ANALYSIS OF SECTORAL SHIFTS IN THE EU ECONOMIES

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Abstract

The paper aims to offer some empirical insights into the structural changes of the EU countries during the recent decade. In order to elaborate on the latent components or aggregated indicators of the countries' economic structure, factor analysis in combination with regression analysis is applied. Two aggregated indicators – factors (or components) of an economic structure are extracted which describe around two thirds of the initial indicators' variance. Factor F1 characterises the development level of the post-industrial service economy and factor F2 the environment for industry-based technological innovation. On the basis of the aggregated indicators of an economic structure three groups of the EU countries can be distinguished: West and North European welfare countries with developed service economy (Sweden, Denmark, Finland, Germany); South European countries where tourism has a strong position in the economic structure (Portugal, Greece, Spain); East and Central European countries, where production sector still maintains a relatively big share, which is gradually declining in favour of business and service sectors (the Baltic States, Poland, Hungary). The first group of countries is 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 move from the low value added sectors to the high value-added less harmfully. These countries should profoundly analyze the possible options in order to find the advanced tertiarization way which would be the best for their economic development.

1. Introduction

Sectoral change is an important feature of modern market economies that supports economic development and allows adjustment with the requirements of globalisation processes. Therefore, the analysis of economic structure and its dynamics which started already in the first half of the 20th century (see Firsher 1935, Clark 1940; Fourastié (1949) is a research topic that continuously attracts researchers from different parts of the world. Sectoral shifts and their effects on productivity have been analysed from different angles and using several methodological approaches (eg Baumol 1967; Peneder 2002; Havlik 2004 and 2007; Burda 2006; Breitenfellner and Hildebrandt, 2006, Bachmann and Burda 2008). Research results mainly confirm that processes of tertialization (movement to service based economic structure) are widening over the world.

The paper aims to offer some empirical insights into the structural change in the economies of the EU countries during the recent decade, the period that characterizes the EU eastward enlargement processes. The analysis bases on Eurostat sectoral data of the EU-27 economies which are examined using the combination of several statistical methods

(correlation, regression and factor analysis) in order to elaborate on the aggregated indicators of the economies' sectoral structure and examine the relationship between the aggregated indicators of economic structure and productivity. The paper also emphasizes on elaborating a typology of the EU economies based on to the aggregated indicators of sectoral structure. One focus of the study is on the comparative analysis of the Estonian economic structure within the EU. Estonia like the other two Baltic States, Latvia and Lithuania are the only former Soviet Republics that are the members of the enlarged EU. Their favourable location between the East and the West, market economy experience they gained during the independence period between the two world wars, and historical and cultural traditions of co-operation with developed countries around the Baltic Sea were important initial conditions affecting the economic development of these states. Therefore, these countries provide an interesting case for generalizing the post-socialist transition and the European (re)integration processes also in the global context.

The paper consists of six sections. In the next section, we introduce the framework for the analysis of sectoral structure. Section 3 presents the results of elaborating and analysing the aggregated indicators that describe sectoral structure of the EU-27 countries. Section 4 discusses the typology of the countries. The results of examining the relationship between the aggregated indicators of productivity and sectoral structure are presented in section 5. 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), Clark (1940) and Fourastié (1949) 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 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.

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 economies. The industrialized countries of the EU have already entered the stage of post-industrialised service economies which generates certain impact of sectoral structure on the aggregated productivity of an economy.

The first research results of structural change in the EU countries after the eastward enlargement have show that the EU new member states (NMS) have expressed an impressive productivity catching-up, at macroeconomic level and in manufacturing industry in particular, but these sectoral shifts had only a negligible effect on aggregate productivity growth (see Havlik, 2007, p. 10). The economies with different sectoral structures have essentially different opportunities of growth. Therefore it is obvious that a profound analysis of sectoral change is unavoidable in order to elaborate models which would be the best ways for adjustment of national economies with global and regional developments.

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. In this paper the analysis of a sectoral structure of the EU economies mainly bases on the share of added value in GDP. The data for the analysis are derived from the Eurostat figures on the sectoral structure of value added in EU27 member states in six economic sectors during the years 1995 – 2006, the period that describes the EU eastward enlargement processes. Table 1 presents the 6-level classification system of economic sectors used in the Eurostat database.

The main changes of sectoral structure of the EU17 economies during the period 1995-2006 are visible from the figures of the Annex 1 (figures F1-F6). 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 industry and the increase of the share of service sectors. 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.

Table 1. Classification of economic sectors

Economic sectors	Aggregated sectors and short acronyms (S1-S6)	Classification code in the Eurostat database (A-O), acronyms.
Agriculture, hunting, forestry, fishing	**S1** (Agriculture**)**	A-B; **AGR**
Industry (except contruction)ehitus)	**S2 (**Industry)	C-E; **C**- Mining industry; **MIN;** **E** – Energy, gas- and water supply; **EGW**
Construction	**S3 (**Construction**)**	F – Construction; **CON**
Wholesale and retail trade; repair of motor vehiles and household appliances, hotels and restaurants, transport, warehousing, communication	**S4 (**Trade)	G-I; **G** - Wholesale and retail trade; repair of motor vechiles and household appliances; **WRT** **H** - Hotels and restaurants, **HOR**; **I** - Transport, warehousing, communication; **TRA**
Financial mediation, real estate, renting and business activities	**S5 (**Financial) service)	J-K; **J** - Financial mediations; **FIN ;** **K** - Real estate, renting and business activities; **REB**
Public administration and civil defence; compulsory social insurance, education, health and social care; other social and individual services.	**S6 (**Public service)	L-O; **L** - Public administration and civil defence; compulsory social insurance; **PAD;** **M –** Education, **EDU** **N –** Health and social care; **HES** **O –** Other social and individual services; **OTH**

Source: Eurostat

In order to get a more in-depth overview of the sectoral structure of the EU-27 economies several methods of a statistical analysis 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, 2000-2006). In order to study the relationship between the aggregated indicators of sectoral structure and productivity several regression models are estimated. These 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 some institutional factors.

3. Aggregated indicators of the EU-27 economies' sectoral structure

Development of economic sectors is mutually densely connected and changes in one sector cause changes in the other sectors. The results of correlation analysis of the indicators that describe the share of economic sectors in creating GVA of the EU-27 economies are presented in Appendix . The correlation analysis was carried out based on the cross-section data and on the pooled data. As shown in Table 2, the construction sector (S3) has a statistically important positive correlation with S4 (trade, etc.) and a negative correlation with S6 (public services). The share of sectors 5 (S5; acronym Finance; see table 1) and 6 (public services) in the added value is above the average in countries where the role of agriculture (S1) and industry (S2) in creating GVA is smaller. The share of added value created in sector S4 (trade, tourism, etc.) is somewhat higher in these countries where the share of agriculture (S1) is higher, and in the countries where the share of financial service (S5) is lower. These statistical results are not surprising and they do not always indicate the causal relationship between the elements of a sectoral structure. The results of the correlation analysis first of all confirm the necessity to implement the method of factor analysis for elaborating aggregated indicators that describe sectoral structure of the EU-27 economies. These aggregated indicators (factors) allow us to conduct the regression analysis for examining the relationship between the aggregated productivity and economic structure of the EU-27 countries avoiding multicollinearity problems and for estimating the level of the so-called "potential productivity".

The aggregated indicators for describing the economic structure of EU27 countries are obtained by using factor analysis. We estimated factor models both on the basis of cross-section and pooled data of EU-27 economies checking also for robustness of the results. 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.

