What Affects the Main Engine of Growth in the European Economy? Industrial Interconnectedness and Differences in Performance of Business Services Across the EU25

Maciej Sobolewski

Grzegorz Poniatowski

Keywords**: Industrial Linkages, Business Services, Growth, Multipliers, Input-Output**

JEL Codes**: D57, L52, R15**

Contents

Maciej Sobolewski, Dr Maciej Sobolewski obtained his PhD in economics from the University of Warsaw. His research interests include industrial organization, regulatory economics, access pricing and competition theory with particular focus on electronic markets, ICT technologies and innovation. From 2007 to 2011, he worked as a senior expert at Orange Labs, a France Telecom R&D Center. He has participated in numerous research projects regarding modeling of competition in markets, diffusion of innovation, spectrum auctions and social networks. Maciej Sobolewski is an Assistant Professor within the Department of Economics at the University of Warsaw. In 2011, he was appointed Vice President of CASE, where he is responsible, inter alia, for developing new research areas.

Grzegorz Poniatowski is a Junior Economist at CASE and a PhD candidate at the Warsaw School of Economics. He holds a joint Master's degree in Economics from the University of Paris-1 Pantheon-Sorbonne and the Autonomous University of Barcelona. He also completed an MA and BA in Quantitative Methods in Economic and Information Systems at the Warsaw School of Economics. His research interests include mathematical modeling, macroeconomics and mechanism design.

Abstract

The main purpose of this study is to determine what are the main factors which stand behind the diversity in performance of business services measured by their contribution to growth in the EU Member States. We show that in addition to typical growth factors which enhance labour productivity, also the extent of interconnectedness of business services with upstream industries is important to explain service-based economic growth.

Our analysis yields two interesting results. Firstly, we show that patterns of industrial interconnectedness of business services are considerably diversified across the EU Member States indicating large differences in the integration of services as supplier with other sectors on a country level. Secondly we show that the diversified growth performance of business services across the EU25 countries can be explained by differences in labour productivity and differences in forward linkages.

Our results indicate the fundamental role of business services as the main engine of growth in the European economy. This service-based growth is channelled mainly through increases in labour productivity and forward interconnectedness of services with downstream industries.

On the policy making level our results indicate that investment in human and intangible capital are crucial for the service-dominated economy as they not only enhance economic growth inside knowledge intensive services but also facilitate transmission of growth impulses to downstream industries by increasing diffusion and integration of services as suppliers of high value added inputs to the economy.

1. Introduction

Over the last decade the service sector has gained a dominant impact on the European economy. Currently, economic growth in Europe is based largely on knowledge, human and intangible capital located in services. It is difficult to assess whether continuous increases in the share of services in economic growth will bring positive outcomes in the long term. Yet, there is no indication that this tendency of service based-growth will change in the foreseeable future.

Increasing importance of services as the main part of economic growth implies that one should take a closer look at critical factors that lie behind the increase in the value added generated in the services. The wide literature on the topic stresses in particular the importance of human and intangible capital, which affect labour productivity - the main channel of growth in service sector (van Ark et al. 2008, Roth et al. 2010). The growth literature also confirms the importance of specific types of fixed tangible capital, in particular investment in ICT equipment (Uppenberg & Strauss, 2010, Bertschek et al. 2010).

Recently, researchers have paid a lot of attention to the fact that growth based on services is related to the use of high value-added sectors of the economy vertically related to services sector (Jarocińska and Falck 2010). Therefore, not only the factors affecting the productivity of labour such as human and intangible capital, but also the degree to which services impact on other sectors should play a role in the growth model based on the economies driven by services.

To date, the literature on sectoral relations is mainly descriptive (Soofi, 1992, Claus & Li 2003). However, it seems that in an economy with a dominant share in the growth of services, the degree of linkages with other sectors of services is in itself an important determinant of growth. Vertical sectorial links show the degree of integration of services with the rest of the economy – manufacturers and suppliers of factors of production with high added value. Greater degrees of services interlinkages, being for example a result of domestic outsourcing, changes the structure of the production factors. There is a growing demand for high value-added and knowledge-based human capital and decreasing importance of physical capital and raw materials. All these changes should be reflected in the structure of growth reflecting a greater share of the services sector in the creation of added value.

This paper examines the determinants of the share of knowledge intensive services in growth of value added. Our goal is to examine whether the degree of cross-sectoral linkages of upstream services sectors is an important factor in explaining this increase. According to the intuition developed above, we expect that the growth of vertical linkages with other sectors of services is positively associated with the share of the services sector in the creation of value added growth.

The rest of the paper is organized in the following way: Section 2 presents an overview of service sectors across the EU, showing overall importance for economic growth and cross-country differences in performance. In Section 3 we operationalize the idea of integration of services using industrial interconnectedness measures. We calculate forward linkages and forward dispersion indicators based on input-output data and describe patterns of interconnectedness based on cluster analysis. In section 4 we develop a simple econometric analysis to test for the relation between the level of vertical integration of business services and their growth performance. Section 5 concludes.

2. Service sector performance - an overview

Many studies show that services play a dominant role as a driver of economic growth in the economy of the EU25. For example Uppenberg and Strauss (2010) indicate that with a few exceptions high-growth countries have mostly expanded on account of their services sectors, not manufacturing.

Indeed looking at industrial data collected in the EU KLEMS database, the domination of services in economic performance is evident. In 2005 service sectors accounted for around two-thirds of total value added and for three-fourths of real value added growth in the decade to 2005.[1] Consequently, share of manufacturing in value added creation has fallen well below one-fifth in 2005 and contribution to real value added growth has been only around ten percent over the decade to 2005 – see Figures 1 and 2.

