

Towards regional knowledge-based economies: did Structural Funds matter? A comparative case study of the English West Midlands and Polish Silesia.

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Abstract

With the approaching end of the current financial perspective (2007-2013) and the changes brought forward by the new programming period of the Cohesion Policy it is worth re-examining the effects which the policy's measures have had in the previous years, especially with regard to regional aspect.

The paper is set to investigate the nature of the relationship between the knowledge-based economy, which sprung into significance after announcing the Lisbon Agenda in the year 2000, and the Structural Funds, which are the key tool of implementing the Cohesion Policy and are very often considered as one of the prime sources of financing regional KBE development.

Despite a significant amount of studies regarding KBE both in the scholarly environment and official publications of the EU and the OECD, there is no commonly agreed definition of the Knowledge-Based Economy and how it could be measured. Although the Knowledge-Based Economy is a concept that has gained significant popularity since naming it as the aim for EU development, the initial idea of KBE was introduced much more recently than the last two decades. Concepts of knowledge/information economy/industry, information society etc. have confirmed the importance of defining the role which is played in contemporary societies by knowledge-rich products, leading to the development of economies on regional and national level.

Also, there is no common agreement as to the methods used for measuring the KBE, with individual scholars as well as various organisations proposing their own measurements and indicators for evaluating the Knowledge-Based Economy.

Furthermore, most of the literature on European Funds concentrates on Structural Funds and does that in a particular way – focusing on assessing the impact of Structural Funds on the development of the whole economy, be it its national or regional aspect - not on chosen topics “within” the economy. However, in most cases issues such as patterns of employment or changes in the proportion of population in education are taken into account, but only as macroeconomic factors, i.e. parts of assessing the changes in economy as a whole (e.g. Dall’erba, Le Gallo, 2008). What is more, despite there being studies focusing on comparing regions within the EU (e.g. Sinn, Westermann, 2000;), what has most often been taken into consideration was the general economic growth within given regions (e.g. Puigcerver-Peñalver, 2007; Mohl, Hagen, 2010).

The regions of West Midlands (UK) and Silesia (Poland) share many features, notably being both being very coal- and manufacturing- dependant economies, which have to an extent struggled with the transition to the new, knowledge-based economical environment. One of the other reasons behind the choice is that it allows comparison between one of the “old” member states’ region with one of the regions of a state relatively new to European funding.

Taking into consideration all of the above mentioned points, this is an original study which reviews the impact of Structural Funds on a very particular issue: the development of the regional Knowledge-Based Economy. The uniqueness of the study stems firstly from devising the original methodology which allows quantitative assessment of the Knowledge-Based Economy on a regional level; secondly the study provides a comprehensive overview of the KBE-Structural Funds relation paying special attention to two EU regions which have not been compared before in the literature and does it in a particular time-scale: the years 1999 to 2009.

This is methodologically addressed by firstly establishing a new way of calculating the General Indexes of the Knowledge-Based Economy of the two regions and, secondly, applying a number of statistical methods to measure the influence of the Funds on the changes in the regional KBE over time.

The paper is ultimately designed to establish whether the allocations of the Structural Funds provided adequate measures for the development of Knowledge-Based Economies in Silesia and the West Midlands – in other words: did the Funds at all matter for the development of the regional Knowledge-Based Economies in the West Midlands and Silesia.

Introduction

With the approaching end of the current financial perspective (2007-2013) and the changes brought forward by the quickly approaching new programming period of the Cohesion Policy it is worth re-examining the effects which the policy's measures have had in the previous years. Given that Cohesion Policy is a term incorporating the regional policy (Bache, 1999) it can be expected that examining its influence on the European regions may yield particularly interesting findings.

What should be kept in mind as a starting point for inquiries is that for over a decade there has been a keen political interest in the idea of the Knowledge-Based Economy (KBE), one of the key examples being the announcement of the Lisbon Strategy in the year 2000 (Lisbon European Council, 2000). It was then when the aim was set for the EU to become "the most dynamic and competitive knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010" (Lisbon European Council, 2000, point 5). Notably, this announcement was made in line with the start of the financial perspective 2000-2006. At present the end of yet another financial perspective (2007-2013) is approaching and therefore it seems of particular importance to attempt to assess how the previous Cohesion Policy measure, of which undoubtedly the Structural Funds are key component (see e.g. Bachtler & Wren, 2006), has interacted with the KBE.

The research presented in this paper firstly, attempts to establish the new KBE General Index, which could be obtained for all of the EU regions on NUTS2 level, and secondly, uses this original numerical index to investigate into the statistical relationship between the changes in KBE over time and Structural Funds allocated to a given region with a particular focus placed on two European regions: the English West Midlands and Polish Silesia. The period of time this analysis takes into account are the years 1999-2009.

A new approach to the regional KBE

The first important issue arising is the choice of methodology for calculating a composite index to assess the regional KBE performance. There were various attempts of calculating general indexes relating to the Knowledge-Based Economy, addressed by international organisations and individual researchers alike.

The most-know "organisation-derived" lists of indicators are undoubtedly the OECD's "Indicators for the knowledge-based economy" and the World Bank's "Knowledge Economy Index". As the OECD defined almost sixty indicators, it was noted that the idea of the KBE became nothing more than a label, an "umbrella concept", allowing the gathering of existing concepts on knowledge, science and technology together with the statistical indicators into an "all under one roof" conceptual framework (Godin, 2005). However, the biggest issue with the two sets is that they require data which are only obtainable on a national level and would not suffice for exploring the KBE in particular regions.

One can also notice that also within the European Union itself, there is no common set of KBE indicators, as these vary for example between the sets proposed in the 2006 Synthesis Report to DG Regio, the European Innovation Scoreboard (preparation of which was ordered by the European Commission) and the Knowledge Economy Indicators, which were the outcome of the Universität Trier's project funded by the 6th Framework Programme (a part of European Funding scheme for research). Another important piece of work is the European Regional Innovation Scoreboard, which is the closest solution to the one proposed in the paper. Nevertheless it has a number of limitations which make it unsuitable for the purpose of this research: it takes into account only recent years and

many of the indicators considered (which again, differ from the ones proposed in the European Innovation Scoreboard) are unobtainable for the period which this analysis takes into account.

Yet, as already said, it is not only the indicators proposed by international organisations that differ; scholars seem not to have agreed on universally approved set of indicators as well. In brief, the main three approaches could be broadly defined as: “human-oriented”, “technically-oriented” and “innovation-oriented”, where each of the following approaches builds on the findings of its predecessor. The examples of the first approach are de la Fuente and Ciccione (2002) who state that the crucial role in what they refer to as “knowledge-driven-economy” is played by human capital, as according to them it is an important determinant of productivity and hence – economic outputs. Other authors, who despite still considering the role of human capital as important, add to it another significant determinant, namely the information and communication technologies (ICT) are e.g. Antonelli (1998) and Chatziparadeisis (2006). Another example of the “technically-oriented” approach is the work of Powell and Snellman (2004) who believe that KBE can be measured based on the number of patents and new technologies in a given state, and these are derivatives of the number of people completing their higher education and the workplace organisation of workplace preferred in a given company. The third, “innovation-oriented” approach can be represented most of all by Cooke and Leydesdorff. In their journal paper (Cooke and Leydesdorff, 2006) they state that systemic innovations are one of the determinants of the trajectory of a region’s evolution. This approach led to another of Leydesdorff’s concepts, namely the “Triple Helix model”, which evaluates the KBE based on wealth generation (industry); novelty production (academia), and public control (government) (Leydesdorff, Meyer, 2006).