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 sectoral structure of EU-27 countries

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 opening economic meaning of the latent variables – factors and giving those respective names. The next step of the analysis focuses on the factor scores which describe the value of the aggregated indicators (latent variables, factors) of every observation. Factor scores are standardised.

Factor F1 has higher negative factor loads for initial indicators describing sectors S1 (agriculture, forestry) and S2 (industry), 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 industry (S2). We suppose that industry can be considered as the necessary prerequisite for broad-based innovation. Most service areas of sectors S3 and S4 are relatively passive in terms of innovation – they are rather recipients than providers of innovation spillovers. Thus we decided to interpret factor F2 as the factor describing the environment for industry-based technological innovation.

The levels of the aggregated indicators of the EU-27 countries' sectoral structure – development of a post-industrial service economy and environment for industry-based technological innovation are characterised by the factors scores of the factors F1 and F2. Figure 1 illustrates the level of two aggregated indicators of the EU-27 economies' sectoral structure in 2005.

Annex 3 figures F7 and F8 as well as Annex 4 tables T2-T3 present dynamics of the factor scores of both aggregated indicators elaborated on the basis of pooled data (EU-27 countries during the period 2000-2005).

The aggregated indicator that characterise the development level of the post-industrial service economy (F1) is mainly low in all Central and East European countries that acceded to the EU. 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 the case for some Central European countries such as Hungary, Czech Republic and Slovenia. Looking simultaneously at the EU countries in the framework of the two abovementioned aggregated indicators, one can distinguish economic structures dominated by a strong service economy (Luxembourg, France and United Kingdom), from structures dominated by industry and technology (Germany, Sweden, also Hungary) and from economic structures not dominated by either component. As expected, most post-socialist countries belong to the last-mentioned group.

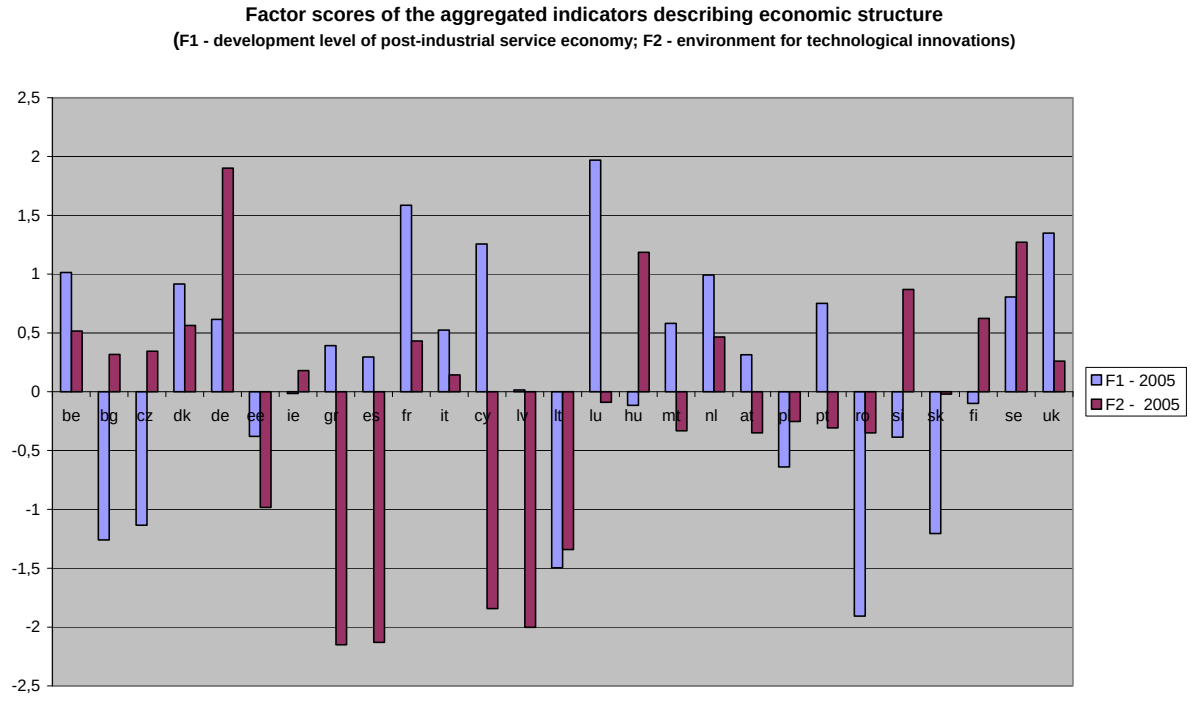

Figure 1. Factor scores of the aggregated indicators – Factor 1 (F1) and Factor 2 (F2) of sectoral structure of the EU-27.

3. Typology of the countries

On the basis of the aggregated indicators of sectoral structure and dynamics of the respective factor scores of F1 and F2 (see Annexes 3 and 4) three groups of countries can be distinguished within 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 production sector still maintains a relatively big share, which is gradually declining in favor of business and 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 F1. In these countries (particularly in Germany, Sweden) industry 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 (the so-called "trading" economies). 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 countries are becoming closer to the countries of Southern Europe. Hungary and Slovenia are 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 industrial and technological innovation (see Figure 1). What should one conclude from the relationship between the declining share of industry and the economy's innovation capacity? In countries with developed industry, the technological innovations created in the industry are transferred gradually to other economic sectors, thus creating additional opportunities for technological innovation and also for developing and offering new services. However, the dominant view is that modern industry plays an important role in the transfer of innovative thinking into services. 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). It is difficult to build up a modern and internationally competitive service

sector without passing the interim stage of more complex industry (Hirsch-Kreinsen et al, 2005). Estonia's current development may not support the long-term competitiveness. Such an economic structure and its development are 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 other NMS – the post-socialist economies.

In general, the above presented grouping of countries also fits with countries' typology elaborated by Andreas Breitenfeller and Antje Hildenbrandt (2006). Based on the analysis of the EU-15 economies' development over the period 1950-1998 they distinguished four groups of countries according to the models of tertiarization.

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 industry 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 other 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. These countries passed serious deindustrialization and deagriculturalization processes like also NMS made.

The shifts to the service-based economies occurred in the Central and Eastern European countries with a time; at the same time these shifts were much more rapid. The NMS have some similarities with the Southern European countries in development of their economic structure and in following the tertiarization processes. But the NMS do not need

and they also cannot follow the same development pattern that the countries that followed the model of catching-up tertiarization did. The global environment for competitive development is changing quickly; that needs good abilities to adjust and to find new niches for sustainable economic growth. The rapid adjustment of the economy requires flexible structures in product and factor markets, the promotion of innovation diffusion and human capital creation in order to achieve sustainable economic structure and high productivity.

4. The relationship between sectoral structure and aggregated productivity

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 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 (*j=1,2; k=2*);

D_{ji} - dummy variables, proxies that characterize some institutional factors: 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 estimation results are presented in table 4.

The estimated regression models describe approximately 64-87% of the variability of aggregated productivity in EU-27 countries. 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, in ceteris paribus terms, while the productivity of small

countries is somewhat higher than average. Knowledge spillovers are sometimes quicker in small countries inducing innovations and crating conditions for productivity growth.