---

[1] All results presented in this section are own calculations on data on industrial performance from EU KLEMS Growth and Productivity Accounts Database. See http://www.euklems.net/

Figure 1. Share in value added generated in the EU25 by industry
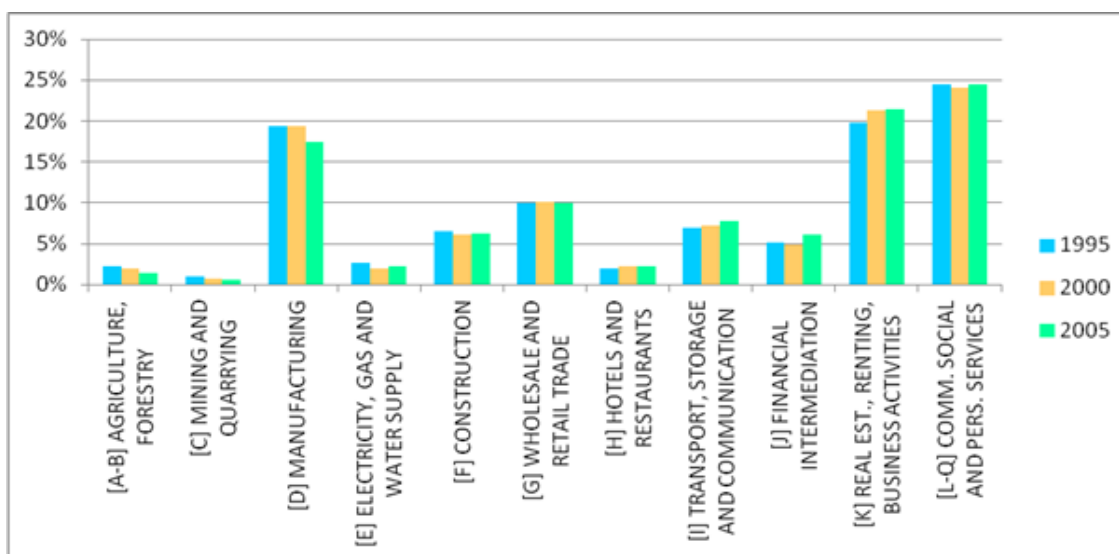
Source: own, based on EU KLEMS database.

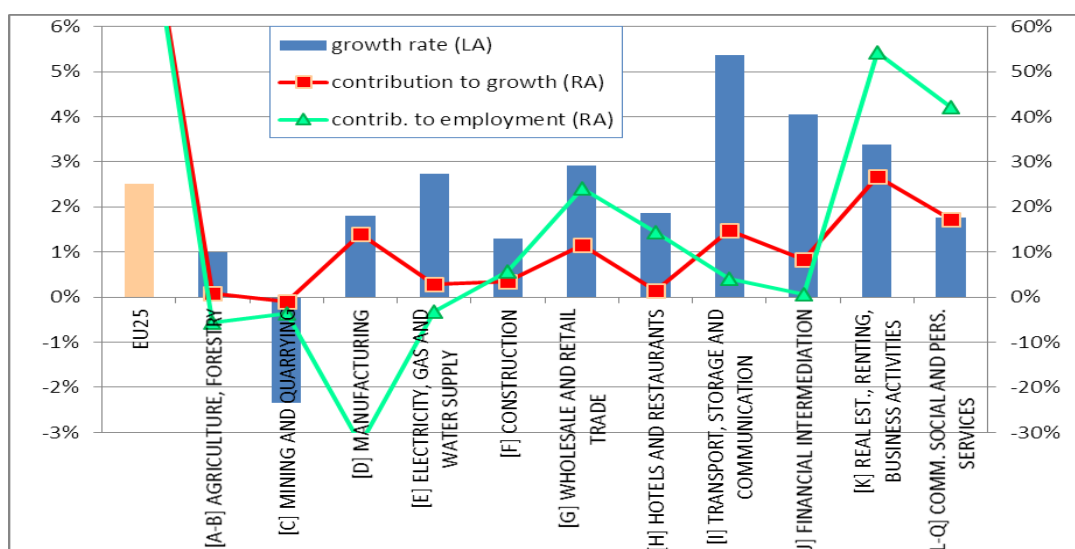**Figure 2. Average value added growth rate; contribution to value added growth and contribution to employment growth in 1995-2005 by industry (real values from 1990)**

Source: own, based on EU KLEMS database.

In terms of employment, the dominance of services is even more striking with 115% contribution to employment growth over the decade between 1995 and 2005. The major part of this growth was recorded in market-based services (73%) while the remaining 42% of the total employment growth in that period took place in public sector based services (sections L-Q). With few exceptions, manufacturing employment in most European countries has shrunk considerably by 33% over the decade preceding 2005 at EU25 level. Also other industries apart from services experienced a decrease in employment: agriculture by 6%, mining (4%) and energy supply (3%)– see Figure 2. Altogether the share of services in total employment in the EU25 increased over the decade from 51 to 56% - see Figure 3.

Figure 3. Share in employment in the EU25 by industry
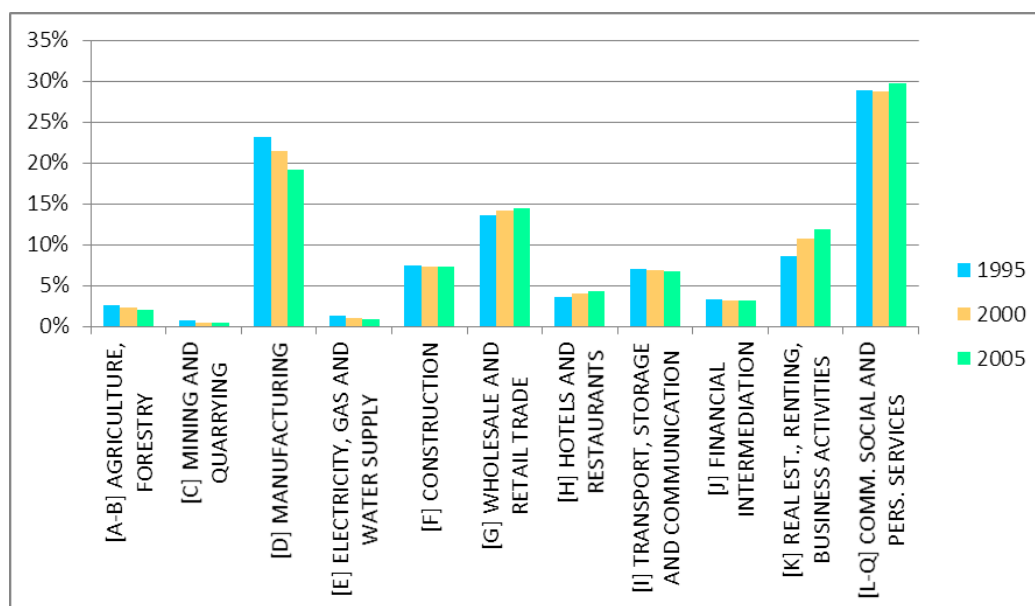
Source: own, based on EU KLEMS database.