Taking into account all the scholarly effort it has to be stated that as versatile as the proposed indicators are, none of the approaches seems to fill both of the two core criteria essential for this research: they are either not comprehensive enough or they are not “operationable” due to lack of data obtainable on the regional level. Out of the two criteria, the key issue seems to be the availability and comparability of the data used when focusing on the regional performance of the KBE. Therefore for the purpose of this research the following indicators are proposed: i) Human Resources in Science and Technology, ii) Employment in technology and knowledge-intensive sectors, iii) Pupils and students in education, iv) Total intramural R&D expenditure, and v) Patent applications to the European Patent Office: hi-tech, ICT and biotechnology. All of the indicators are scaled to relative values, i.e. expressed as either: the percentage of active working population (i and ii), all population (iii), the percentage of the GDP (iv), or per million inhabitants (v). The numerical values of the above indicators are obtained directly from the Eurostat database; as these data are based on information submitted by individual EU Member States and regions, the author considers them a reliable source. For more information and detailed reasoning behind the choice of those particular KBE indicators please refer to Wrona (2012).

The General Index

The first step of the analysis requires assigning the regions a KBE General Index, calculated as a composite indicator according to the methodology presented below. This operation was performed for all of the 273 EU regions. After calculating the general KBE index in real values, totals for each region (NUTS 2) and each year from the time-span 1999-2009 are normalised to a coefficient where the mean is equal to 100 and each score is transformed into a value >100 or <100. Expressing the value of KBE GI in relative values adds far better possibilities of comparison between the regions.

There are many methods for calculating composite indexes (for a comprehensive list see e.g. Saisana, Tarantola, Saltelli, 2003). Based on the list of possible methods, for the purpose of this

research a decision was made to choose the method of Ratio or percentage differences from the. This method takes the average of the ratios (or percentages) around the EU mean for each indicator, for each year. The ratios for all regions are then summed and divided by the number of indicators (multiplied by their respective weights). The advantage of this method is that it can be used for calculating changes in the composite indicator over time (Saisana, Tarantola, Saltelli, 2003, p.5), which is exactly what is needed for the research.

When adapted to the framework and data required and used in this analysis, the mathematical formula for the chosen method presents as follows:

$$GI_r^t = \frac{\sum_{i=1}^N w_i y_{ir}^t}{\sum_{i=1}^N w_i}$$

where:

$$y_{ir}^t = \frac{x_{ir}^t}{x_{iEU}^t}$$

and:

GI denotes the “General Index”, which is the composite indicator value for the region r at time t;

x_{ir}^t is the value of indicator i for the region r at time t;

x_{iEU}^t is the value of indicator i for the EU mean at time t;

w_i is the weight assigned to the indicator i.

The final significant issue regarding calculating a composite index is assigning the weight to the indicators. As noted by Saisana, Tarantola, and Saltelli (2003), it is not possible to know (or estimate) the real weights since this would require a dependent variable (in the case of this research this is the KBE General Index). On the other hand, if there were a satisfactory dependent variable there would be no need for a composite indicator.

For the purpose of this research it was decided to assign the weights depending on cross-referencing the indicators, i.e. the frequency of consideration of the indicators in the indicators lists as presented in Appendix 1. The assigned weights are then used in calculating the KBE General Index following the methodology presented below.

Taking into account the fact that the significance of chosen indicators among the analysed organisations is diverse, what needs to be calculated first is the weight coefficient (α_i) for a single indicator within the list of indicators of each of the organisations listed in Appendix 1. This is defined as a reciprocal of the number of indicators (m) considered by each one of the analysed organisations for evaluating the KBE.

$$\alpha_i = \frac{1}{m_i}$$

where:

m_i is the number of indicators used by a given organisation to evaluate the KBE.

In order to assign weights to the indicators chosen for calculating the KBE General Index, it was chosen to calculate the relative coefficient of weight (t_i) for each of the five indicators. This coefficient will consist of the ratio of sum of weight coefficients for a given indicator taken into consideration by various organizations dealing with the KBE (n) to the maximal value of the coefficients’ sum for this indicator, i.e. the situation if the indicator was used by all of the analyzed organisations (k).

This can be presented using the formula:

$$t_i = \frac{\sum_{j=1}^n \alpha_{i,j}}{\sum_{j=1}^k \alpha_{i,j}}$$

where

$\alpha_{i,j}$ is the weight coefficient

i is the number of indicator, $i=1,\dots,5$

j is the number of organisations taking the given indicator into consideration, $j = 1,\dots,n,\dots,k$.

k is the total number of analysed organisations which deal with the KBE.

The obtained values of the relative coefficients of weight (t_i) for each of the indicators will have weights assigned according to the rule that maximal value of the relative coefficient will be assigned weight = 5. The other weights will be assigned proportionally to the obtained numerical values of the relative coefficients of weight of the other indicators.

The results of the weight calculations are presented in the Appendix 2.

Measuring the Structural Funds' influence

The EU is often credited for its success in developing central policies and the progress achieved in reducing regional disparities, especially by the implementation of its Cohesion Policy (CP) (Martin & Tyler, 2006; Musyck & Reid, 2007; Bachtler & McMaster, 2008). The CP, and the Structural Funds which are its key financial components (Bachtler & Wren, 2006:143) are generally considered to be a powerful tool in reducing disparities among European regions (Begg, 2003; Bachtler & Mendez, 2007:537), although prior to 1989 the extent of their effectiveness was perceived as only of minor importance and influence (Armstrong & de Kervenoael, 1997).

There is a consensus between researchers, political scientists and sociologists that one of the main rationales behind the existence of the European Union is to deliver economic integration (Tsoukalis, 1991; Swann, 1992; Armstrong, de Kervenoael, 1997; Puigcerver-Peñalver, 2007) as tying countries together economically is can be used as a way of consolidating democracy and thus resolving one of the causes which lead to conflicts between the states in the past (Dinan, 2005:2).

An argument central to the rationale behind the need of furthering economic integration is that regional socio-economic disparities across the Union are still wide (Martin, Tyler, 2006:202) and that the Union has a responsibility to reduce the extent of the variation, mainly through regional economic restructuring (Michie, Fitzgerald, 1997) and aiming at general regional development.

Although the literature on analysing the impact of Structural Funds and Cohesion Policy in general on regional economic disparities seems to be vast, there are only a few empirical verifications which various scholars adapt for the purpose of measuring their impact, mainly on regional and national development (see e.g. Bachtler, Wren (eds.), 2006). Another vital observation is that most of the literature focuses on the impact of the Funds on the convergence between the regions (e.g. Neven & Gouyette, 1995; Boldrin & Canova, 2001; Midelfart-Knarvik & Overman, 2007; Dall'erba & Le Gallo, 2008) or on the issues of general economic growth in particular groups of regions (Cappelen et al, 2003; Rodriguez-Pose & Fratesi, 2004; Puigcerver-Peñalver, 2007).

One of the approaches considered recently by some scholars (e.g. Puigcerver-Peñalver, 2007) as particularly appropriate for the measurement of the Structural Funds' impact is the

“growth” approach, based on the neoclassical Solow growth model, in which the implementation of Structural Funds increases the level of physical capital and hence corresponds to a higher steady state income. At the same time, because of the decreasing marginal product of capital, the investment rate declines towards the steady state income and the stock of capital per capita is constant. Therefore, a higher investment rate in poorer regions can increase the pace of convergence, but this is only transitional since it does not raise the growth rate in the long run (Puigcerver-Peñalver, 2007). However there are also empirical studies which present somewhat contradicting findings. For example, García-Solanes with María-Dolores (2002) found that the absolute β -convergence between the regions which were recipients of structural funding in the period 1989 – 1996 was 2.5% comparing to 8.6% β -convergence between states in the years 1989-1996. Yet if taking into account the Structural Funds they received the speed of convergence reached respectively 3.8% for regions and 15.18% for states (García-Solanes, María-Dolores, 2002).