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

Intercept	*F1*	*F2*	*D1*	*D2*	R^2	$\hat{R}^2$
34882.2 (1084.730) (0.000)	16424.0 (1070.259) (0.000)	6848.3 (1068.444) (0.000)	–	–	0.644 (0.000)	0.640 (0.000)
46683.975 (1104.541) (0.000)	7506.682 (950.759) (0.000)	3981.018 (735.709) (0.000)	-28047.430 (1995.451) (0.000)	–	0.845 (0.000)	0.842 (0.000)
34479.098 (1394.585) (0.000)	16454.254 (1074.892) (0.000)	6929.245 (1085.472) (0.000)	–	1047.561 (2268.950) (0.645)	0. 645 (0.000)	0.638 (0.000)
44942.179 (1058.508) (0.000)	6739.633 (880.855) (0.000)	4276.095 (675.225) (0.000)	-31156.129 (1910.254) (0.000)	7926.625 (1433.306) (0.000)	0.871 (0.000)	0.868 (0.000)

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

In some way, these evaluations results could be considered as the so-called potential productivity – 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. In order to compare the predicted productivity (the so-called "potential" productivity) with real value the standardized residuals are calculated. The results are in some sense different if additionally to the sectoral variables also proxies of institutional conditions are taken into account (see Annex 5, tables T4-T5).

A comparable assessment of the so-called 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 the explanatory analysis as well as the estimators of the regression equations 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 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 role of low-labour oriented foreign direct investment remarkably contributed to the sectoral shifts and the rise of productivity in post-socialist countries, nowadays the NMS during the recent decade. Estonia like other post-socialist countries should profoundly analyze the lessons of the previous rounds of the EU enlargement taking into account that sectoral change is natural process that occurs in all countries being also related to global and national business cycles.

5. Conclusions

The remarkable changes in the sectoral structure are associated with the dynamics in shares of sectors by creating value added. The most important common long-run trend for the developed economies has been a marked shift of sectoral structure away from production towards service activities, the process of tertiarization. The EU enlargement and globalization processes pose new challenges for structural shifts particularly for the EU new member states like Estonia. These countries should profoundly analyze previous lessons and possible options in order to find the advanced tertiarization way which would be the best for their development.

One possibility for the profound analysis of heterogeneity and dynamics of the EU-27 economies' sectoral structure is to implement the method of factor analysis in order to find the latent variables – the aggregated indicators (factors) of sectoral structure. We estimated factor models both on the basis of cross-section and pooled data of the EU-27 economies checking also for robustness of the results. In all cases two aggregated indicators – factors of an economic structure are extracted which describe around two thirds of the initial indicators' variance. Factor F1 characterises the development level of the post-industrial service economy and factor F2 the environment for industry-based technological innovation.

On the basis of the aggregated indicators of economic structure three groups of the EU countries can be distinguished: 1) West and North European welfare countries with developed service economy (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 production sector still maintains a relatively big share, which is gradually declining in favour of business and 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. The latter are

facing the problem of how to overcome the deindustrialization phase and to move from the low value added sectors to the high value-added less harmfully.

Comparing the results of the explanatory analysis as well as the estimation results based on the regression models one should emphasize that the rise of productivity requires planned efforts in modernizing the economic structure. The process of modernization is unachievable without targeted innovation policies, flexible labour markets, systematic investments into human capital and proper migration policies that are the key factors for conducting successful national policies.

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ANNEX 1. Sectoral changes in the EU-27 countries, 1995-2005 in sectors 1-6 (the share of GVA in GDP, %): figures F1-F6