Together with the dominant contributions to total value added and employment growth over the decade to 2005, services outperformed other sectors of the economy in terms of labour productivity, with one exception of electricity and gas supply (section E) which is a highly profitable industry due to high barriers to entry and inelastic demand. In 2005 the level of value added per hour of labour for market based services accounted for 55 EUR while for manufacturing one hour of labour brought about only 34 EUR of value added. The difference becomes smaller although still positive if we account also for public sector services which has very low productivity (only 11 EUR) due to considerably higher employment – see Figures 3 and 4.

Figure 4. Value added per unit of labour (hour) in the EU25 by industry (real values from 1990)
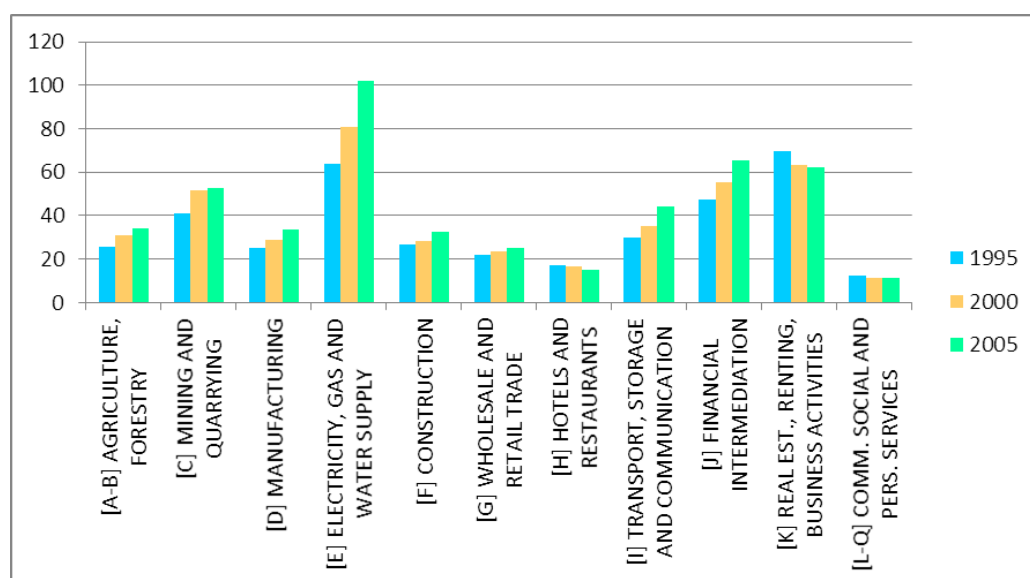
Source: own, based on EU KLEMS database.

Essentially, services constitute quite heterogeneous conglomerates with large market based and public sector parts.[2] Among market based services the largest one is section K which is the main focus of this paper. It groups services dedicated mainly for businesses such as real estate, machinery renting, computing and consultancy and hence in this paper will be called Business Services [BS]. We now turn to a brief overview of this specific and very important part of service industry.

2.1. Business services

Data on business services industry performance clearly show that it has been the main engine of growth in the whole EU25 economy over the decade 1995-2005.

In the years 1995-2005 total value added in EU25 economy grew on average by 2.5% per annum. At the same time all types of market based services achieved faster growth rates. The most rapid growth was recorded in transport and communications (5.3% p.a.) then in financial intermediation (4% p.a.) and then in business services (3.6% p.a). Manufacturing performed well below average growth rate (1.8% p.a.) – see Figure 2. One has to remember that compared to business services both transport and communication as well as financial intermediation are much smaller in terms of shares in total value added generation – see Figure 1. Thus looking only at the value added growth rates would lead to underestimation of true economic importance of business services.

For a couple of reasons, overall economic importance of business services for the EU25 economy is undoubtedly the greatest. Firstly, business services section has the largest size measured by share in annual value added generation among all market based sections of the EU25 economy. In 2005 business services accounted for 21% share in value added while total manufacturing generated 17%, trade 10% and construction only 5% - see Figure 1. Only public sector services altogether had a larger contribution (24%).

Secondly, business services had the largest contribution to total value added growth in the decade preceding 2005. This sector generated almost one third of the total growth, while manufacturing and trade contributed two times less and construction only by 3% – see Figure 2. Thirdly, contribution of business services to total employment growth over the decade has been also the largest (54% share), followed by trade sector (24%). In the same period several

---

[2] According to NACE Rev. 1.1 services consist of 4 market based sections: Hotels and Restaurants (H), Transport Storage and Communication (I), Financial Intermediation (J), Real Estate, Renting and Business Activities (K) and public sector based sections (from L to Q) under joint heading Community Social and Personal Services.

sectors experienced decrease in employment, largest in manufacturing (33%) and modest in agriculture (6%), mining (4%) and energy supply (3%).

In terms of productivity measured by value added per unit of labour, business services were in the top three sectors after energy supply (102 EUR/hour) and financial services (66) with the indicative value of 62 EUR per hour. Productivity of labour in manufacturing was almost twice lower (33 EUR/hour) – see Figure 4. To understand better the role of business services we have further decomposed this sector.