A second group of theories are the endogenous growth theories, which grant an important role in determining the growth rates in the long run to public policies. For example it is predicted by Aschauer (1989) and Barro (1990) that if the production function is to take account of public expenditure then policies which finance new public infrastructure will increase the marginal product of private capital and through that – foster the accumulation of capital and growth.

Yet another different approach aims to analyse the contribution of the Structural Funds towards economic convergence by estimating conditional convergence equations (e.g. before mentioned García-Solanes and María-Dolores, 2002; Cappelen et al, 2003). In this aspect the research of Cappellen, Castellacci, Fagerberg and Verspagen yields particularly important results, as its findings suggest that whereas regional support has had a generally positive impact on the growth of regions, economic benefits of such support tend to be much stronger in the economies which are already more developed (Cappellen et al, 2003: 640). Although, as demonstrated, there is a considerable amount of studies which confirm the positive impact of the Structural Funds on regional growth, it has to be said that not all scholars agree with that and the empirical studies’ evidence remain ambiguous.

Considering the research on non-positive effects of the Funds, authors who need to be mentioned are Boldrin and Canova (2001). Their research focused on the period 1982-1992 and included examination of changes in the statistical distribution of different factor productivities and income per capita in European regions. They concluded that the economic progress of regions receiving structural funding did not differ much comparing to the rest of the EU and that regional and structural policies and subsequent allocation of Structural Funds mostly serve a redistributive purpose, but have little relationship with fostering economic growth.

Authors, who also present a rather critical point of view on the Structural Funds’ effectiveness are e.g. Dall’erba and Le Gallo (2008), whose focus is placed on the spatial econometric analysis of the Funds’ impact. They believe that exclusion of significant spatial statistical and econometric features (such as β -convergence, technology spillovers and migration effects) may lead to unreliable results in measuring the Fund’s impact. The authors argue that since the majority of Structural Funds in the period they measured (1989-1999) was to finance transportation infrastructure they induced industry relocation effects, and the research and econometrical tests they conducted proved such a distribution of the Funds to be ineffective – at least in its current form.

Bearing in mind the issues brought forward by the already existing literature, it was decided that the methodology of the research will loosely follow the one proposed by Martin and Tyler (2006), who evaluated the impact of European Union regional policy on cumulative job creation in the least prosperous Objective 1 regions not by “formal econometric model building” (Martin, Tyler, 2006: 204) but using more straightforward statistical methods, e.g. correlation.

The author acknowledges that as useful as econometric models can be, devising models works best in the cases of multiple variables, as demonstrated in the literature review. Such methods seem fit for addressing the issues of “convergence”, “growth” etc. but in the case of measuring the relation between two clearly defined variables: the KBE and the volume of Structural Funds allocation using straightforward statistical methods seems more appropriate.

As the analysis’ core aim is to investigate into the relation between the Knowledge-Based Economy and the Cohesion policy, it becomes rather obvious that the second set of data should rely on numerical data which can describe the input of the Cohesion policy in the best manner: the value of allocated Structural Funds. These include the European Regional Development Fund (ERDF) and European Social Fund (ESF), treated as an aggregate.

The data on Structural Funds allocation were extracted from the hard copy of *Table of Allocation for the years 1999-2009* obtained personally by the author from the DG Regio in February 2011.

The case-study regions and research time-frame

A crucial concept which needs to be defined for the purpose of this research is the idea of a ‘region’. As made clear by Loughlin (1996:154) this word can be used in many different ways meaning either ‘global’ regions, i.e. collections of countries (e.g. Central-Eastern Europe), or particular territories within or across countries. The second approach to the concept can be divided even further; a comprehensive attempt to classify the various ideas of regions *within/across* countries was undertaken by Keating and Loughlin (1996) who distinguish four types of possible understanding of a term ‘region’: economic, historical (ethnic), administrative (planning), or political. It is not often that all of the four ways of determining a region overlap (Loughlin, 1996:156) and for this reason, as pointed out by Mathias (2006:214), the scholars within the field of regional studies tend to adopt various definitions of a region, depending on their research objective.

Following this observation, the nature of this research topic makes it logical that henceforth “regions” would be understood best by using the European NUTS nomenclature.

However, there is an important point that needs further consideration; whereas for the majority of the EU states using the NUTS-2 level data is perfectly logical, in some cases the use of NUTS hierarchy presents a more nuanced issue. The NUTS nomenclature was created adopting the regional units of the Member States (Loughlin, 1996:156) and did not always take into account the fact that in some of the states, the regions and their administrative functions have been reformed over and over again by changing governments (Mathias, 2006:215). Such is in fact the case for the UK, where in 1999 the Labour government created 9 regions for regional development, corresponding to the classification of the NUTS-1 level, instead of NUTS-2 (Sanford, 2006:175).

For Silesia the NUTS-2 division is a very adequate spatial measurement as it is in accordance with Silesia’s present administrative, not historical or ethnic borders. The historical region of Śląsk (incorporating both Upper and Lower Silesia) consists of areas lying in what is contemporarily south-eastern Germany, south-western Poland and northern Czech Republic. The administrative region (also called voivodeship – “województwo”) of Silesia was created on January 1, 1999, out of the former Katowice, Częstochowa and Bielsko-Biała voivodeships, pursuant to the Polish local government reform adopted in 1998 (Ustawa o wprowadzeniu zasadniczego trójstopniowego podziału terytorialnego państwa, 1998). The reform introduced a new three-level division of local authorities. A powiat is part of a larger unit – województwo (“voivodeship”) and in turn a powiat is usually subdivided into gminas (“municipalities”). However some of the towns and cities function as

separate counties in their own right, with no subdivision into gminas. These are called “city counties” (powiaty grodzkie); other powiaty are called “land counties” (powiaty ziemskie).

Therefore henceforth “Silesia”/ Śląsk will be used solely as the name of the Polish administrative region (“województwo”) corresponding to the NUTS-2 region coded as PL22 (Eurostat, 2010).

However, for the West Midlands the issue is far more nuanced.

The term “West Midlands” can be used as a name for both a metropolitan county (corresponding to NUTS 2: UKG3; Eurostat, 2010) and a whole region (NUTS 1: UKG; Eurostat, 2010). What is more the issue of defining administrative “regions” in the UK and especially in England requires further attention. In 1946 the Treasury attempted to achieve a territorial measure of standardisation (Mackintosh, 1968:72) and nine "standard regions" were set up, in which central government bodies, statutory undertakings and regional bodies were expected to cooperate. From the mid 1960s some elements of regional development and economic planning activities were carried out by the newly-established Economic Planning Councils and Boards, which were then abolished by the Conservative Government in 1979 (Balchin, Sýkora, 1999:89-100). In April 1994 the John Major government created a set of Government Offices for the English Regions (within the boundaries of the nine standard regions, plus London) (Sanford, 2006:175) but it was not until the structural reform of 1997 introduced by the New Labour when the regions gained more say in regional development affairs (Wilson, Game, 1998:362). Labour introduced the Regional Development Agencies Act (1998) which established the RDAs in the nine regions from April 1999. The RDAs were defined by the needs of regional development (Keating, 2006) and one of their key objectives was to take over the responsibility from Government Offices for administering the European Funds (Wilson, Game, 1998).