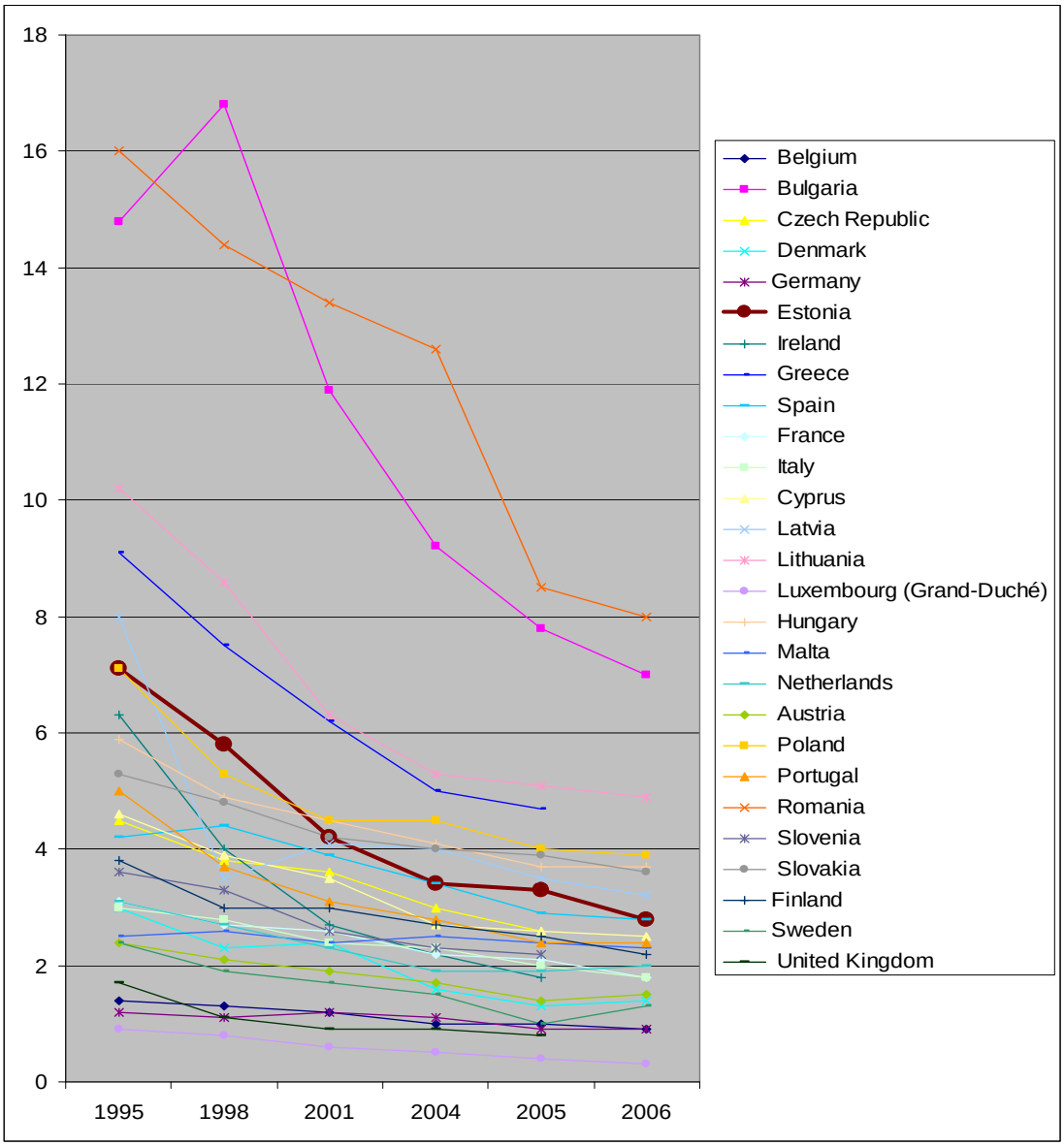

Figure F1. Dynamics of the share of GVA in GDP, Sector 1

Source: Eurostat

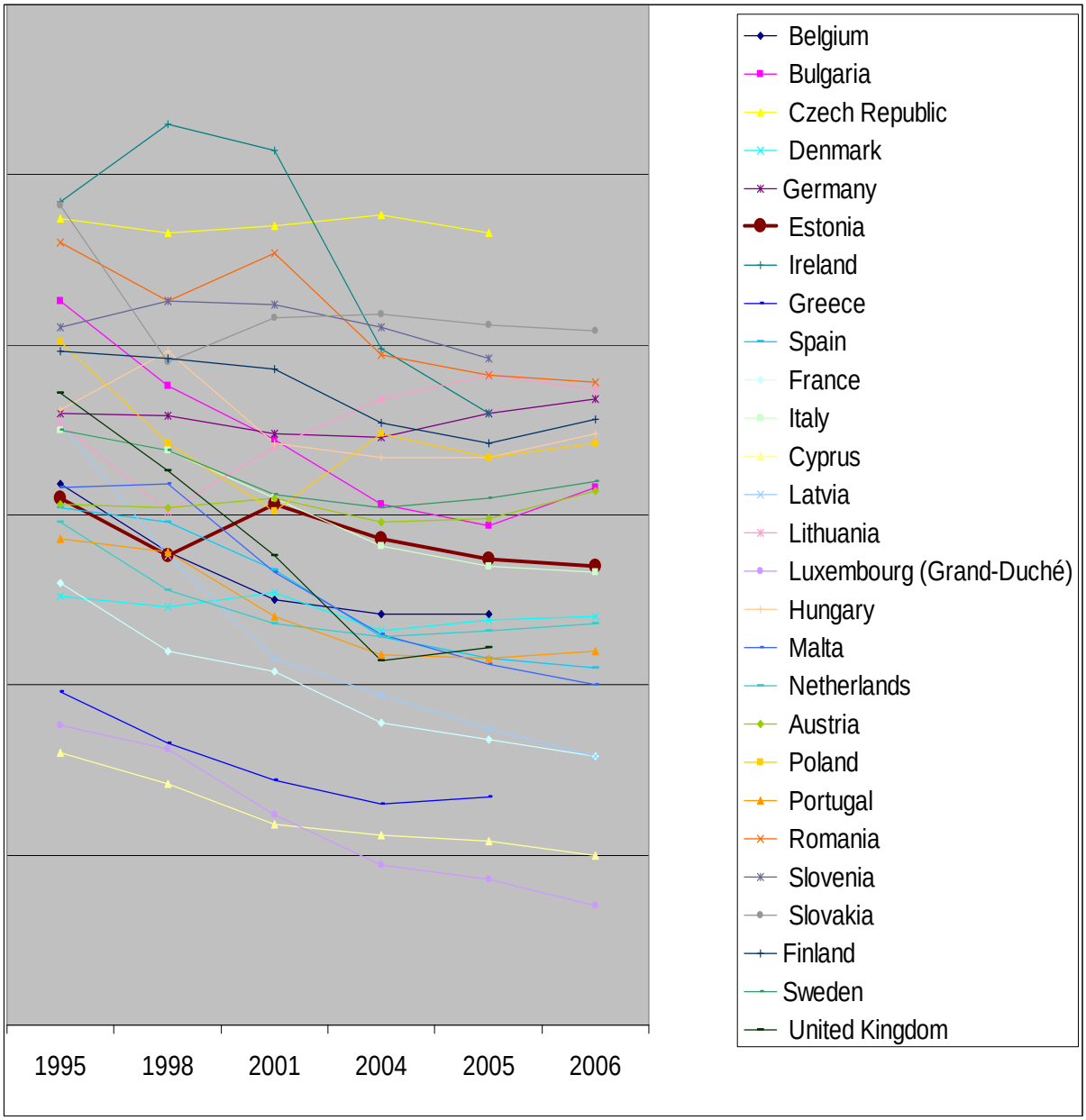

Figure F2. Dynamics of the share of GVA in GDP, Sector 2

Source: Eurostat

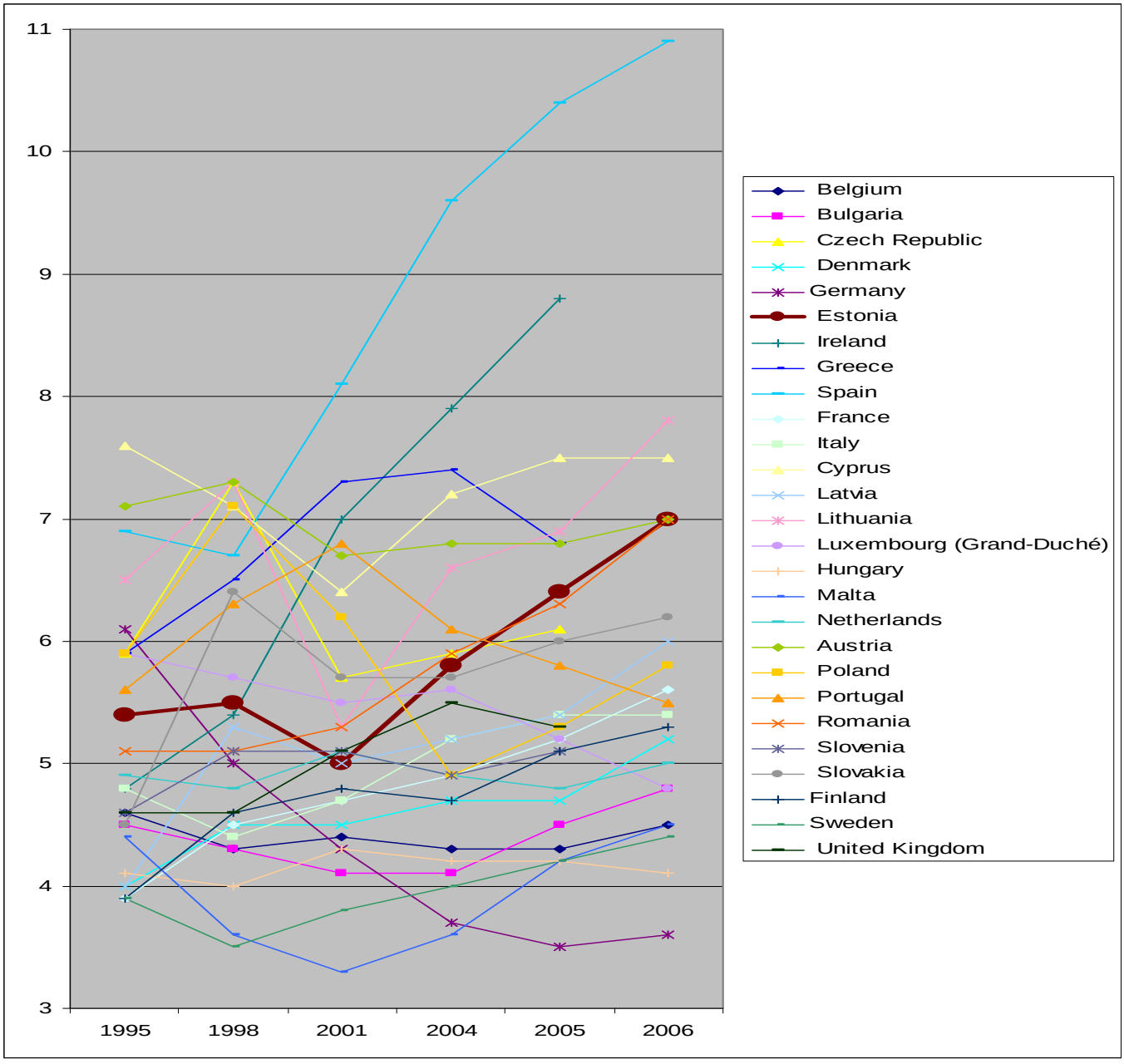

Figure F3. Dynamics of the share of GVA in GDP, Sector 3

Source: Eurostat

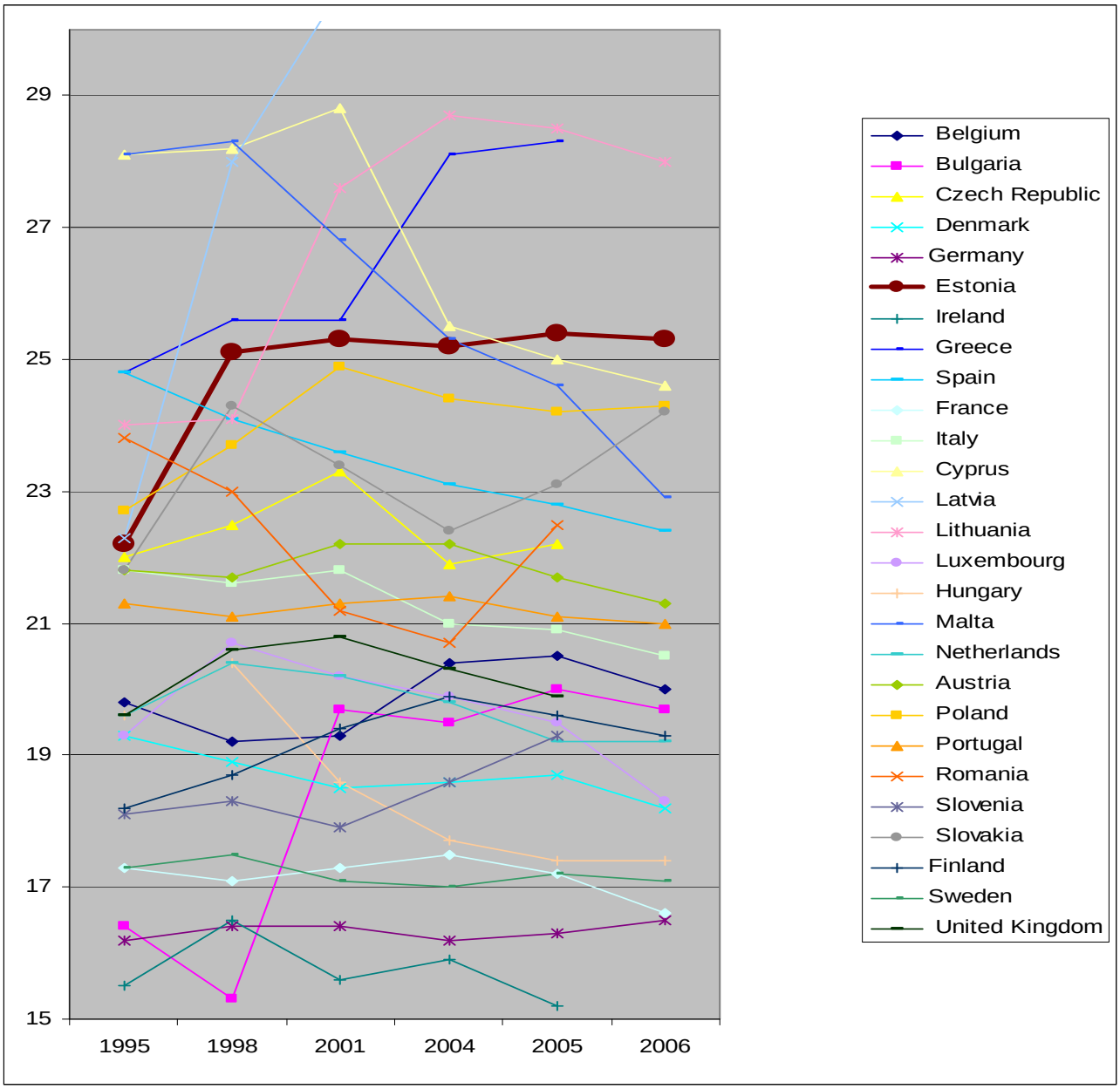

Figure F4. Dynamics of the share of GVA in GDP, Sector 4

Source: Eurostat

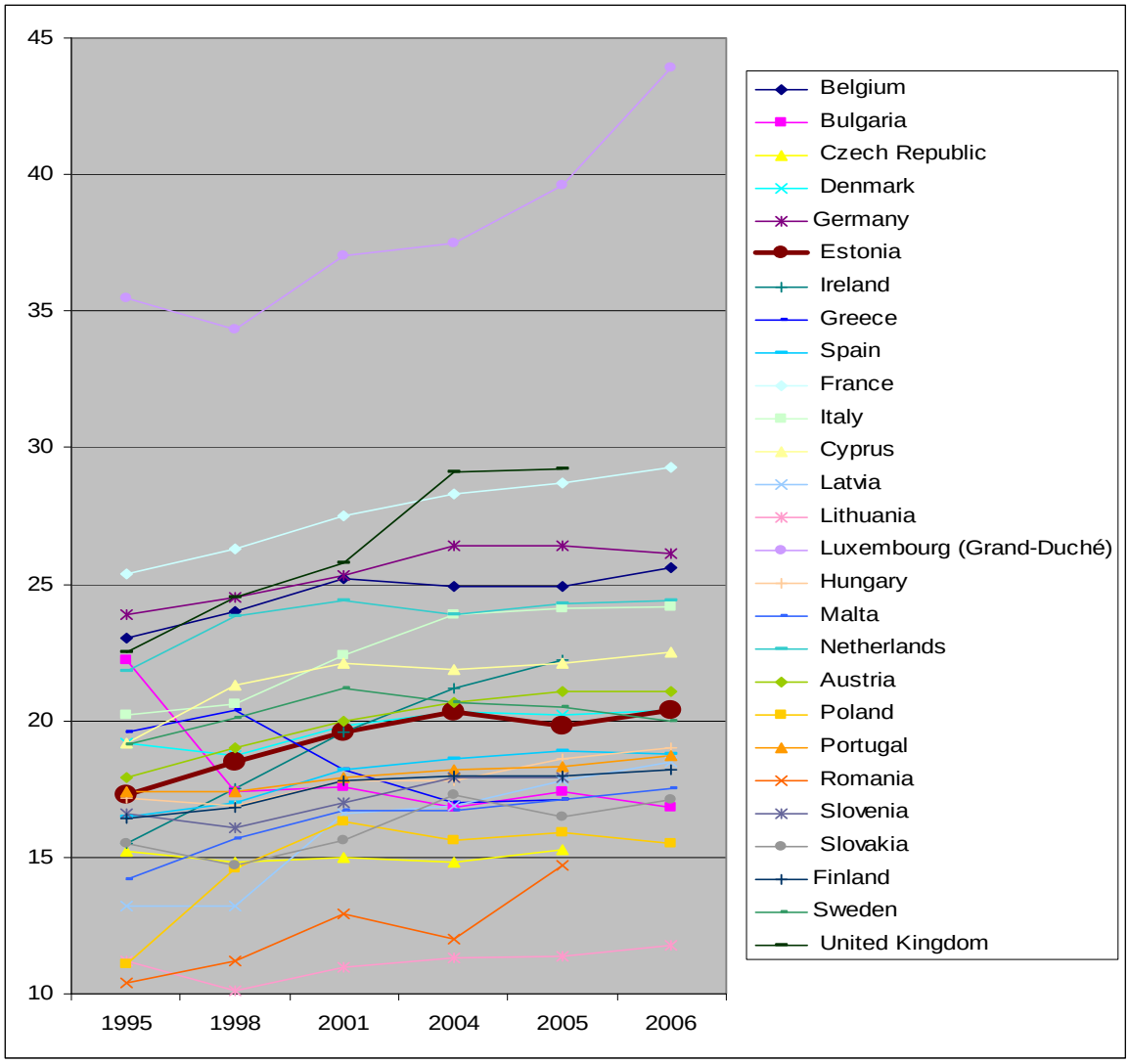

Figure F5. Dynamics of the share of GVA in GDP, Sector 5

Source: Eurostat

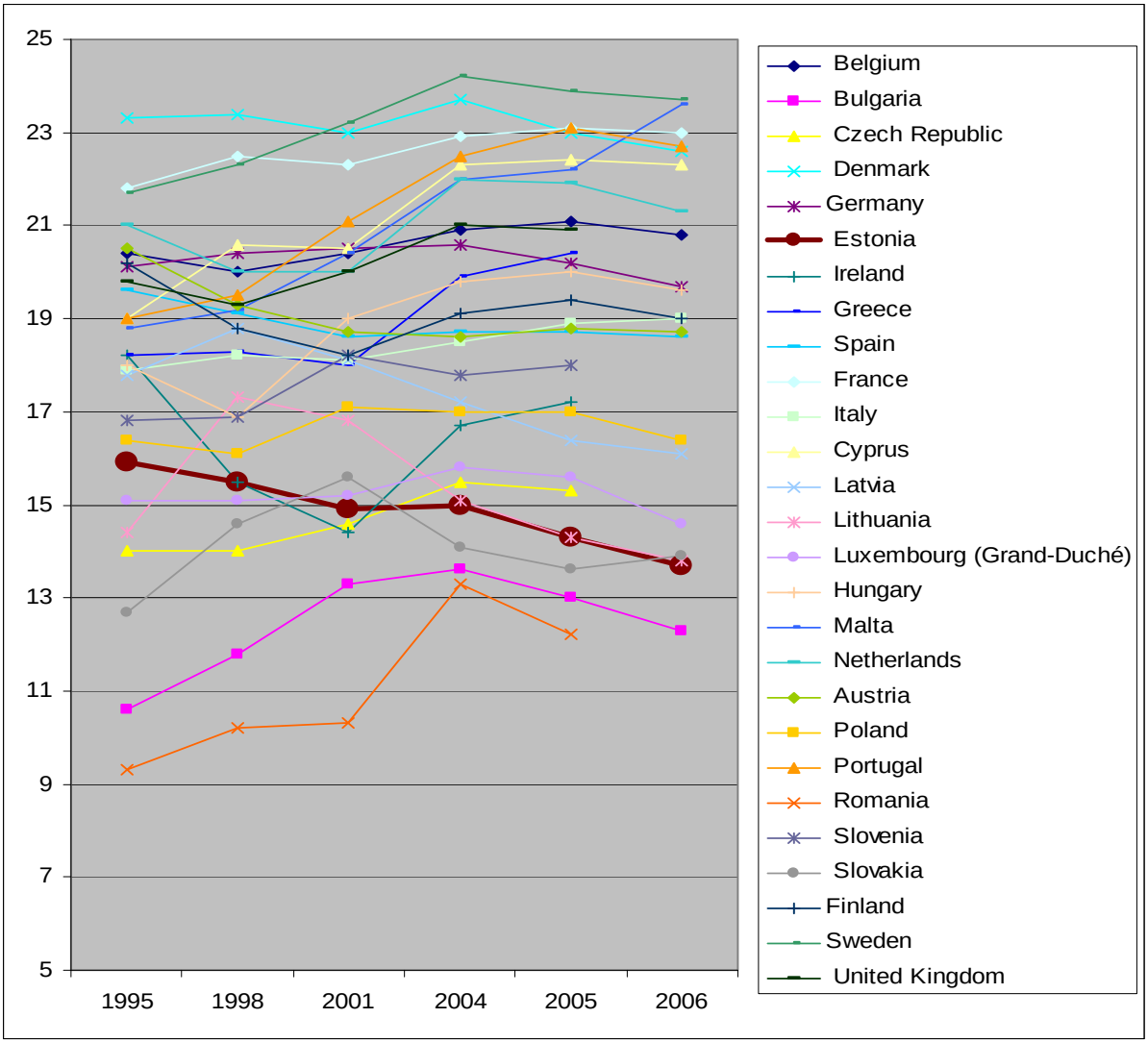

Figure F6. Dynamics of the share of GVA in GDP, Sector 6

Source: Eurostat

ANNEX2: Table T1. Correlation matrix of the initial indicators of the EU-27 economies' sectoral structure (based on the share of value added in GDP), 1995-2005

	S1	S2	S3	S4	S5	S6
S1	1	.261(**)	.064	.246(**)	-.596(**)	-.599(**)
S2	.261(**)	1	-.102	-.298(**)	-.536(**)	-.473(**)
S3	.064	-.102	1	.285(**)	-.137	-.218(**)
S4	.246(**)	-.298(**)	.285(**)	1	-.411(**)	-.218(**)
S5	-.596(**)	-.536(**)	-.137	-.411(**)	1	.294(**)
S6	-.599(**)	-.473(**)	-.218(**)	-.218(**)	.294(**)	1

* the level of significance 0.05; ** the level of significance 0.01; n=168

Source: calculations based on the Eurosta data

ANNEX 3. Factor scores of the factors 1 and 2 in the EU-27 countries, 2000-2005: figures F7-F8

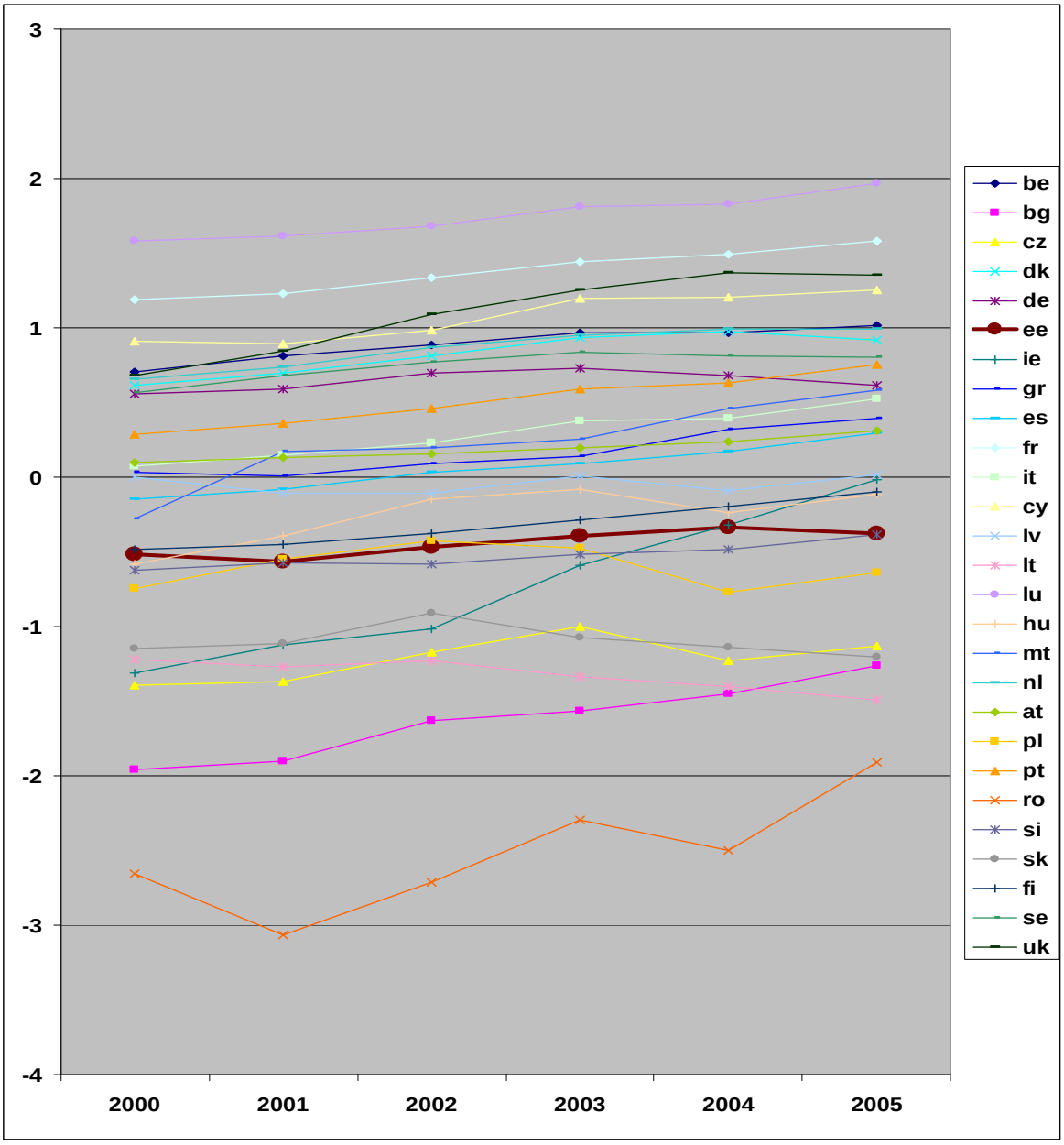

Figure F7. Factor scores of the Factor 1 - the development level of post-industrial service economy in the EU-27 countries, 2000-2005

Source: author's estimations based on the Eurostat data

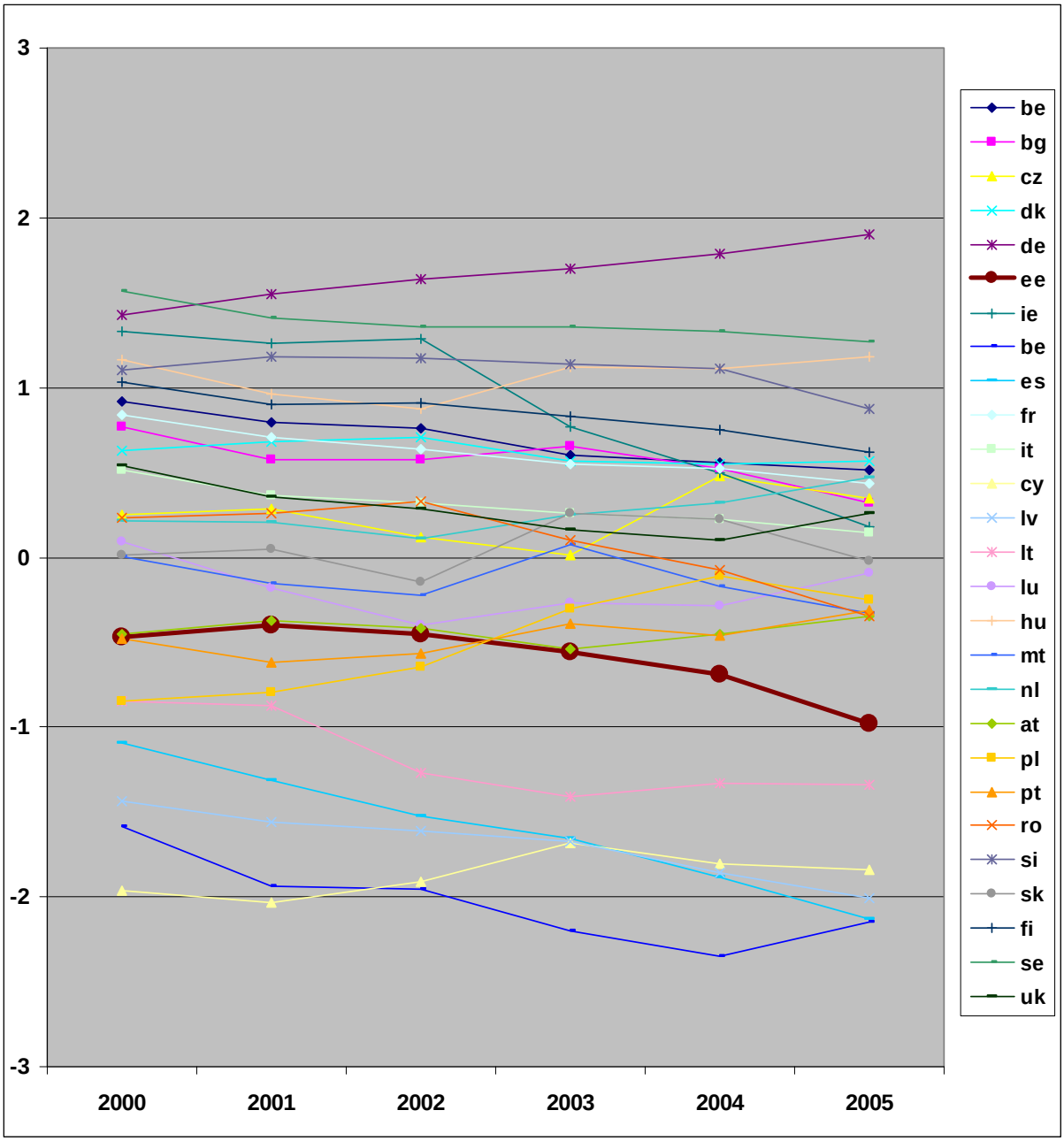

Figure F8. Factor scores of the Factor 2 - environment for industry-based technological innovation in the EU-27 countries, 2000-2005

Source: author's estimations based on the Eurostat data

ANNEX 4. Factor scores of the factors 1 and 2 in the EU-27 countries, 2000-2005: tables T2-T3

Table T2. Factor scores of factor F1 – development level of post-industrial service economy

Country	2000	2001	2002	2003	2004	2005
Belgium	0,71	0,81	0,89	0,96	0,96	1,01
Bulgaria	–1,96	–1,90	–1,63	–1,56	–1,45	–1,26
Czech Republic	–1,39	–1,37	–1,17	–1,00	–1,23	–1,13
Denmark	0,61	0,70	0,81	0,93	0,98	0,92
Germany	0,56	0,59	0,70	0,73	0,68	0,61
Estonia	–0,52	–0,56	–0,47	–0,40	–0,34	–0,38
Ireland	–1,31	–1,12	–1,02	–0,59	–0,32	–0,01
Greece	0,03	0,01	0,09	0,14	0,32	0,39
Spain	–0,15	–0,08	0,03	0,09	0,17	0,30
France	1,19	1,23	1,34	1,44	1,49	1,59
Italy	0,08	0,14	0,23	0,38	0,39	0,52
Cypros	0,91	0,90	0,98	1,19	1,20	1,26
Latvia	0,00	–0,11	–0,10	0,01	–0,09	0,02
Lithuania	–1,22	–1,27	–1,23	–1,34	–1,40	–1,50
Luxemburg	1,59	1,61	1,68	1,81	1,82	1,97
Hungary	–0,58	–0,40	–0,15	–0,09	–0,23	–0,12
Malta	–0,28	0,17	0,20	0,25	0,46	0,58
The Netherlands	0,66	0,74	0,87	0,95	0,99	0,99
Austria	0,10	0,13	0,15	0,20	0,24	0,31
Poland	–0,74	–0,55	–0,43	–0,48	–0,77	–0,64
Portugal	0,28	0,36	0,46	0,59	0,63	0,75
Romania	–2,66	–3,06	–2,71	–2,30	–2,50	–1,91
Slovenia	–0,62	–0,58	–0,58	–0,52	–0,48	–0,39
Slovakia	–1,15	–1,11	–0,91	–1,07	–1,14	–1,20
Finland	–0,49	–0,45	–0,38	–0,29	–0,20	–0,10
Sweden	0,56	0,68	0,77	0,84	0,81	0,81
UK	0,68	0,85	1,09	1,25	1,37	1,35

Source: author's estimations based on the Eurostat data

Table T3. Factor scores of factor F2 – environment for industry-based technological innovation

Country	2000	2001	2002	2003	2004	2005
Belgium	0,92	0,80	0,76	0,60	0,56	0,52
Bulgaria	0,77	0,57	0,57	0,66	0,52	0,32
Czech Republic	0,25	0,29	0,12	0,01	0,48	0,34
Denmark	0,63	0,68	0,71	0,57	0,55	0,56
Germany	1,43	1,55	1,64	1,70	1,79	1,90
Estonia	–0,47	–0,40	–0,45	–0,55	–0,69	–0,98
Ireland	1,33	1,26	1,28	0,77	0,50	0,18
Greece	–1,59	–1,94	–1,96	–2,20	–2,35	–2,15
Spain	–1,10	–1,31	–1,52	–1,66	–1,88	–2,13
France	0,84	0,71	0,64	0,55	0,52	0,43
Italy	0,51	0,36	0,32	0,26	0,23	0,14
Cypros	–1,96	–2,04	–1,91	–1,68	–1,81	–1,84
Latvia	–1,44	–1,56	–1,61	–1,68	–1,86	–2,00
Lithuania	–0,85	–0,88	–1,27	–1,41	–1,33	–1,34
Luxemburg	0,09	–0,18	–0,40	–0,27	–0,28	–0,09
Hungary	1,17	0,96	0,88	1,12	1,11	1,18
Malta	0,01	–0,15	–0,23	0,08	–0,17	–0,33
The Netherlands	0,22	0,21	0,11	0,25	0,32	0,47
Austria	–0,45	–0,37	–0,42	–0,54	–0,45	–0,35
Poland	–0,85	–0,79	–0,64	–0,30	–0,11	–0,25
Portugal	–0,48	–0,62	–0,57	–0,39	–0,46	–0,31
Romania	0,23	0,26	0,33	0,10	–0,07	–0,35
Slovenia	1,10	1,18	1,17	1,13	1,11	0,87
Slovakia	0,01	0,05	–0,14	0,26	0,22	–0,02
Finland	1,03	0,90	0,91	0,83	0,75	0,62
Sweden	1,57	1,41	1,36	1,36	1,33	1,27
UK	0,54	0,36	0,29	0,16	0,10	0,26

Source: author's estimations based on the Eurostat data

ANNEX 5. Actual and predicted productivity (predicted in EU-27 countries in 2005: tables T4-T5

Table T4. Actual and predicted productivity in EU-27 countries in 2005 (estimations based on factor scores of F1 and F2)

Country	Actual	Predicted	Residuals	Standardised residuals[1]
Belgium	67200.00	55055.90383	12144.09617	.89640
Bulgaria	4400.00	16371.28768	-11971.28768	-.88365
Czech Rep.	12000.00	18603.70779	-6603.70779	-.48745
Denmark	56400.00	53778.40637	2621.59363	.19351
Germany	58900.00	58007.27115	892.72885	.06590
Estonia	9200.00	21919.88188	-12719.88188	-.93890
Ireland	56100.00	35870.42500	20229.57500	1.49322
Greece	35100.00	26591.67398	8508.32602	.62803
Spain	36200.00	25140.96636	11059.03364	.81631
France	58400.00	63895.76939	-5495.76939	-.40566
Italy	47700.00	44474.38436	3225.61564	.23810
Cyprus	31700.00	42896.30352	-11196.30352	-.82644
Latvia	7200.00	21410.79274	-14210.79274	-1.04895
Lithuania	6700.00	1125.48096	5574.51904	.41148
Luxembourg	76300.00	66615.97100	9684.02900	.71482
Hungary	13500.00	41085.20581	-27585.20581	-2.03617
Netherlands	52900.00	54356.14562	-1456.14562	-.10748
Austria	62100.00	37643.47140	24456.52860	1.80523
Poland	13200.00	22655.77328	-9455.77328	-.69797
Portugal	25000.00	45106.45653	-20106.45653	-1.48414
Romania	5100.00	1180.71534	3919.28466	.28930
Slovenia	25500.00	34493.95149	-8993.95149	-.66388
Slovakia	10700.00	14962.05133	-4262.05133	-.31460
Finland	58700.00	37528.15945	21171.84055	1.56278
Sweden	53700.00	56817.65420	-3117.65420	-.23013
UK	43400.00	58819.36524	-15419.36524	-1.13816

Source: author's estimations based on the Eurostat data

[11] Standardized residuals $\hat{u}_i^* = \frac{Y_i - \hat{Y}_i(i)}{\hat{\sigma}(i)}$, $\hat{\sigma}^2(i) = \sum_{j=1}^{n} \hat{u}_j^2(i)/(n-k)$, k – the number explanatory variables, n – sample size. If $\left|\hat{u}_i^*\right| > 1.96$, then the observation could be considered as an exceptional.

Table T5. Actual and predicted productivity in EU-27 countries in 2005 (estimations based on factor scores of F1 and F2 and dummies D1 and D2)

Country	Actual	Predicted	Residuals	Standardised residuals[2]
Belgium	67200.00	56342.93432	10857.06568	1.21134
Bulgaria	4400.00	10446.86313	-6046.86313	-.67466
Czech Rep.	12000.00	11489.53243	510.46757	.05695
Denmark	56400.00	55799.42461	600.57539	.06701
Germany	58900.00	58871.95768	28.04232	.00313
Estonia	9200.00	11875.45138	-2675.45138	-.29851
Ireland	56100.00	47288.56488	8811.43512	.98311
Greece	35100.00	41064.53430	-5964.53430	-.66547
Spain	36200.00	40418.17209	-4218.17209	-.47063
France	58400.00	60312.24238	-1912.24238	-.21335
Italy	47700.00	51189.03402	-3489.03402	-.38928
Cyprus	31700.00	20730.50859	10969.49141	1.22389
Latvia	7200.00	10774.75692	-3574.75692	-.39884
Lithuania	6700.00	2066.35760	4633.64240	.51698
Luxembourg	76300.00	61111.13811	15188.86189	1.69465
Hungary	13500.00	22479.79892	-8979.79892	-1.00189
Netherlands	52900.00	55980.99901	-3080.99901	-.34375
Austria	62100.00	47647.84187	14452.15813	1.61245
Poland	13200.00	12834.26463	365.73537	.04081
Portugal	25000.00	51094.66498	-26094.66498	-2.91143
Romania	5100.00	2935.97608	2164.02392	.24144
Slovenia	25500.00	19199.61557	6300.38443	.70295
Slovakia	10700.00	9515.91125	1184.08875	.13211
Finland	58700.00	48423.85564	10276.14436	1.14653
Sweden	53700.00	57790.69292	-4090.69292	-.45641
UK	43400.00	57845.70085	-14445.70085	-1.61173

Source: author's estimations based on the Eurostat data.

[22] Standardized residuals $\hat{u}_i^* = \frac{Y_i - \hat{Y}_i(i)}{\hat{\sigma}(i)}$, $\hat{\sigma}^2(i) = \sum_{j=1}^{n} \hat{u}_j^2(i)/(n-k)$, k – the number explanatory variables, n – sample size. If $\left|\hat{u}_i^*\right| > 1.96$, then the observation could be considered as an exceptional.