Figure 5. Business services by subindustry: share in value added in 2005, average value added growth rate, contribution to value added growth in 1995-2005 (real values from 1995)
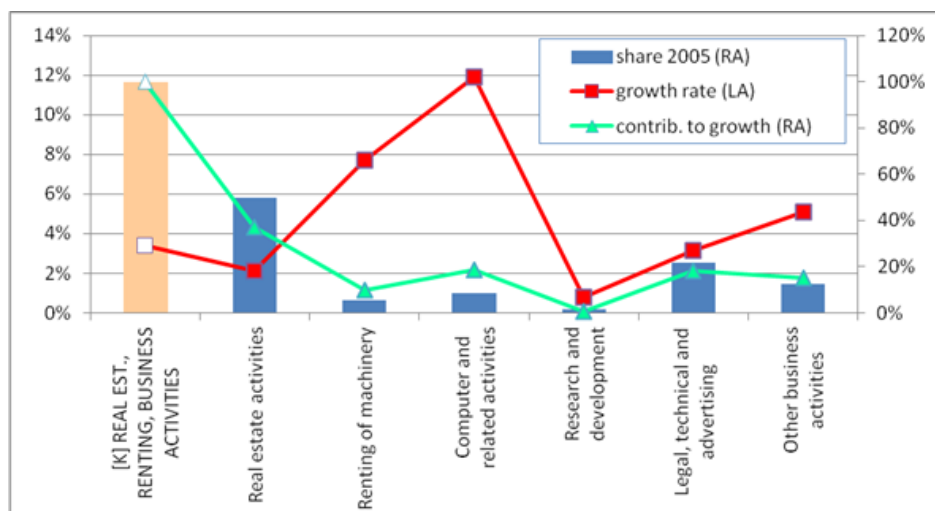
Source: own, based on EU KLEMS database.

Business services is composed of six subsections. Looking at Figure 5, the contributions to value added total growth in the decade 1995-2005 are well spread among subsections. Real estate, business consultancy and computer services were among top three contributors accounting together for 80% of value added growth. In terms of share in value added in 2005 the largest two subsections were real estate (50%) and business consultancy (22%). On the other hand computer related services was the fastest growing business services subsection in the decade (12% p.a.) – see Figure 5.

2.2. Business services performance - country level

Business services are highly diversified among EU25 countries with respect to size and performance. This diversity has two dimensions. Firstly, there is huge gap in economic impact of business services between Old and New Member States, indicating substantial underdevelopment of this sector in EU10. Secondly the performance of the business services sector is much more diversified in New Member States then in EU15.

Surprisingly, 92% of total EU25 value added in business services is generated in Old Member States. EU10 countries generate the remaining 8%. The leading countries of EU15 group are the large developed economies: Germany (23%), France (19%), UK (16%), Italy (13%) and Spain (6%) – see Figure 6. Among New Member States the largest contribution to EU25 value added has Poland (1.3%) although it is very low in comparison to abovementioned EU15 Members.

Figure 6. Share of business services in value added generated in 2005 on the EU25-level by country
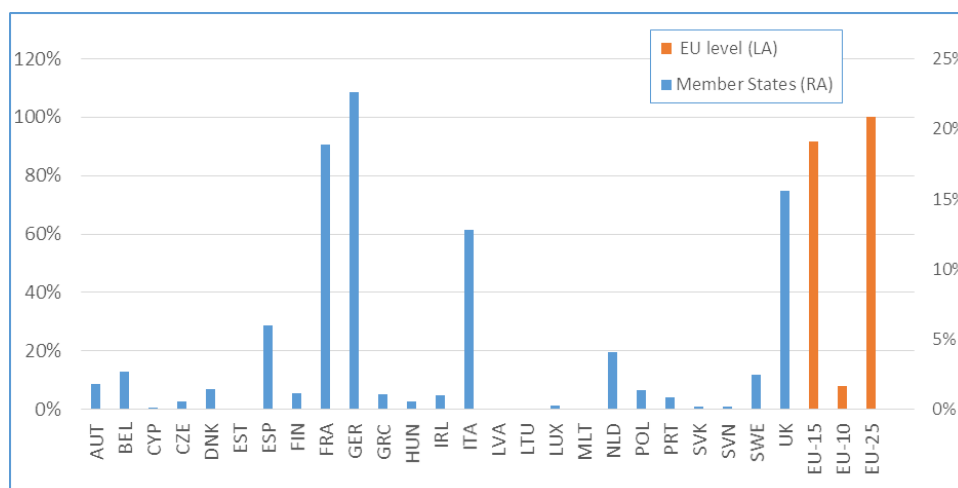
Source: own, based on EU KLEMS database.

The size of the business services section differs quite substantially on a country level inside the EU25. The share of this section in value added in 2005 ranged from above 25% for Germany and France to less than 15% for Poland, Slovakia, Czech Republic, reaching the bottom in Lithuania (10%). Generally New Member States have lower size of business services then EU15 Member States (18 vis-a-vis 22%). On the other hand EU10 countries have substantially larger size of public sector services (31 vis-vis 18%). This is an apparent consequence of legacy inherited from times of command economy – see Figure 7.

Figure 7. Share of business services in value added generated on a country-level in 2005
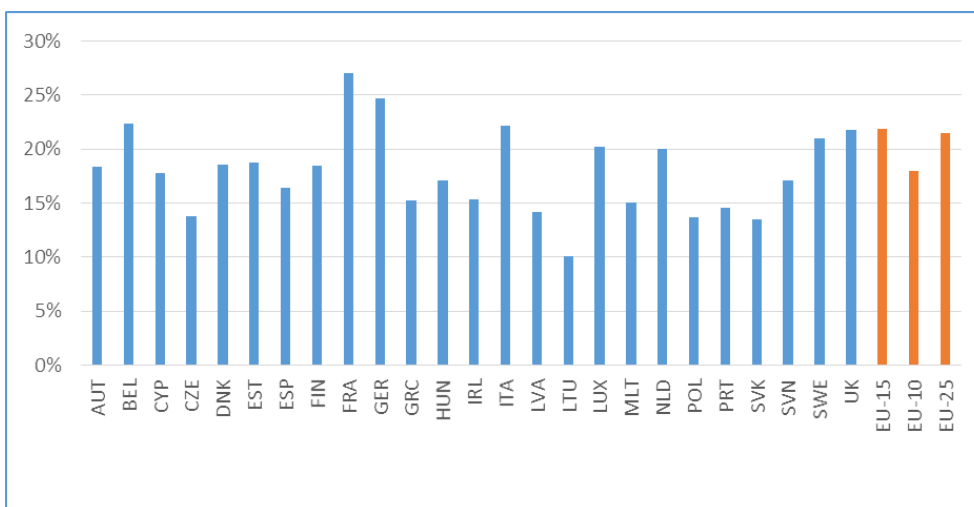
Source: own, based on EU KLEMS database.