Therefore, due to the fact the RDAs were established on what is ultimately NUTS 1 level, the quantitative analysis for all of the UK will be presented based on the data derived from the information provided on the NUTS 2 level, however, aggregated to represent NUTS 1, that is English standard regions. Another reason supporting this choice is that, as explained further on in the section, the time-frame taken into account in this research will only consist of the years 1999 to 2009, which are ultimately the years of RDAs functioning.

In the particular case of West Midlands this has two implications. Firstly, the data for the West Midlands region will consists of aggregated data from Herefordshire, Worcestershire and Warwickshire, Shropshire and Staffordshire, and West Midlands (county) (according to NUTS codes: UKG1, UKG2, and UKG3, respectively; Eurostat, 2010b). Secondly, the terms “West Midlands” and “the West Midlands Region” will henceforth mean the West Midlands standard region, unless explicitly stated otherwise.

Figure 1. Location of the West Midlands Region and Silesia respectively within England and Poland



One of the reasons for the choice of the two particular is that it allows comparison between one of the “old” member states’ region with one of the regions of a state relatively new to European funding. However, because the West Midlands and Silesia appear to be similar in many background characteristics, they can be used as examples for the two “most similar systems design” (MSSD) (Anckar, 2008:389-390).

The chosen geopolitical factors of the two regions are listed in the Table 1. and the similarities and contrasts between the regions are further discussed below.

Table 1. Chosen geo-political factors of the West Midlands and Silesia (2007)

| Factor | West Midlands | Comparing to whole of the UK | Silesia | Comparing to whole of PL |
|--|---------------|------------------------------|--------------|--------------------------|
| Area | 12,998 sq km | 7 th | 12,334 sq km | 14 th |
| population | 5,267,337 | 8.4 % | 4,676,983 | 12.0% |
| population density | 405 / sq km | 5 th | 379 / sq km | 1 st |
| unemployment | 8.3% | + 1.2% | 9.2% | - 3.5% |
| GDP per capita | 24,800 € | 85.2% | 14,400 € | 105.8% |
| Number of public universities ¹ | 9 | Out of 115 (7.8%) | 13 | Out of 131 (9.9%) |

Sources: West Midlands Observatory (2009), GUS (Główny Urząd Statystyczny) (2010), Universities UK (2010), PARP (Polska Agencja Rozwoju Przedsiębiorczości) (2008).

As visible from the table, both of the regions have comparable area in sq km; West Midlands is ranked 7th out of 9 regions in England, Silesia is 14th out of 16 voivodships in Poland. WM population exceeds slightly 5 million, accounting for just over 10 per cent of UK population, and 4.5 million inhabitants of Silesia make 12 per cent of the whole population of Poland. What also seems significant is that the population density in both regions remains similar, and oscillates around 400 people per sq km. Another factor which is similar in the regions is the number of universities located within them (9 and 13 respectively) and the percentage they make in comparison to both whole countries. The regions also have a similar unemployment rate, but what is worth noticing is that WM’s rate is 1.2 per cent higher than the average UK rate, whereas the slightly higher value of the unemployment rate in Silesia is 3.5 per cent lower than the Polish average. Yet the most significant difference between the two regions occurs in the GDP per capita, with West Midland’s average being almost twice as much as the one of Silesia (in real values). However, when comparing the regions’ GDP with the average GDP of the whole of their respective countries, Silesia is standing at a more favourable position than WM, as its GDP exceeds the Polish average, while the WM’s GDP does not reach the national UK average.

What is also worth pointing out is that both of the regions share “industrial heritage” - until recently they were reliant on manufacturing (as opposed to agriculture and services) and in the last two decades they both needed to face significant changes and decrease in the traditional manufacturing industry (Spencer et al, 1986; Wiedermann, 2010) and the transition towards a Knowledge-Based Economy.

The author has decided to compare the two above regions in a specific timescale: from 1999 to 2009. This is for several reasons. 1999 was the year in which significant legislative changes with respect to the regional division took place in both the West Midlands and Silesia: in England the Regional Development Agencies took over the roles of administrating the European Funds in the nine English Standard Regions; and in Poland the administrative reform came in force, substituting the hitherto 49 regions with new 16 units. Furthermore, the Lisbon Agenda was announced just a year later (European Council, 2000); therefore the year 1999 seems a convenient baseline, a starting point for further analysis.

¹ This set of data excludes university colleges (UK) and private universities (Poland).

The choice of the time scale's ending year was also made because of number of reasons. Firstly, 2009 was the second year of the 2007-2013 perspective, and according to the "n+2" rule, this is when the evaluation of the already funded projects needs to be completed. Secondly, the year 2009 constitutes the span of 20 years, which is long enough for conclusions to be drawn. Also, at the time of collecting the data for the purpose of the quantitative analysis, the year 2009 was the last year for which comprehensive regional data were available.

Statistical analysis

In order to answer the key puzzle of the paper in the fullest possible quantitative way, the statistical analysis of the relation between the KBE and the Structural Funds takes into account two measurements: Pearson's Product-moment correlation coefficient (r) and a two-way Analysis of Variance.

The first measurement, Pearson's product-moment correlation coefficient (r), takes into account each of the volume of Funding allocated to a given region (x) and the region's KBE GI (y) for each of EU's NUTS 2 regions. This particular correlation is a measure of linear dependence between two variables and is considered to be highly informative regarding this type of dependence between variables, especially within vast datasets, even if their distribution is not normal (Rodgers, Nicewater, 1988).

An important issue arising here is the problem of interpretation of the magnitude of obtained correlation coefficients. Several authors offered different levels of interpreting the value of correlation coefficients (e.g. Cohen, 1988; Smithson, 2000) and there is no overall consensus regarding the criteria and values unequivocally defining a "strong" correlation. Therefore for the purpose of this research the author assumes following interpretation:

Table 2. Interpretation of correlation coefficients' values

| Correlation | Coefficient values |
|-------------|-----------------------------|
| None | $ 0.00 < r, \rho < 0.09 $ |
| Small | $ 0.1 < r, \rho < 0.39 $ |
| Medium | $ 0.4 < r, \rho < 0.59 $ |
| Strong | $ 0.6 < r, \rho < 0.79 $ |
| Very strong | $ 0.8 < r, \rho < 1 $ |

Therefore henceforth the term "meaningful correlation" will be used to cumulatively describe correlations ranging from medium to very strong, i.e. coefficient values exceeding $|0.4|$.

What is also significant and an original part of this analysis is that the coefficients are calculated in three different time series: t , $t+1$ and $t+2$. Time t implies that the strength of correlation is calculated for the same time spans of Funding allocation and KBE GI, i.e. it is examined whether the Funds allocated in 1999 are correlated with KBE GI value in 1999, the Funds allocated in 2000 are correlated with KBE GI results of the year 2000 and so on up to 2009. The second time series is $t+1$, which takes into account the correlation of funds from year t and KBE GI from the following year; for example Funds from the year 1999 to the KBE CI from the year 2000 and so forth. The final time series is $t+2$, in which case the funds from the year 1999 are compared to KBE GI from the year 2001 etc. The time series $t+1$ and $t+2$ were chosen to be calculated due to the fact that the allocation in a given year might not bring results (in terms of KBE GI change) until next financial year, and "n+2" rule of European Funds' spending requires all of the projects to be completed within 24 months.

The next statistical method used was the Analysis of Variance (ANOVA). Here the possible problem of non-normal distributions which would be an indicator of not using this analysis technique can be solved by recalling the Central Limit Theorem (CLT,) which in simplest terms states that when the number of the sample is sufficiently large (most often exceeding 100 is sufficient, see e.g. Rice 1995, p.168) the means of variable will be approximately normally distributed, even if the variable in the whole of population is not distributed normally. The ANOVA was calculated separately for four groups of regions organised according to the allocated average level of annual funding: up to 10 million Euro, between 10 and 99 million Euro, between 100 and 499 million Euro and above 500 million Euro. Importantly, the West Midlands and Silesia are both a part of the third group. The ANOVA was calculated as a two-factor one as not to neglect the potential effect that may occur on the KBE not only because of the volume of the allocated Funds but also due to any other specific circumstances of given regions. In other words, the two potential independent variables are: i) the allocated Structural Funds and ii) any other socio-economic features of the regions apart from the volume of the Structural Funds allocated.

All the above described statistical calculations were performed using Microsoft Excel and the SPSS Programme.

Findings

KBE in European regions

The first stage of analysing the performance of European regions in terms of their Knowledge-Based Economy is to compare the regions with the highest- and lowest- value of KBE GI per all of the EU Member States (Figure 2 on page 12). What was taken into account is the multi-year average of the KBE GI and the figure presents only the regions of a given member states which had the highest and the lowest score (alphabetically according to the State's name). Member States consisting of just one NUTS2 region (i.e. Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Malta) are presented in the figure as well. Value = 100 denotes the European average. Additionally, the figure includes the results for Silesia and West Midlands, denoted in darkest colour and placed accordingly between the regions with the highest and lowest value of KBE GI in Poland and the UK.

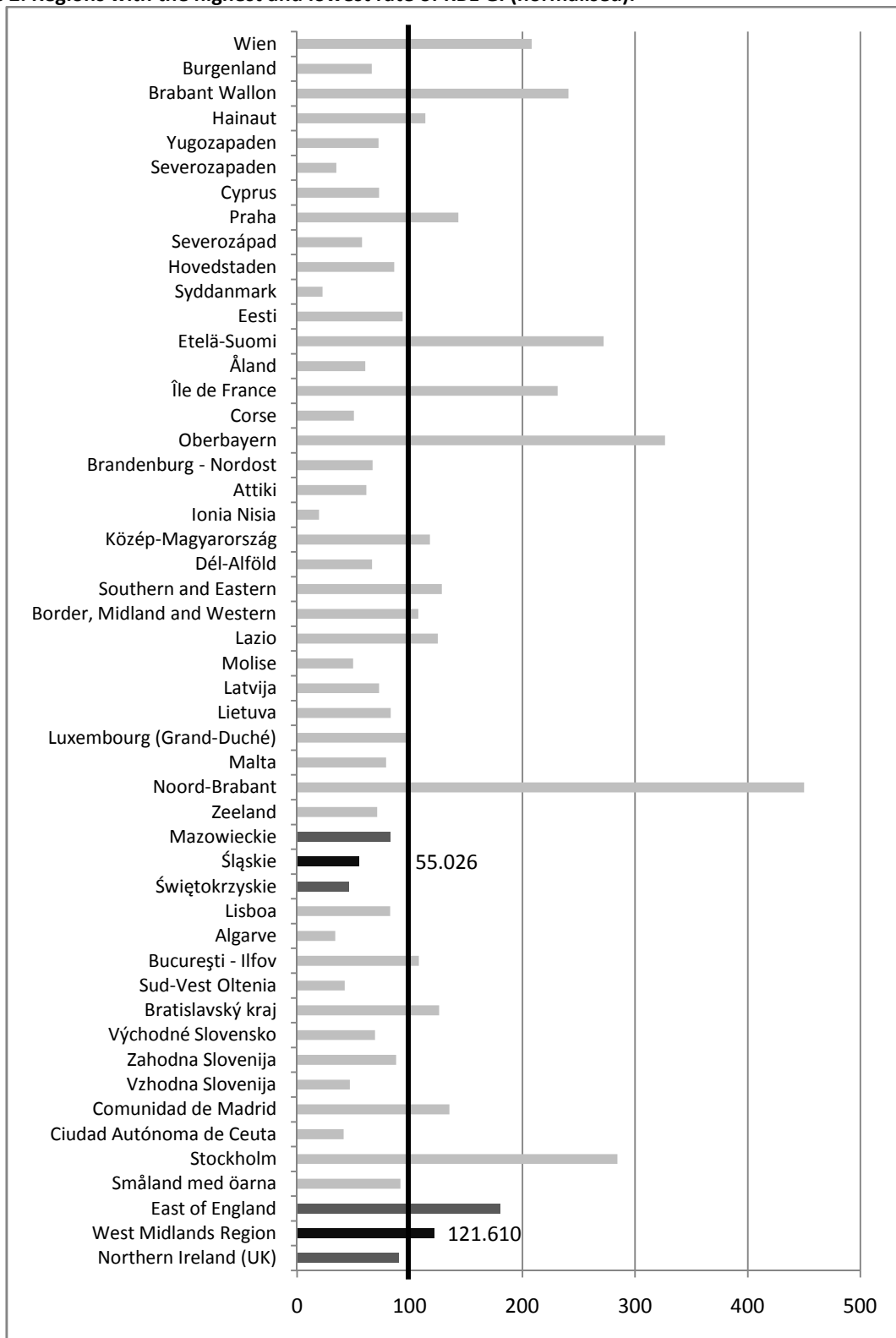
The differences in regional performance are clearly visible here. Out of all of the best performing regions, the highest result was obtained by Dutch Noord-Brabant (which scored very high in the indicators of R&D intensity and was by far the region with most patent applications), whose KBE GI was over 4.7 times higher than EU average. What can be observed is that majority of the highest performing regions are the capital regions of respective states, but strikingly, is not the case for Belgium (where the best performing region in terms of KBE GI is Brabant Walloon, not Brussels), Germany (Oberbayern, not Berlin), Netherlands (Noord-braband instead of Noord Holland), and the UK (East of England, not London). The UK case can be explained by the estimations that in London significant part of the labour force is employed in the finance sector, not in high technologies and knowledge-rich sectors (Prothero, 2007).

When looking at the other side of the KBE scale, the region with the lowest national performance (i.e. KBE GI below 30) is Greek Ionia Nisia (21.03). What is interesting, although not shown in Fig. 27 is that out of the 10 worst-performing regions of the entire EU (i.e. with KBE GI below 30), 8 regions are Greek; their KBE GI ranges from 29.75 (Anatoliki Makedonia) to 19.35 (Ionia Nisia).

In case of West Midlands and Silesia it is visible that while the former slightly exceeds the EU average (at 121.61), the latter scored far lower with the KBE GI value standing only at 55.03. There is also a significant gap between the best performing regions in the UK and Poland. The before mentioned East Anglia is one of the best performing regions in the entire EU (it is in the first 25 regions with its KBE GI reaching 180.35), while Mazowieckie falls short of reaching the EU average (82.93). When looking at the worst performing regions in the two states (Northern Ireland and

Świętokrzyskie) the differences between their results are also significant, with the regions reaching 89.96 and 46.23 respectively.

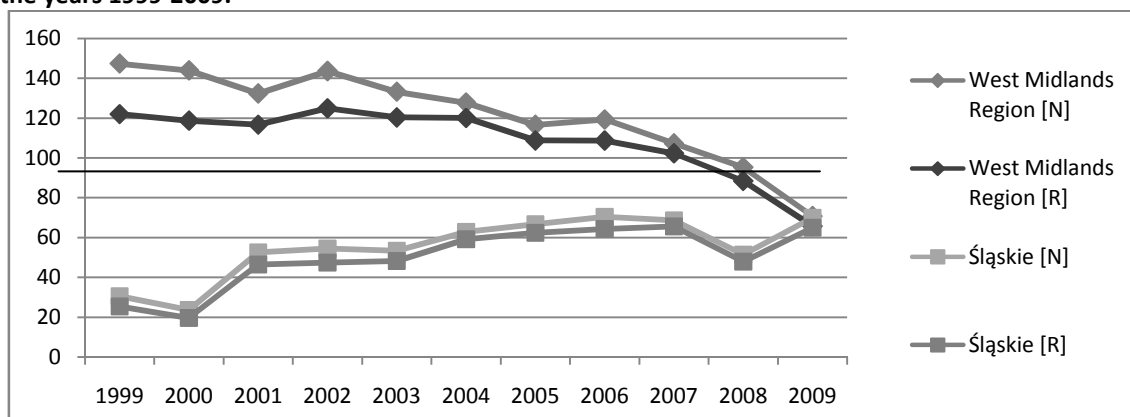
Figure 2. Regions with the highest and lowest rate of KBE GI (normalised).



Source: author's own study

The next stage of the analysis requires focusing of the particular performance of Knowledge-Based Economy General Indexes for West Midlands region and Silesia over time (Figure 3). The higher lines denoted in lighter colours present the values of KBE GI normalised (N) to an EU average = 100 (marked with a bold black line). What must be kept in mind is that the values are expressed in relation to the EU average which was calculated for each year separately and therefore was subject to annual changes. The lower lines in the figure, denoted in darker shades, represent the KBE GI in real values (R). In order for both the normalised and real values to be more legible in the visual representation, the normal values were all multiplied by a factor 100.

Figure 3. The change in the KBE GI (normalised [N] and real [R]) in Silesia and the West Midlands in the years 1999-2009.



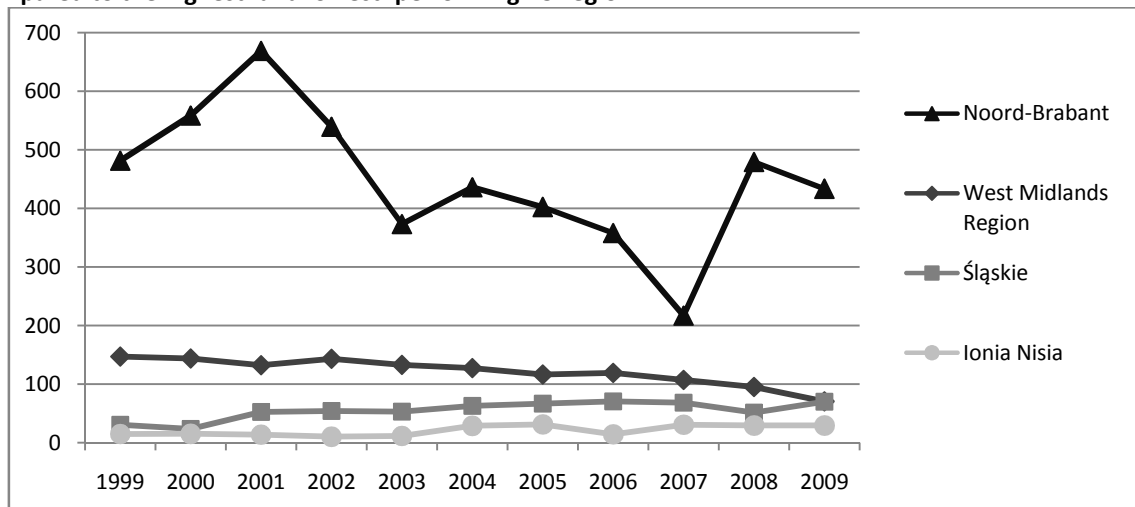
Source: author's own study

The first general observation is that although the values fluctuated over the years, Silesia kept a rather upward trend, whereas West Midlands experienced a downfall. The second vital observation is that despite the downfall, West Midlands kept above the EU average (in normalised values) for almost all of the examined time period. The most significant slump which occurred in this region took place in 2008/2009 when the values decreased by 24.51 in normalised values (and by 22.68 in real values). Generally, over the course of the time-span taken into account in this research, West Midlands' KBE GI value dropped in nominal values by 56.38 (from 122.13 to 65.75); and in real values by 76.57 (from 147.37 to 70.80).

At the same time the value of KBE GI for Silesia experienced an increase of 39.24 in normalised values (39.51 in real values), with the most significant upwards change in the year 2000/2001: 28.89 in normalised values (26.85 R). The only significant downfall in Silesia's performance took place in 2007/2008 when the KBE GI decreased by 17.17 N (17.75 R). Yet overall the increase of the values in Silesia over the course of examined period reached 39.43 in normalised values, from initial 30.72 to 69.96 (in real values: 39.51, i.e. from 25.45 to 64.96). What is worth emphasis is that the initial normalised disparity between the regions which reached 116.65 in 1999 has decreased to 0.85 in 2009, which is a decrease by 115.81 (a decrease of 95.89 using real values).

Notable findings come into light when the performance over time of West Midlands and Silesia is compared to the overall best- and worst-performing regions of the EU (namely Noord-Brabant (Netherlands) and Ionia Nisia (Greece)) (Figure 4.) Here all the values are presented as normalised to the EU average =100.

Figure 4. The change in KBE GI (normalised) in Silesia and the West Midlands in the years 1999-2009 compared to the highest- and lowest- performing EU region

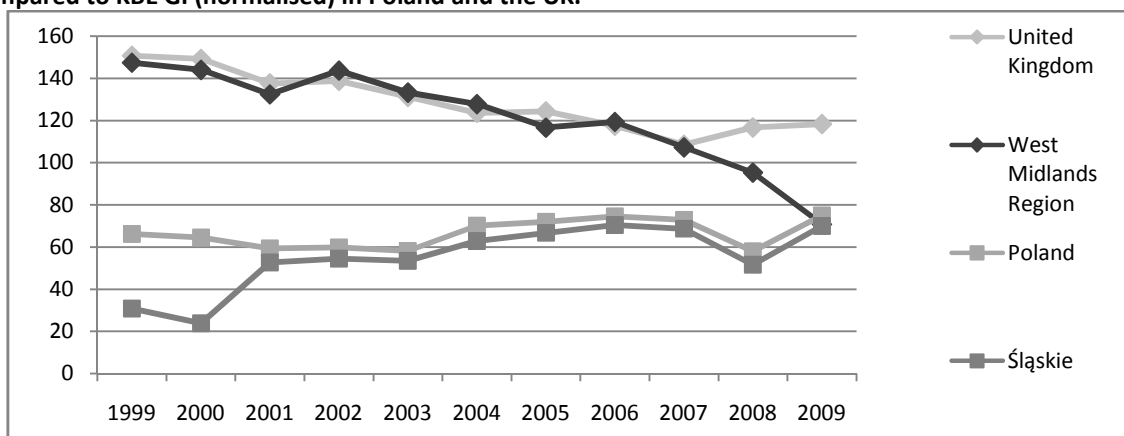


Source: author's own study

In terms of their KBE performance, both West Midlands and Silesia can be seen as much closer to the worst-off region. It can also be seen that despite the changes in the levels of KBE GI as described in the paragraphs above and visualised by Figure 29, both West Midlands' and Silesia's values did not fluctuate that significantly; whereas during the examined time period Noord-Brabant has experienced quite a few significant increases and decreases in the value of KBE. The overall amplitude of those changes reached as much as 452.00 (669.17 in 2001 compared to 217.18 in 2007). In the end, the overall change of Noord-Brabant's performance was a decrease over the years by 48.52. Yet it must be noted that all through the time-span taken into account the values of KBE GI for this region did not drop below the EU average. On the other hand, the worst performing region - Greek Ionia Nisia – experienced a small (14.56) increase in the values of KBE GI (from 14.92 in 1999 to 29.48 in 2009) and faced slight fluctuations in the KBE GI values over the course of the examined time period.

The final stage of analysing the changes of KBE GI in West Midlands Region and Silesia is to compare them with the performance of their respective states over time (Figure 5).

Figure 5. The change in KBE GI (normalised) in Silesia and the West Midlands in the years 1999-2009 compared to KBE GI (normalised) in Poland and the UK.



Source: author's own study

It can be seen that for most of the examined time span, both of the regions followed a rather similar pattern to the one exhibited by average values of KBE GI in their respective states.

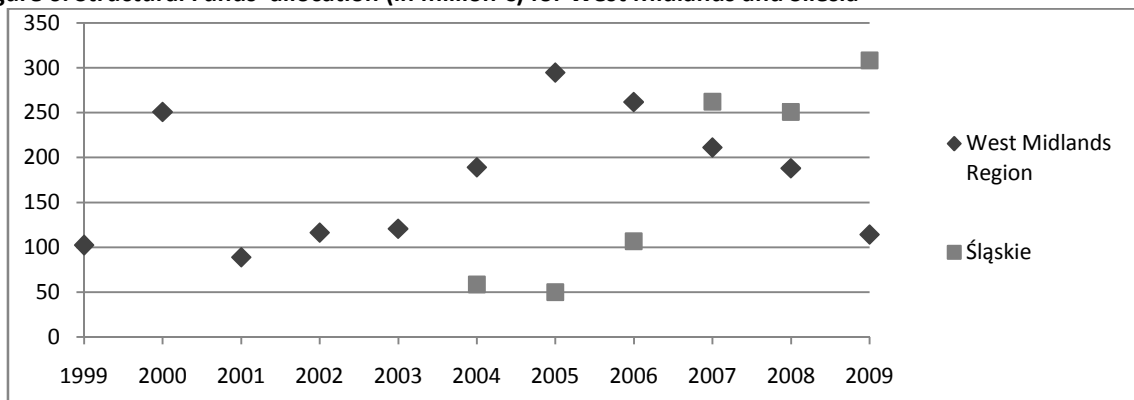
However, both of the regions deviated from the national pattern in two years, yet what is notable is that this occurred on two different ends of the scale. Silesia was a region exhibiting values of the KBE GI much lower than the national level in the years 1999 and 2000, and in subsequent years its performance was almost an exact reflection of the Polish level, albeit always less than 10 points lower. On the other hand, West Midlands KBE GI was of almost exact values as the UK level from the very beginning of the examined time-frame, however in the years 2008 and 2009 the WM experienced a significant decrease in KBE GI values and fell much below the UK level. What also should be pointed out again is that despite their general upward trend, the values of KBE GI in Poland (and Silesia) have not yet reached the level of EU average, whereas UK (and the West Midlands up to the year 2008) have kept above the EU average.

Having this in-depth knowledge of one part of the research puzzle allows moving on to the statistical analysis of the relationship between the KBE and the volume of Funds allocated to given regions.

The KBE and the Structural Funds

Particularly interesting findings result from comparing the allocations for West Midlands and Silesia on one graph (Figure 6).

Figure 6. Structural Funds' allocation (in million €) for West Midlands and Silesia



Source: author's own study based on the *Table of Allocation for the years 1999-2009*

It can be visible that WM was given a relatively high allocation in the first year of the 2000-2006 financial perspective, and in the year 2005. After that the volume of allocation experienced a steady steep downfall. Silesia, on the other hand, was receiving an increasing Funds' allocation, with a most significant rise in the first year of 2007-2013 perspective (€ 202 million, compared to € 106.6 M in the year 2006). In the final analysed year the West Midlands region was allocated just above €100 million, whereas allocation for Silesia exceeded €300 million. In other words, from the year 2005 onwards, the trends of allocations for the two regions were in completely opposite directions.

Following the previously explained methodology, the first stage of analysis consists of calculating the Pearson product-moment correlation coefficients and Spearman's rank correlation coefficients of the volume of Funding allocated to a given region and the region's KBE GI.

Pearson product-moment correlation

In case of Pearson's r , after calculating the correlation coefficients for all of the EU regions in the three chosen time series (t , $t+1$, $t+2$), the regions were sorted according to the strength of each correlation (determined independently by the two correlation coefficients), separately for t , $t+1$ and $t+2$.

Table 3 presents the values of Pearson’s correlation coefficients in all three time scales for West Midlands Region and Silesia and, to put their results into perspective, the regions with best and worst performance across the entire EU and best- and worst- regions from United Kingdom and Poland in terms of Pearson’s coefficients. The values of correlation coefficients are approximated to third decimal space.

Table 3. Correlation coefficients for chosen regions in the three time series

| | t | | t+1 | | t+2 | |
|----------|-------------------------|--------|-------------------------|---------|-------------------------|--------|
| | regions | r | regions | r | regions | r |
| EU-best | Jihozápad | 0.894 | Friuli-Venezia Giulia | 0.722 | Észak-Magyarország | 0.828 |
| UK-best | North East | 0.285 | North East | -0.146 | North East | -0.365 |
| PL-best | Świętokrzyskie | 0.374 | Świętokrzyskie | - 0.002 | Świętokrzyskie | 0.734 |
| WM | West Midlands Region | -0.016 | West Midlands Region | -0.383 | West Midlands Region | -0.425 |
| Silesia | Śląskie | -0.065 | Śląskie | -0.556 | Śląskie | 0.086 |
| PL-worst | Kujawsko- pomorskie | -0.495 | Kujawsko-pomorskie | -0.614 | Zachodniopomorskie | -0.041 |
| UK-worst | East Midlands | -0.144 | East Midlands | -0.544 | Northern Ireland | -0.612 |
| EU-worst | Severovýchod | -0.958 | Lietuva | -0.965 | Latvija | -0.996 |

It can instantly be seen that over the time scales the regions which were considered for comparative reasons do not remain unchanged. In the first time scale (t) the region which holds the strongest positive correlation coefficient out of the whole EU is Czech Jihozápad, but in the subsequent time scales this changes to Italian Friuli-Venezia Giulia (in t+1) and Hungarian Észak-Magyarország (in t+2). The regions with the strongest negative correlation in the whole EU change as well: from Czech Severovýchod in t, to Lietuva (Lithuania) in t+1 and Latvija (Latvia) in t+2.

However, the UK’s “best” region remains the same for the three time-scales: it is the North East. What should be noted is that in t+1 and t+2, the “best” correlation results are indeed negative. The UK regions with the “worst” correlation change from East Midlands in t and t+1 to Northern Ireland in t+2.

When it comes to Poland, Świętokrzyskie remains to be the region with the “best” correlation in all three time scales, although in t+1 the correlation is of a small weight negative value. The Polish regions with the strongest negative correlations in the three time scales are Kujawsko-pomorskie (in t and t+1) and Zachodniopomorskie, yet it must be pointed out that it is only the first region whose correlation coefficient can be described as being of meaningful strength.

Overall, in two of the three cases (t and t+2) the regions with the strongest positive correlations belong to Central-Eastern European (CEE) States, who joined the EU in 2004: Czech Republic (Jihozápad) and Hungary (Észak-Magyarország); yet what is very interesting is that in all of the three time-scales the greatest negative correlation values occur for regions which are from CEE states as well (again Czech Republic, Latvia and Lithuania). Also, the negative correlations are of greater strength than positive ones in all three time-scales.

When focusing on the two case-study regions it becomes visible that in most instances the correlations are of negative values (all time-scales for West Midlands and t and t+1 for Silesia). What is more, irrespective of their values the correlations are in majority of a relatively weak strength; the only correlations which could be described as meaningful, i.e. exceeding the values of |0.4| are the correlations occurring in the West Midlands for the time scale t+2 and in Silesia in t+1. What seems of particular importance is that in both of those cases the correlations are negative, which implies a lack of positive linear relationship between the KBE and the volumes of SF allocation.

Analysis of Variance (ANOVA)

The next stage of statistical analysis consists of performing ANOVA tests for datasets grouped not by origin of a given region (“old”/“new” member state) but for groups of regions classified according to the average annual allocation of structural Funds. Due to the actual spread of allocation values, i.e. the particular volumes of allocation decided by the EC, it was decided that for the purpose of this ANOVA analysis the groups were divided as follows: i) regions with average annual allocation under 10 Million Euro; ii) regions with average annual allocation between 10 and 99 Million Euro; iii) regions with average annual allocation between 100 and 499 Million Euro; and iv) regions with average annual allocation exceeding 500 Million Euro. Importantly, both the West Midlands and Silesia are a part of the third group.

In order to assess what has a statistically significant impact on the changes of the regional KBE, namely is it the amount of allocated Structural Funds or other phenomena occurring in the region, the performed ANOVA analyses are of two-way type. Therefore the independent variables included in the ANOVA analyses are a) the average annual volume of Structural Funds’ allocations for the given region; and b) the characteristics, economical properties intrinsic to the region, any other than the volume of allocated SF (denoted in the ANOVA tables below as “regions”). The dependent variables in those analyses are the real (i.e. not normalised) values of KBE GI calculated according to the previously presented methodology. The significance level assumed for all ANOVA analyses is $\alpha = 0.05$.

For the purpose of the analysis, each of the factors (“SF allocation” and “region”) has a null hypothesis (H0) stating that varying the given factor had no effect on the outcome (the value of regional KBE GI). If the calculated F-statistic is greater than F critical with the $\alpha = 0.05$, the null hypothesis of the lack of impact of a given factor can be rejected with a certainty of at least 95%.

Table 4. ANOVA for regions with average annual SF allocation between 100 and 499 million €.

| ANOVA [100<SF≤499 M€] | | | | | | |
|----------------------------|-----------|-----------|-----------|----------|----------------|---------------|
| <i>Source of Variation</i> | <i>SS</i> | <i>df</i> | <i>MS</i> | <i>F</i> | <i>P-value</i> | <i>F crit</i> |
| SF allocation | 891.25 | 5 | 178.25 | 1.08 | 0.37 | 2.25 |
| Regions | 8137.21 | 49 | 166.06 | 1.00 | 0.48 | 1.41 |

The ANOVA performed for this group allows for accepting the null hypotheses for both independent variables., i.e. stating that both “SF allocation” and “regions” lacked impact on the changes of the regional KBE GI.

Conclusions

Based on the extensive analysis it was found that although the two regions exhibit differences in their performance regarding the KBE GI and its particular indicators and are not perfectly matching in terms of the Pearson product-moment correlation, they share identical results of the ANOVA analysis.

Regarding the performance of the Knowledge-Based Economy General Index for the West Midlands region and Silesia over time it was found that although the values of KBE GI for the two regions fluctuated over the years, Silesia kept an upward trend, whilst the West Midlands experienced a downfall (p. 133). Yet despite the decline of KBE GI values, and unlike Silesia, the West Midlands remained above the EU average for almost all of the examined time period. What is worth emphasis is that over the examined decade, the disparities in the KBE GI values between the regions have significantly decreased, with the regions obtaining a very similar result in the final year of the time-frame.

When investigating the KBE – SF statistical relationship's analysis, it can be seen that with regards to the Pearson product-moment correlation (p. 143) both Silesia and the West Midlands yielded negative r values in t , and $t+1$. However, the r value for Silesia in $t+1$ was of a greater strength, and whereas in $t+2$ the West Midlands' correlation coefficient remained negative, Silesia's r became a positive, albeit weak value.

With respect to the performed ANOVA, in which both Silesia and the West Midlands were included in the same group of regions (with 100 to 499 million Euro average annual allocations), the results of this analysis were alike, i.e. allowed for accepting the null hypothesis for both independent variables, stating that both of "SF allocation" and "regions" lacked impact on the changes of the regional KBE GI (p. 151).

A document which deserves recalling at this point is the study undertaken by the Committee of the Regions (2005), which investigated to what extent the need for a closer and more developed partnership between the different levels of government in order to successfully implement the Lisbon Agenda's objective has materialised in the individual Member States. The study focused on the National Reform Programmes (NRP) which served as action-plans for reaching the Lisbon objectives. It has revealed that in the UK no systematic involvement of Local and Regional Authorities (RDAs and Devolved administrations) was foreseen in the implementation of the NPR; similarly in Poland the NPR did not mention the role or potential role of Local and Regional Authorities and institutions in its implementation (CoR, 2005:142,143,161-163).

Nonetheless, the importance of regional institutions' strength for effective implementation of the Cohesion Policy measures on a regional level has long been recognised in scholarly literature. One of the key studies was undertaken by Hughes et.al (2004), which proved that it was the difference in administrative capacities that accounted for proper management (or lack thereof) of the Funds in European regions (Hughes et al. 2004:532); this finding was also confirmed by more recent studies such as Milio (2007). Looking at the former scholarly studies, especially with regards to the almost 'classic' cases of Mezzogiorno and Ireland, as the worst- and best- practice examples of the use of Structural Funds, it is difficult not to agree that the administrative capacities are indeed a decisive factor of how effectively the Funds are spent within the regions.

However, it should be emphasized that this study's core element i.e. the quantitative analysis took into account the volumes of allocated amounts of the Structural Funds, not the values spent within the regions. This distinction is of great importance, as the amounts spent in the regions may vary from the allocated amounts, and this in turn may lead to completely different results of the quantitative analysis, even if the same statistical methods were to be used. Focusing on the amounts spent, not allocated, would potentially yield different results.

As a final point, what can be assumed is that it might be that the pure nature and scale of the challenge of becoming Knowledge-Based Economies means that the Structural Funds are doomed to failure in this respect. Therefore the one 'flaw' for which addressing may result in significantly boosting the regional KBE is the problem of insufficient amount of Funds destined to tackle this issue; however this does not necessarily mean simply increasing the amounts of the aggregated SF allocated to given regions, but rather re-distributing funds within the already allocated amounts in the Operational Programmes and Regional Operational Programmes towards more KBE-oriented Measures. Verification of this hypothesis points towards a need of a future extensive study, focused on in-depth analysis of the National Reform Programmes, National Strategic Frameworks, Operational Programmes and Regional Operational Programmes in the two case-study regions.

Appendix 1.

Examples of indicators used for evaluating the Knowledge-Based Economy

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| <p>OECD <i>Indicators for the knowledge-based economy:</i></p> <ol style="list-style-type: none"> 1. Knowledge-based economy <ol style="list-style-type: none"> a. Investments in capital and knowledge b. Human resources (education) c. GERD d. Fundamental research e. