estonia

We are aware that sectoral structure of an economy is a complicated phenomenon, the different sides of which could be characterized by a number of different indicators. Use of several individual indicators would make the analysis complicated and incomprehensive, whereby in the present study we first attempt to generalize the initial indicators to some aggregated variables which will be applied in further analysis. For the generalization procedure there are several methods available; in our study the method of principal components (confirmative factor analysis) has been chosen.

3. Main shifts in the sectoral structure of the EU economies

The main shifts in sectoral structure can be characterized by the following steps: 1) the shift from agricultural to industrial economy, which began in England and has been widened to most western countries (the process of industrialization); 2) the shift from industrial to service economy which started in the United States and is evident in all developed economies (the process of tertialization). These shifts in sectoral structure have extensively been analyzed in the literature on the changing economic structure of the highly industrialized economies, which allows to summarize that the expansion of service industry may be the result of: a) a shift in the structure of final demand from goods to services; b) changes in the inter-industry division of labour, favouring specialized service activities rising; and c) inter-industry productivity differentials. (e.g. overview Schettkat and Yocarini, 2003).

The shift to service sector does not always result from changing final demand, but also from differential productivity growth (see Baumol 1967 and 2001). Since service sector productivity increases less than manufacturing productivity, the share of employment in the service sector will be higher in high-income economies. If wages in the service sector increase in line with an economy's average rate of wage growth, then the share of services in nominal output will also rise with income. Such an increase does not always reflect a greater desire for services, but may also indicate that the level of technology implemented in service sector is often lower than in manufacturing.The shift in sectoral structure of an economy can be analyzed on the basis of a wide range of indicators (employment, added value, GDP, etc.) and at different levels and structure of economic sectors. In this paper the analysis of a sectoral

structure of the EU economies bases on the share of added value in GDP of the six aggregated economic sectors.

Sectoral shifts in employment and in GVA structure describe the widening process of tertiarization of the EU economies. According to the ILO data, the service sector's share of total employment has grown from 66.1% in 1995 to 71.4% in 2005; the industry sector shrunk from 28.7% to 24.9% at the same time (ILO 2006). The main trends in the sectoral change of the EU-27 economies can be described by the decline of the sectors' shares connected to agriculture and manufacturing and the increase of the share of service sectors. The industrialized countries of the EU have already entered the stage of post-industrialised service economies. There is also a remarkable variation in these shifts between the EU economies, particularly if comparing economic structures of the EU old (EU-15) and new member states (NMS, EU-12). It may be concluded that by the mid-2000-s the economic structure of the so-called old members of the EU (except Spain and Greece) became relatively similar.

Andreas Breitenfeller and Antje Hildenbrandt (2006) analyzed the development of sectoral structure of the EU-15 economies' over the period 1950-1998 and they distinguished four groups of countries according to the models of tertiarization. These models adequately describe the variation in economic structure of the EU economies before the EU eastward enlargement processes started. The first group of countries (Belgium, France, Ireland, Netherlands and UK) followed the model of dynamic tertiarization, which is characterized by accelerated development of market services. Demand for consumption-related services was stimulated by strong focus on the domestic economy as well as by trade specialization on service export. Structural shifts were supported by liberalization and deregulation. The second group of countries (Germany, Italy, Austria) followed the model of lagging tertiarization. This development is characterized by a comparatively stable position of the manufacturing sector in an economic structure. The assumption for introducing this approach was the view that productivity growth can be first of all generated in industry sector. Another reason for lagging tertiarization was the corporatist system of social partnership, which gives higher priority to the competitiveness of industrial locations than to national policies. The Nordic countries (Denmark, Finland, Sweden) followed the model of managed tertiarization. This model embodies a strategy to promote the development of knowledge-based and social services supported by promotion of human capital development and innovation. The fourth group of countries (Greece, Spain and Portugal) followed the model of catching-up tertiarization. This model reflects the general shift toward the service sectors that is associated with rising per capita income mainly due to the EU accession.

The shifts to the service-based economies occurred in the Central and Eastern were much more rapid than in the EU-15. The NMS have some similarities with the Southern European countries in development of their economic structure and following the tertiarization processes. Evidently the NMS do not need to follow the same development pattern that the countries that followed the model of previous catching-up tertiarization did. The global environment for competitive development is changing quickly and adjustment to the rapid changes requires flexible structures of product and factor markets as well as promotion of innovation diffusion and human capital creation.

Estonia's transition to a market economy and sectoral shifts to tertiarization has been enhanced by integration with the EU. In 1970s and 1980s Estonia had typical features of an industrial country. At the end of 1980-ies the share of manufacturing and agriculture was larger than in developed countries whereas the share of service sectors was modest. By the way, the structure and dynamics of the Estonian economy have been substantially influenced by local natural resources, of which oil shale is the most important. That industry produces the majority of electricity in Estonia. Substantial investments were made in the 1980s in transportation. The most important construction was Muuga Port near Tallinn. This port has been increasingly important for the Estonian economy serving domestic needs as well as transit trade after regaining independence (see Lumiste et al, 2008). The transition of the Estonia to a market economy has also been accompanied by the introduction of modern banking and finance, real estate markets, and business services (see (see Annex 1, figures F1-F6). The retail and wholesale trade grew also very rapidly. We can consider Estonia as an example of an open economy whose economic growth and sectoral change is largely based on foreign trade and FDI and also on quick development of construction and unfortunately also on the recent real estate boom.

4. Aggregated indicators of sectoral structure as factors explaining variability of countries' productivity level

4.1. Aggregated indicators of sectoral structure

In order to get a more in-depth overview of the sectoral structure of the EU-27 economies several statistical methods are applied in the paper. At first, the relationships between the initial sectoral indicators of the countries' economic structure are assessed by a correlation analysis. Then, by using factor analysis (method of principal components) the aggregated indicators characterising the economic structures of the EU-27 economies are elaborated. We estimate a factor model both based on the cross-section data of the years 1995, 2000 and 2005 and on the pooled data (27 countries and 6 years, 2000-2005) checking also for robustness of the results. In order to study the relationship between the aggregated indicators of sectoral structure and productivity, several regression models are estimated. These modes allow us to evaluate the differences between the actual productivity and the so-called potential productivity – the productivity calculated on the basis of the aggregated characteristics of a sectoral structure taking also into account the size and path-dependence of the economies.

The aggregated indicators (latent variables) for describing the economic structure of the EU27 countries are obtained by using factor analysis. In all cases two aggregated indicators of an economic structure are extracted – factors F1 and F2. These two factors describe around two-thirds of the variance of initial indicators of sectoral structure (the share of GVA of a sector in GDP). Factor matrix based on cross-sectional data is presented in table 3. The components of a factor matrix – factor loads describe the correlations between the initial (measured) indicators (shares on sectors S1-S6 GVA in GDP) and factors – latent variables, the aggregated indicators of a sectoral structure.

Table 3. The matrix of factor loads describing the sectoral structure of the EU-27 countries

	Factor loads	
Sectors	**F1**	**F2**
S1	-.786**	-.211
S2	-.745**	.531**
S3	.096	-.642**
S4	.188	-.858**
S5	.791**	.213
S6	.762**	.127

** - level of significance 0.01

Source: calculations based on the Eurostat data.

The most challenging part of implementing factor analysis is the economic interpretation of the statistical results. The first step in this work is the analysis of the factor loads in order to explore the economic meaning of the latent variables (factors) giving those respective names. The next step of the analysis focuses on the factor scores which describe the value of the aggregated indicators of every observation. Factor scores are standardised.

Factor F1 has higher negative factor loads for initial indicators describing sectors S1 (agriculture, forestry) and S2 (manufacturing), and higher positive factor loads for sectors S5 (financial service, etc) and S6 (public sector services). Based on these indicators we decided to call F1 as a factor describing the development level of a post-industrial service economy. In the case of factor F2, the largest negative factor loads detected regarding sectors S3 and S4 (construction and trade-tourism-transport), while the largest positive factor loads were observed regarding S2. We suppose that manufacturing as an economic sector can be considered as the necessary prerequisite for broad-based technological innovation. Most service areas (sectors S3 and S4) are often relatively passive in terms of technological innovation – they are rather recipients than providers of innovation spillovers. Thus we decided to interpret factor F2 as the factor describing the environment for technological innovation.

The levels of the aggregated indicators of the EU-27 countries' sectoral structure, factors F1 (development level of a post-industrial service economy) and F2 (environment for technological innovation) are characterised by the factors scores of these factors. Figures 1 and 2 respectively illustrate the level and dynamics of the aggregated indicators of economic structure (factors F1 and F2) of the EU-27 counties during the period 1995-2005. The aggregated indicator that characterise the development level of the post-industrial service economy (F1) is ordinarily low in all Central and East European countries that acceded to the EU in 2004 (the EU-8; Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and , Slovenia) and later (Bulgaria and Romania). Based on the level of the indicators describing the environment of technological innovation (F2), Southern Europe and Baltic countries differ from the average European indicator notably, being much lower.

However, this is not always the case for some Central European countries such as Hungary, Czech Republic and Slovenia.

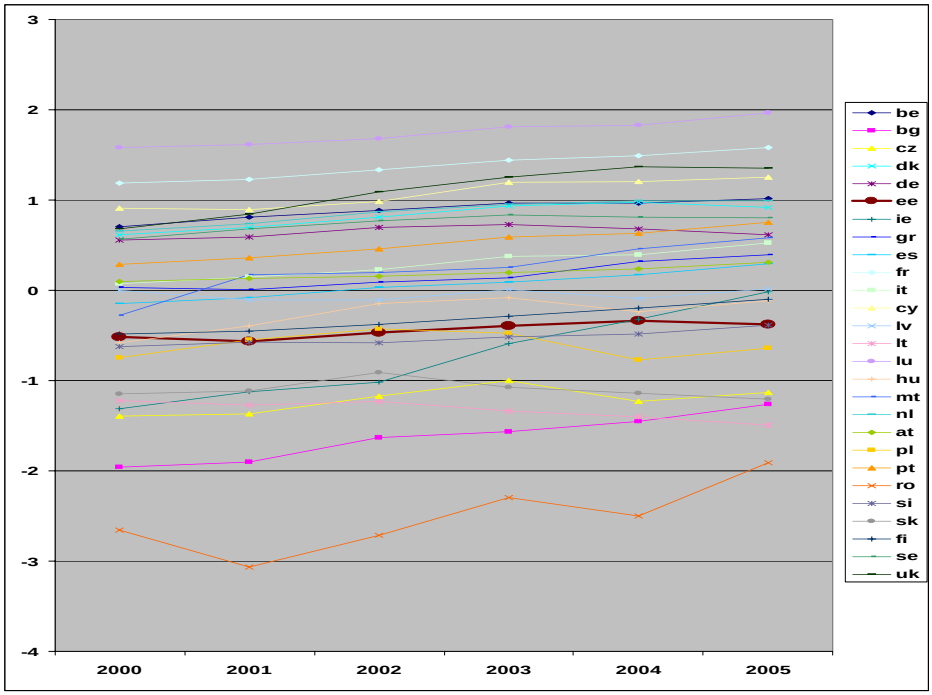

Figure F1. Factor scores of the Factor 1 - development level of post-industrial service economy in the EU-27 countries, 2000-2005. *Source:* author's estimations based on the Eurostat data

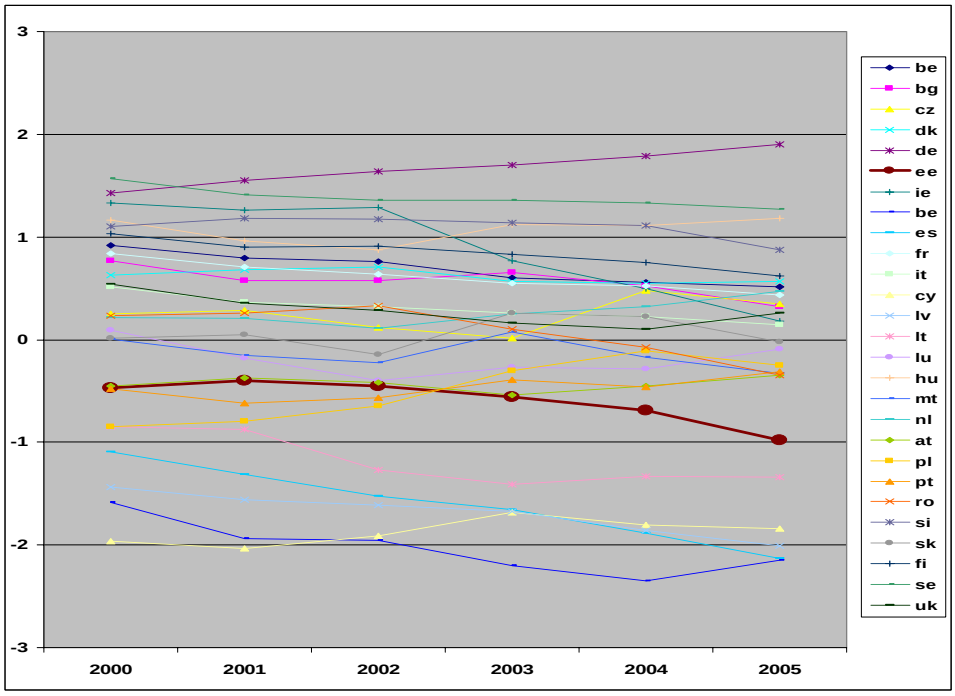

Figure 2. Factor scores of the Factor 2 - environment for technological innovation in the EU-27 countries, 2000-2005. *Source:* author's estimations based on the Eurostat data

On the basis of the level of the aggregated indicators and dynamics of the respective factor scores of the latent variables – factors F1 and F2 three groups of countries can be distinguished within the EU-27:

1) West and North European welfare countries with developed service economy (Belgium, Sweden Denmark, Germany, etc);

2) South European countries where tourism has a strong position in the economic structure (Portugal, Greece, Spain);

3) East and Central European countries, where manufacturing sector still maintains a relatively big share, which is gradually declining in favor of service sectors (the Baltic States, Poland, Slovakia, etc).

The first group of countries is made up of West and North European countries with developed service economies, characterized by the relatively high level of factor scores of the factor F1. In these countries (particularly in Germany and Sweden) manufacturing maintains a strong position in creating added value. Thus in this respect, they are clearly distinctive from the second group of countries, consisting mainly of South European economies in which the share of sector S4 is remarkable in creating GVA. In general the two first groups of countries are representing the EU-15 countries resounding the possible development ways for the EU new member states. The latter are facing the problem of how to overcome the deindustrialization phase and to less harmfully move from the low value added sectors to the high value-added. The third group of countries is made up of transition countries with low factor scores for F1. Taking into account the level and dynamics of factor scores for F2 this group of countries is not homogenous. With their recent development which is characterized particularly by construction boom, the Baltic states are becoming closer to the countries of Southern Europe. Hungary and Slovenia are in some sense closer to Finland and Ireland. Of course, we should treat these results with cautions taking into account that the economies under observation are in different stages of their development as well in different business cycles.

Sectoral structure of Estonia's economy has been experiencing the trends of declining factor scores of both factors F1 and F2, although the declining trend has been notably slower by F1 than by F2. The Estonian economic structure is characterized by a low level of manufacturing based technological innovation. In countries with well developed manufacturing sector, the technological innovations created in this sector are transferred gradually to other economic sectors, thus creating additional opportunities for technological innovation and also for developing and offering new services. It is difficult to build up a modern and internationally competitive service sector without passing the interim stage of more complex industry (see also Hirsch-Kreinsen et al, 2005). Thus, it can not be predicted that Estonia's economic future could be following the path of Luxembourg (i.e., to develop strong modern service sectors including financial services). Estonia's current economic structure may suggest that its development is closer to that of the countries of Southern Europe. In other words, the structure of the Estonian economy is becoming more similar to that of Greece than that of Luxembourg. Of course, Estonia is not the only exception among the NMS. The described

situation and trends are also predictable for other two Baltic states as well to majority of NMS.

4.2. The relationship between aggregated productivity and sectoral structure

In order to study the relationship between the sectoral structure and aggregated productivity of the EU-27 economies we estimate regression models based on the Eurostat productivity data and the aggregated indicators (factor scores of factors F1 and F2) of sectoral structure of the EU-27 economies.

The basic regression equation for exploring the relationship between the indicators of productivity and secroral structure of an economy is as follows:

$$Y_{it} = \alpha + \sum_{j=1}^{k} \beta_j X_{jit} + \sum_{j=k+1}^{k'} \beta_j D_{ji} + u_{it} \qquad (1),$$

where

Y_{it} - aggregated productivity in the country *i* at time *t* (added value per employee in euros; in year 2000 prices);

X_{jit} - explanatory variable characterizing sectoral structure of the country *i* at time *t,* factor scores of the aggregated factors F1 and F2;

D_{ji} - dummy variables, proxies that characterize path-dependence and size of an economy;

D_{1i} =1 if country *i* is the NMS and D_{1i} =0 otherwise;

D_{2i}=*1*, if small country (the population is 6 millions and less), D_{2i}=*0* otherwise;

α -intercept;

β_j - parameters of the explanatory variables;

j = *0 1,2,* …k and k' ; n = sample size.

The estimated regression models describe approximately 64-87% of the variability of aggregated productivity in EU-27 countries (table 4).

Tabel 4. Regression models for estimating aggregated productivity in the EU-27 countries

Models	Intercept	*F1*	*F2*	*D1*	*D2*	R^2	$\hat{R}^2$
Model 1	34882.2	16424.0	6848.3			0.644	0.640
(*se)*	(1084.730)	(1070.259)	(1068.444)	–	–		
(p)	(0.000)	(0.000)	(0.000)			(0.000)	(0.000)
Model 2	44942.179	6739.633	4276.095	-31156.129	7926.625	0.871	0.868
(se)	(1058.508)	(880.855)	(675.225)	(1910.254)	(1433.306)		
(p)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Dependent variable: aggregated productivity measured as the added value per employyee in euros (in year 2000 prices); n= 162.

Source: author's estimations based on the Eurostat data

The estimators show that both the development level of the post-industrial economy (F1) as well as the environment for technological innovations (F2) is related to the productivity in the same direction. The productivity of new member states is below-average. Thus, we argue that

the hypothesis of post-socialist path-dependence got confirmation. The estimation results also confirmed the validity of the hypothesis that productivity of small countries of the EU-27 is somewhat higher than average. Evidently knowledge spillovers are sometimes quicker in small countries inducing innovations and creating conditions for productivity growth.

The path-dependency in sectoral level is often expressed by the technological trajectories and knowledge which are cumulative and build upon the earlier technology and learning abilities. The firms of the new EU member states are ordinarily much more constrained by their environment than the firms in the highly developed countries. The firms of the NMS may have the capability to introduce a new product or process, these possibilities to do that significantly depend the skills of entrepreneurs and workers of the country; there is also often lack of substantial investments.

These evaluations results could be considered as the so-called potential productivity – the productivity level could have been in the given country if it had been influenced by sectoral structure characterized by aggregated indicators - factors F1 and F2 taking also into account the size and path-dependence of an economy. In order to compare the predicted productivity (the so-called "potential" productivity) with the real one standardized residuals are calculated

A comparable assessment of the potential productivity of the EU27 economies shows that the real productivity of the Estonian economy is notably lower than the estimated level. Taking into consideration the results of our analysis it is possible to conclude that Estonia's economic structure and sectoral change mainly fits to the model of catching–up tertiarization described by Andres Breitenfeller and Antje Hildebrandt (2006). This model generally summarizes the developments in sectoral structure experienced by countries that joined the EU later stage: during the southern enlargement round (like Greece, Spain and Portugal) or during the eastern enlargement round (like post-socialist countries). The low-labour oriented foreign direct investment remarkably contributed to the sectoral shifts in Estonia and that still has an impact of the sectoral structure of the economy.

5. The relationship between sectoral structure and GDP per capita in the case of regions of Estonia

In order to examine the relationship between the sectoral structure and GDP per capita of the Estonian counties we estimate regression models based on the Estonian Statistics regional GDP data and the aggregated indicators (factor scores) of factors of sectoral structure (see formula 1; dummies are included for the years).

The estimated regression models are presented in the tables 5 (model 1) and 6 (model 2). Table 4 presents estimators of the regression model (model 2) that describe the relationship between GDP per capita and sectoral structure taking into account also the location of the counties (distance between the capital city and counties' centre). The estimated regression models describe approximately 64% (model 1) and 80% (model 2) of regional variability of GDP per capita.

The estimators show that the aggregated indicators both of primary and tertiary sectors are related to the GDP per capita as a proxy of economic wealth. The signs of the parameters are as expected: in the case of primary sector negative and tertiary sector positive. The estimation

results also confirmed the validity of the hypothesis that location of the counties has a statistically significant impact on the regional variability of GDP per capita. The sign of the respective parameter is as expected negative indicating that there is a core-periphery structure with high income levels in the capital region, Harju county, and low income levels in peripheral regions. Divergence in regional GDP levels may indicate to the concentration of production inputs and development of sectoral structure in regions, where economies are functioning more efficiently.

Table 3. Empirical results: estimators of the model 1

Variables	Estimators		t	Significance
	Coefficients	Standard error		
Intercept	100825.861	5284.054	19.081	.000
Primary sector	–7866.794	2528.880	–3.111	.003
Tertiary sector	15892.736	2496.843	6.365	.000
2001	–42313.331	7542.407	–5.610	.000
2002	–36318.361	7478.053	–4.857	.000
2003	–31145.851	7425.534	–4.194	.000
2004	–24932.554	7403.919	–3.367	.001
2005	–14211.067	7376.164	–1.927	.057

Dependent variable: GDP per capita; $R^2=0.635$; $R^{2adj}=0.604$; $p=0.000$.

Source: Authors' calculations based on the data of Statistics Estonia.

Table 4. Empirical results: estimators of the model 2

Variables	Estimators		t	Significance
	Coefficients	Standard error		
Intercept	128532,524	5266,042	24,408	,000
Primary sector	–7343,265	1901,680	–3,861	,000
Tertiary sector	13886,043	1893,123	7,335	,000
Distance	–189,021	23,594	–8,011	,000
2001	–42117,078	5668,479	–7,430	,000
2002	–36108,631	5620,123	–6,425	,000
2003	–30888,159	5580,684	–5,535	,000
2004	–24659,847	5564,451	–4,432	,000
2005	–13892,224	5543,630	–2,506	,014

Dependent variable: GDP per capita; $R^2=0.797$; $R^{2adj}=0.777$; $p=0.000$.

Source: Authors' calculations based on the data of Statistics Estonia.

The predicted values of GDP per capita which are calculated on the basis of the both modelscould be considered as the so-called potential economic wealth or "potential" – GDP per capita of a county. This is GDP per capita could have been in the given county if it had been influenced only by sectoral structure characterized by aggregated indicators of economic sectors (model 1) or by sectoral structure characterized by aggregated indicators of economic sectors and the distance between the counties' centres and capital city (model 2).

In order to compare the so-called "potential" GDP per capita (or predicted GDP) with its real value the standardized residuals are calculated. Standardized residuals allow us to compare the differences in the actual and so-called potential economic wealth taking into account different size of the counties' economies. Table 7 presents data of actual and estimated (potential) GDP per capita, the differences between them (residuals) as well as standardized residuals for the year 2006.

Table 7. Actual and predicted GDP per capita (potential GDP) in Estonian counties in 2006

County	GDP *per capita*	Estimated GDP *per capita* (potential)	Standardised residuals
Harjumaa	239987	174919	4.307
Hiiumaa	91533	90214	0.087
Ida-Virumaa	86085	95310	–0.611
Jõgevamaa	66918	82281	–1.017
Järvamaa	94112	88220	0.390
Läänemaa	92997	118135	–1.664
Lääne-Virumaa	98499	94770	0.247
Põlvamaa	72284	71547	0.049
Pärnumaa	111515	113612	–0.139
Raplamaa	82229	109952	–1.835
Saaremaa	97469	93178	0.284
Tartumaa	134745	121602	0.870
Valgamaa	74511	88994	–0.959
Viljandimaa	83717	81859	0.123
Võrumaa	76131	78131	–0.132

Source: Authors' calculations based on the data of Statistics Estonia.

The analysis of regional sectoral structure and elaboration of aggregated indicators of sectors allow us to divide counties according their respective sectoral performance into three groups within each of the three sectors. Firstly, based on the aggregated indicators of primary sector, it is possible to divide counties into the following groups: 1) counties with a high share of primary sector where this share has remained comparatively high also at the end of the period under observation (Jõgevamaa, Põlvamaa, Hiiumaa, Viljandimaa and Järvamaa); 2) counties with a comparatively low share of the primary sector and/or where this share did not change remarkably (Harjumaa, Ida-Virumaa, Tartumaa, Läänemaa, Saaremaa and Võrumaa); 3) the counties which has a high share of primary sector, but where this share has significantly declined during the period under observation (Pärnumaa, Valgamaa, Lääne-Virumaa and Raplamaa).

Secondly, the changes in the secondary sector have been most rapid and heterogenous. Again, we can distinguish between three groups of counties: 1) counties where the share of secondary sector is above average in comparison with other counties and it increased during the period under observation; (Lääne-Virumaa, Võrumaa,Pärnumaa, Järvamaa) 2) counties where the share of secondary sector has been below average and it increased over the whole period (Jõgevamaa, Hiiumaa, Tartumaa, Põlvamaa, Valgamaa); 3) counties where in comparison with other counties the share of the secondary sector decreased significantly (Ida-Virumaa, where the share is above average; Harjumaa, whrere the share is below average).

Thirdly, according to the aggregated indicators of the tertiary sector, it is possible to divide counties into the following types 1) counties where the share of tertiary sector is above average and it increased (Harjumaa, Saaremaa) or decreased during the investigated period (Tartumaa, Valgamaa, Läänemaa, Võrumaa); 2) counties where the share of tertiary sector is below the average and has increased (Ida-Virumaa, Lääne-Virumaa, Pärnumaa) and 3) counties where the share of the sector was below the average and has declined (Jõgevamaa, Järvamaa, Põlvamaa, Viljandimaa).

We can summarize that regional pattern of the Estonian counties sectoral structure is heterogenous and dynamic indicating also that small economies are able to adjust with the challenges posed by the rapidly changing socio-economic environment.

6. Conclusions

On the basis of the level and dynamics of the aggregated indicators that describe the sectoral structure if the EU27 economies three groups of the EU countries can distinguish: 1) West and North European welfare countries with well developed service economy as well as manufacturing (Sweden, Denmark, Finland, Germany, etc); 2) South European countries where tourism has a strong position in the economic structure (Portugal, Greece, Spain); 3) East and Central European countries, where manufacturing sector still maintains a relatively big share, which is gradually declining in favour of service sectors (the Baltic States, Poland, Hungary, etc). The two first groups of countries are representing the EU-15 countries resounding the possible development ways for the EU new member states. Estonia like other East and Central European post-socialist countries is facing the problem how to overcome the deindustrialization phase and move from the low value added sectors to the high value-added less harmfully.

Based on the aggregated indicators of sectoral structure and taking also into account the size and path-dependence of an economy, the regression models exploring aggregated productivity of the EU-27 countries were estimated and analysed in the paper. The estimators show that both the development level of the post-industrial economy (F1) as well as environment for technological innovations (F2) is related to the productivity level in the same direction. The productivity of the new member states is as a rule below-average. We conclude that the hypothesis that the post-socialist path-dependence matters, got confirmation. The estimation results also proved the validity of the hypothesis that the productivity of small countries of the EU-27 is somewhat higher than average. We argue that knowledge spillovers are sometimes quicker in small countries inducing innovations and creating conditions for productivity growth.

Summarising the results of the analysis one should emphasize that the real productivity of the Estonian economy is notably lower than the estimated level. Estonia should put serious emphasis in order to use her resources and development potential more effectively and to overcome the consequences of the global financial crisis as well as serious economic decline started in 2008 less harmfully. The rise of productivity requires planned efforts in

modernizing economic structure taking also into account the path-dependence and size of an economy.

The results of the empirical analysis on the level of the regions (counties) of Estonia confirm the validity of the hypothesis that regional disparities in productivity are remarkably affected by the sectoral structure of the regions' economy. Additionally to sectoral structure, the location of a county, measured by the distance between the capital city and regions' (counties') centre, has a significant impact on productivity. There is a core-periphery structure with high income levels in the capital region and low income levels in peripheral regions. The divergence in regional aggregated productivity levels within a small country like Estonia may indicate the concentration of production inputs and development of sectoral structure in regions, where economies are functioning more efficiently. Regional and national policies having target leading to regional income convergence should definitely serve measures both to alleviate poverty and support structural changes improving efficiency of economies.

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