Similar observations can be drawn with respect to performance of business services, measured by contribution to total value added growth. In EU15 business services accounted for 29% of total value added growth in the decade to 2005 while in the EU10 the contribution was half of this (14%). Business services have the strongest impact on growth in Germany (50%), then in Belgium, Italy, UK and France (around 32%). Business services in Poland, Czech Republic, Slovakia and Greece have lowest growth contributions (less than 10%). Surprisingly Sweden has low performing business services with only 15% contribution – see Figure 8.

Figure 8. Contribution of business services to value added growth and contribution to employment growth in 1995-2005 on a country-level (real values from 1990)
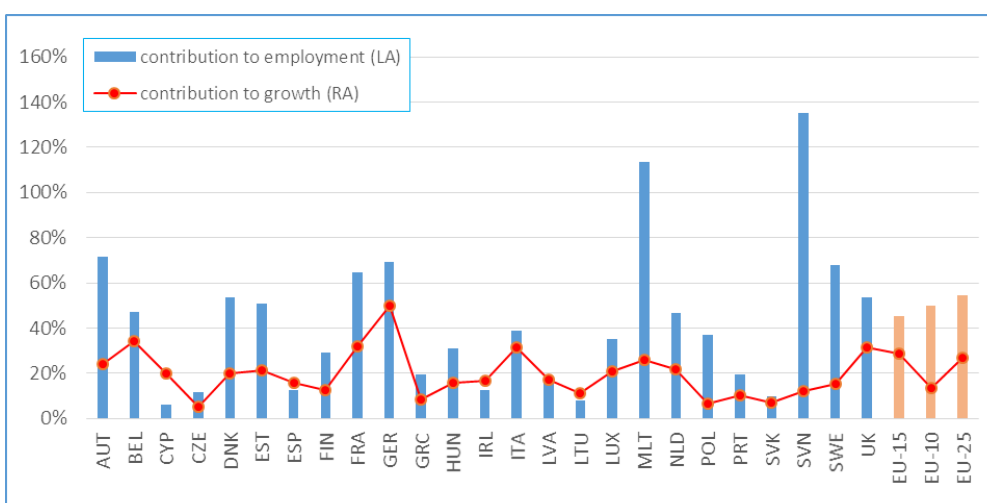
Source: own, based on EU KLEMS database.

3. Descriptive analysis of industrial linkages in the EU

3.1. Theoretical background

For measuring the potential of spreading growth throughout the economy and grasping dependencies between down- and upstream sectors, the economic literature indicates a number of measures based on the Leontief input-output model (see e.g. Oosterhaven, J. & Temurshoev, U., 2010). Having a comprehensive picture of the flows of products and services in the economy in a given period of time allows for computing a variety of indicators measuring strength of particular industries either as demanders or as suppliers.

Backward linkages stand for industries' demand for products and services from upstream sectors. Thus, strength of this type of linkages is equivalent to power of a particular industry as a demander. Strong backward linkages suggest that emergence of a sector would result in a strong development of branches providing its input. This is why backward linkages create a channel of growth through increased investment or capacity utilization in other branches (see Tragenna, F., 2008). On the opposite side, following the idea that output is input determined, forward linkages with downstream sectors induce growth by providing more capacity for final producers. Strength of industry's forward linkage, equivalent to power of industry as a supplier, suggests also that industry's services and products are not delivered in significant values in-house in downstream sectors.

In this research we concentrate on the suppliers' side of the business services sector. As they are of particular importance because of their role to provide an input to other branches, we do not look at the secondary channel of growth through backward linkages. We limit our analysis to forward linkages and depend on the information that stays behind the value of *total forward linkages measure* (*FL*) weighted by industries' share in final uses[3]. With the ceteris paribus assumption (i.e. shares and dependencies between branches stay constant), value of *weighted total forward linkage* for a particular industry informs what would happen to a given industry's total output if the final output of all other branches were to increase by one unit.

As *FL* and *BL* measure only strength of interconnectedness of sectors, they do not capture spread of industries' input and output among other branches. For this purpose the literature

---

[3] Final consumption expenditures, changes in value of inventories, gross capital formation and exports.

indicates measures of dispersion (see Drejer, I., 2002). *Backward measure of dispersion* (*BMD*) is an indicator whose value informs about the spread of input from upstream industries. On the contrary, *forward measure of dispersion* (*FMD*) quantifies the spread of sectorial output regarded as an input to other industries. For explaining patterns and role of business services, whose main role is to serve as supplier to other industries, we use *FMD*. The extreme low value of *FMD*, which is 0, describes the situation when the sector provides input to only one industry. The extreme high value ($\sqrt{N-1}$, where *N* stands for the number of industries) defines the branch that supplies all the sectors with the products and services of the same value. Mathematical formulas of *FL* and *FMD* are based on a standard measure of industry concentration. Their derivations are presented in Appendix 1.

3.2. Data description

Our computation of *FL* and *FMD* indicators was based on the last available product-by-product input-output tables estimated by Eurostat. After eliminating incomplete tables, the final dataset comprised of 22 tables for the year 2005, covering: Austria, Belgium, Czech Republic, Denmark, Germany, Estonia, Spain, Finland, France, Greece, Ireland, Italy, Lithuania, Hungary, Netherlands, Poland, Portugal, Sweden, Romania, Slovakia, Slovenia and United Kingdom.

The original tables from Eurostat present flows of products and services across 59 branches classified according to the European Statistical Classification of Products by Activity, abbreviated as CPA. In order to obtain more aggregated results we build our own classification of 17 separate and consistent industries by accumulating more disaggregated Eurostat data.

The obtained values of forward linkages and forward measures of dispersion are set together with: values of *GDP*, *share of ICT in GDP*, *labour productivity*, *wage gap* (between professionals and unskilled workers) and *share of business services in exports and total output* from Eurostat databases. We compute *share of business services in value added* and *contribution to value added growth* based on data from the EU KLEMS database.

3.3. Results

We obtain values of *FL* for 22 EU countries ranging significantly, from 0.24 to 0.93. It means that patterns of interconnectedness of business services are considerably diversified across the EU Member States. In order to increase final output, some European economies require three times more than other emergence of business services sector. In France, where we observed the strongest interconnection, total use of business services must increase by 0.93 EUR to enable growth in all the industries by one EUR. On the other hand, values of *FMD* range much less significantly ranging from 3 to 3.7. Values of both indicators – *FL* and *FMD* are presented in the graph below (Figure 9).

Figure 9. Forward linkages and forward dispersion across the EU Member States
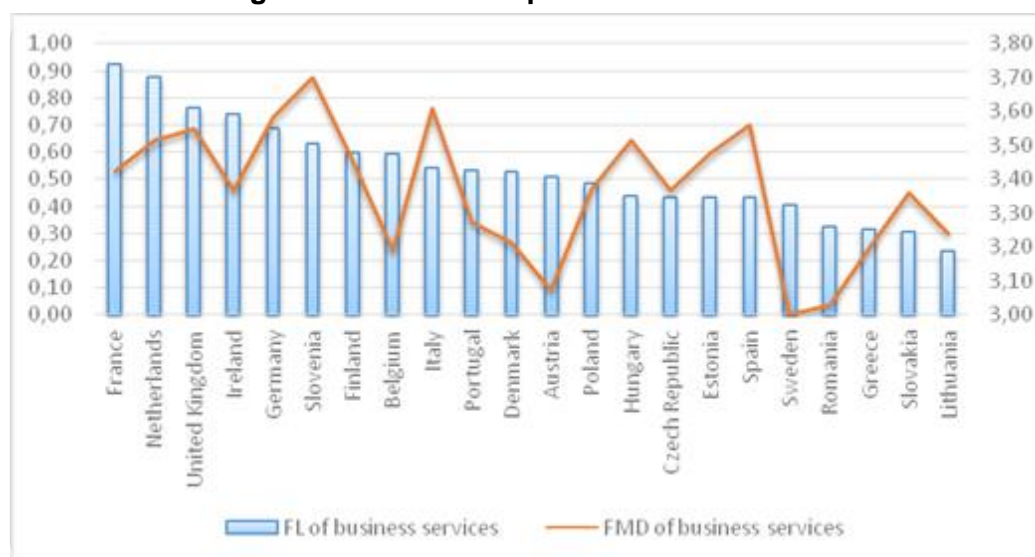
Source: own, based on Eurostat input-output tables.

Our research showed that weighted forward linkages of the business services sector are the strongest for the large economies of the EU Old Member States. In general, the lowest values were obtained for the New and Periphery Member States. Very interesting is the fact that interconnectedness of the business services sector is very weak in Sweden. Sweden with its very substantial manufacturing sector has both small and weakly interconnected business services. Outliers to our EU-geographical pattern are also Poland and Austria. Relatively high value of *FL* of the business services sector in Poland contrasts with relatively small value of this indicator for Austria. Nevertheless, the graph suggests that there is a strong correlation between the interconnectedness of business services and the development level of economies.

Values of *FMD* marked in the graph in Figure 9 give no straightforward evidence of any relationship between *FMD* and *FL*. Dispersion of forward linkages in European countries does not seem to follow any geographical pattern as well. Countries with most even business services as input providers are: Hungary, Italy, Slovenia and Spain. In Austria and Sweden values of *FMD* are the lowest. Further investigation showed that forward linkages of business services in Sweden are strongly dispersed across manufacturing industries, which affects the evenness of distribution of the business services input. In Austria dispersion is relatively uneven because of very significant linkages within business services.

As shown in Table 1, *FL* of the business sector is not only significantly correlated with the level of GDP, which was suggested by Figure 9, but also with its share in value added, its contribution to value added growth and labour productivity. The fact that there is a strong correlation between *FL* and share in value added of the business services sectors results partially from the weighting scheme applied to the computation of forward linkages. The fact that the contribution to value added growth is positively linked with *FL* is in line with the correlation with GDP and labour productivity. It suggests that forward linkages of the business services sector could be an engine for growth of the sector and the entire economy.

Table 1. Forward linkages and forward dispersion across EU countries

	FL of business services	FMD of business services	Share in value added	Contribution to value added growth	Share of business services in export	Labour productivity	Wage gap	GDP	ICT
FL of business services	1	0.389	0.440(*)	0.608(*)	0.427	0.666(*)	0.276	0.642(*)	-0.038
FMD of business services	0.389	1	0.110	0.263	-0.100	-0.127	0.761(*)	-0.107	-0.184

'' – correlation significant at 0.05. Source: own.*

We find that dispersion of forward linkages of the business services sector is not significantly related to the *level of GDP[4]*, *share in value added[5]*, *ICT[6]* and *contribution to value added growth[7]*. Thus, we suspect that strength of business services as suppliers might be much more important for growth than evenness of its linkages.

In searching for a pattern that drives diversification of the role of business services in EU we clustered 22 countries by the following grouping variables: (1) strength of forward linkages of business services, (2) their dispersion, (3) share of the sector in total output and (4) share in exports of goods and services. For the purpose of clustering we standardized all the attributes. We applied *k*-means clustering method with the algorithm that minimizes within-cluster Euclidean distance. Relatively low value of within-cluster sum of squared errors and high sum of squared errors between centres of clusters was obtained for taking into account four baskets. Moreover, we obtained groups of countries very even with respect to the number of classified instances.

The first obtained clusters contains instances with the strongest values of forward linkages business sector (1.64 for the centre), most significant share of the sector in both market share (0.84) and exports (1.32). The centre of the cluster is Ireland; other countries within the cluster are France, Netherlands and the United Kingdom. The second group contains countries which stand out from the average with very strong dispersion of business services' of forward linkages (0.99) and predominant role of business services in total output with respect to exports. The share in total output of business services is much above the EU average, whereas the share in the exports is much below. This group covers: Estonia, Spain, Italy, Hungary, Slovenia and Finland grouped in a cluster with the centre in Germany. The third cluster consists of: Austria, Belgium, Denmark and Portugal. These countries, on the contrary, stand out from the rest with the most significant dispersion of linkages of business services. As far as other attributes are concerned, these countries are very similar to the EU average. The fourth cluster is centred in Czech Republic and contains, with one exception, Periphery and New Member States such as: Greece, Lithuania, Poland, Romania, Slovakia and Sweden. These countries could be characterized with very low values of all included attributes of business services. Values of the standardized attributes for the centres of each cluster are reported in Appendix 2.

Figure 10 below presents a graphical visualization of clusters location, where each of the clusters is marked with a different colour.

---

[4] Value of GDP per capita in PPP.
[5] Share of business services sector in county's value added.
[6] Share of expenditures on ICT in country's GDP.
[7] Growth in value added of business services to total value added growth.

Figure 10. Location of clusters
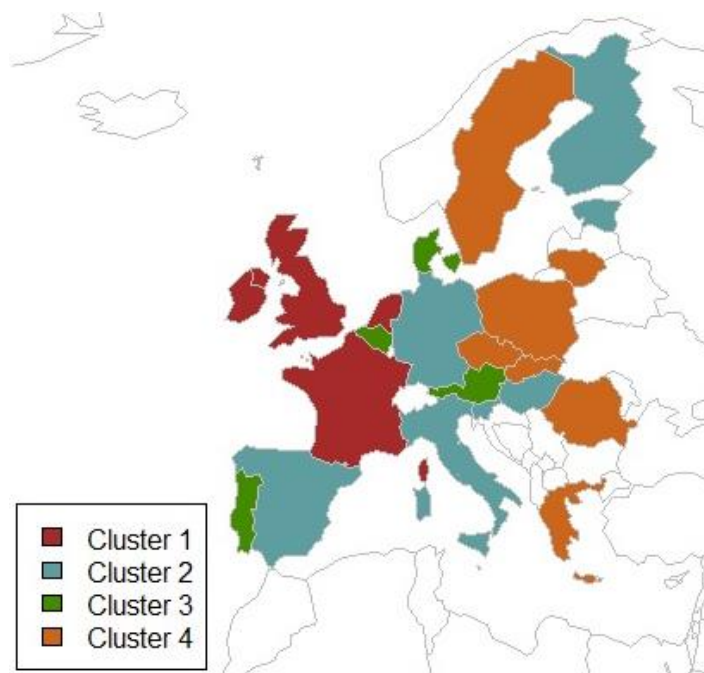
Source: own.

Location of clusters exhibits a geographical and historical pattern. Countries with the most significant size and linkages are part of the core of the EU Member States located in North-West Europe. The cluster that groups countries with average size, low-exporter business sector concerns partially the core, partially large states in South Europe. Countries with average characteristics of the business sector form Cluster 3 and are spread in different parts of EU. The fourth cluster contains the Periphery and New Member States which could be characterized by the smallest business services sector in terms of its share in total output and exports. Business services sector in the fourth cluster is also weakly linked with downstream sectors.

4. The link between linkages of business services and growth of value added

4.1. Interpretation

Understanding the difference between size and linkages of business services and their role in enhancing growth is central for a better targeted industrial policy. Share in value added of the sector that provides mainly intermediate input is suspected to be positively correlated with the value of forward linkages. In spite of this fact, we suspect that FL of business services is the

element that determines not only share of this industry in value added but also enhances contribution to the value added growth and growth of employment in business services.

In Section 2 we showed that that the business services sector in recent years has been the main engine for growth in the EU Member States. In Section 4 with help of regression models we check if the role of business services in growth is affected by the fact companies are concentrated on their core activities and do not involve too much capacity in providing business services in-house. We suspect that the strong role of business services in the economy along with other growth determinants may explain the diversified contribution of the sector within EU.

4.2. Structure of the model

In estimating our regression models we verified standard growth theories and role of business services by applying variables from a long list of theoretical growth determinants (of both contribution to value added and employment growth). Our dataset consisted of: *share of business services in value added*, *FL* of business services, its *FMD*, *FL of R&D sector*, *ICT expenditures*, *ICT capital compensation within business services sector*, *labour productivity*, *unit labour costs* and *wage gap between professionals and unskilled workers*. To comply with values of forward linkages other variables have been collected for the year 2005. Contribution to value added growth and growth of employment in the sample of 21 EU Member States was computed over the long time period, 1995-2005.

Regression diagnostics showed that neither general expenditures on ICT and R&D nor high expenditure on ICT just in business services sector support the sector's more intensive growth. This experiment was to check if "modern" capital intensive economies are subject of higher share in growth of business services. As growth of domestic outsourcing might be partially seen in growth of business services sector we test if labour costs, their structure and labour productivity might explain contribution of business services to value added. Indicators FL and FMD were chosen as growth determinants to check how current linkages determine future growth. In the end, regression diagnostics suggested the following specification of the models:

$$\frac{\Delta VA_i^{BS}}{\Delta VA_i^{total}} = \alpha FL_i^{BS} + \beta LP_i + \varepsilon_i \tag{1}$$

$$\frac{\Delta EMPL_i^{BS}}{EMPL_i^{total}} = \gamma FL_i^{BS} + \delta LP_i + \varepsilon_i \tag{2}$$

Where ΔVA_i^{BS} is value added growth in BS, ΔVA_i^{total} is total value added growth, FL_i^{BS} is forward linkage of BS, LP_i labour productivity in the entire economy, $\Delta EMPL_i^{BS}$ – growth of employment in BS (in total hour worked) and $EMPL_i^{total}$ is total employment for the economy.

Regression results are presented below.

Table 2. Model's specification

Model 1 (contribution to VA growth):				Model 2 (employment growth):			
$F_{(2, 19)} = 74.77$				$F_{(2,19)} = 171.67$			
Prob > F =0.0000				Prob > F = 0.0000			
R-squared =0.8873				R-squared = 0.9476			
Adjusted R-squared = 0.8754				Adjusted R-squared = 0.9420			
contr_va_gr	Coef.	Std. Err.	P>|t|	contr_va_gr	Coef.	Std. Err.	P>|t|
lproductivity	0.2179	0.0932	0.030	lproductivity	0.0006	0.0001	0.002
flofBS	0.0033	0.0016	0.069	flofBS	0.0285	0.0101	0.069

Source: own.

4.3. Results

The regression results confirm that there is a positive role of forward linkages of business services in explaining its contribution to value added growth and growth of employment. The current strength of business services as suppliers captured by forward linkages is important for future growth of this industry. Our analysis suggests that linkages rather than the share in value added define well future potential for this industry's growth. The process of the selection of variables suggests that there is no clear role of *R&D, ICT* and *unit labour costs* in explaining the increasing role of business services. Advanced, capital intensive economies investing in information, communication technology and *R&D* do not experience higher share in growth of business services. On the other hand, high labour productivity that characterizes strong economies is an element explaining the increasing role of business services. These results advocate that there might be two channels for growth of business services. The first channel is due to labour productivity. The second reason for growth is the level of involvement of business services in providing input to all the sectors.

The literature suggests numerous means of influencing labour productivity but also some ways of supporting industrial policy in order to strengthen forward linkages of the business services sector. Woelfl (2006) suggests that increase in interdependency of business services goes hand in hand with the increase in productivity. These results were partially confirmed in our research. We show that although there is a positive correlation between *FL of business services* and *labour productivity* – exogenous variables in or model, test VIF suggests

accepting such specification of the model. On the other hand labour productivity is related stronger to contribution to growth of the sector than to its forward linkages.

According to Falk & Jarocińska (2006) stronger linkages might be an effect of structural change e.g. shift-out of subsistence agriculture, low skilled manufacturing and services. Policies supporting positive technological breakthrough and policy to improve labour productivity may support growth of the business services and entire economy.

Conclusions

Our results indicate the fundamental role of business services as the main engine of growth in the European economy. Business services play more and more significant role across the EU but their strength in different countries is highly diversified. On the contrary, their growth appears to be driven by the same factors. We find that service-based growth is channelled mainly through increases in labour productivity and integration of services with downstream industries. On the other hand the role of physical capital including investment in ICT appear to be negligible. Investment in physical capital such as ICT equipment increases growth through impact on labour productivity.

These results are consistent with common intuition. The growing importance of services simultaneously increases the role of knowledge, human and intangible capital. Altogether they affect the growth mainly through an increase in labour productivity. Skilled labour is required to produce services with high added value. It is also essential that such services use inputs from the other sectors. On the other hand, compared with the traditional growth models, our results show that the importance of physical capital decreases nowadays. Physical capital becomes additional to integrated solutions based on the knowledge essential in today's production.

In our paper we also showed the importance of integration of the services sector as measured by forward industry linkages. Increase in linkages with other sectors of services provides a larger diffusion of services as inputs in the economy. We argue that this process must be reflected in an increase in the share of services in value added growth.

On the policy making level our results indicate that investment in human and intangible capital are crucial for the service-dominated economy. They not only enhance economic growth inside knowledge intensive services but also facilitate transmission of growth impulses to downstream industries by increasing diffusion and integration of services with the economy. Innovation policies inducing positive technological breakthrough may support growth of the business services and the entire economy as well.

References

van Ark, B., O'Mahony, M. and Timmer, M. (2008). *The productivity gap between Europe and the U.S.: Trends and causes*, Journal of Economic Perspectives , 22 (1), pp. 25-44.

van Ark, B., Hao, J.X., Corrado, C., and Hulten, C. (2009). "Measuring intangible capital and its contribution to economic growth in Europe". EIB Papers, (14:1), pp. 62-93.

Bertschek, I., Engelstätter, B., Szczygielski, K. (2010)*. The Role of Information Technology For Service Sector Performance*. SERVICEGAP Review Paper 3.

Claus, I., Li, K. (2003). *New Zealands Production Structure: An International Comparison*. New Zealand Treasury Working Paper 03/16.

Drejer, I. (2002). *Input-Output Based Measures of Interindustry Linkages Revisited: A Survey and Discussion,* Paper presented at the 14th International Conference on Input-Output Techniques, Montreal, Canada.

Jarocinska, E. & Falk, M., (2010), *Linkages between Services and Manufacturing in EU countries*, SERVICEGAP Review Paper 1.

Oosterhaven, J. & Temurshoev, U. (2011). *On input-output linkage measures*, SSRN.

Roth, F., Thum, A., O'Mahony, M. (2010*). Intangible Capital and Productivity Growth: A Literature Review with a Special Focus on the Service Industry.* SERVICEGAP Review Paper 2.

Soofi, A. (1992). *Industry linkages, indices of variation and structure of production: An international comparison.* Economic Systems Research 4(4): 349-375.

Tregenna, F., (2008). *The Contributions Of Manufacturing And Services To Employment Creation And Growth In South Africa*, South African Journal of Economics, Economic Society of South Africa, vol. 76(s2), p. 175-206.

Uppenberg, K., Strauss, H. (2010). *Innovation and productivity growth in the EU services sector*. European Investment Bank.

Woelfl, A. (2006). *The Interactions between Manufacturing and Services and its Role for Productivity Growth*, Intermediate Input-Output Meeting on Sustainability, Trade & Productivity.

Appendix

Appendix 1. Derivation of FL and FMD

The basic equation that links final ($\boldsymbol{y}$) and total ($\boldsymbol{x}$) output in the Leontief input-output model is presented below:

$$\boldsymbol{x} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{y} = \boldsymbol{B}\boldsymbol{y} \tag{3}$$

$\boldsymbol{I}$ in the equation denotes identity matrix, $\boldsymbol{A}$ stands for direct requirements matrix and $\boldsymbol{B}$ is Leontief inverse. Unbiased forward linkage measure for industry *j*, weighted by values of final output and derived from the matrix equation above takes the form:

$$FL_i = \sum_{j=1}^{N} b_{ij} \times \frac{y_j}{\sum_{i=1}^{N} y_i} \tag{4}$$

Where $\sum_{j=1}^{N} b_{ij}$ stands for the *j*-row sum in Leontief inverse, $\frac{y_j}{\sum_{j=1}^{N} y_i}$ is industry's share in final output and N is total number of industries.

Equation depicting *FMD* measure goes as follows:

$$FMD_i = \left[N \left(1 - \sum_{j=1}^{N} \left(\frac{b_{ij}}{\sum_{j=1}^{N} b_{ij}} \right)^2 \right) \right]^{\frac{1}{2}} \tag{5}$$

where b_{ij} denotes the (*i*-row, *j*-column) element of Leontief inverse and N is total number of industries.

Appendix 2. Clustering results

Table 3. Clustering results: values of attributes for the clusters' centres

Business services attributes:	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**
FL	1.6427	0.0203	0.0462	-0.9854
FMD	0.5112	0.9985	-0.9437	-0.7514
Share in export	1.3197	-0.3724	0.016	-0.3908
Share in total output	0.8407	0.4769	0.3155	-1.1376

Source: own.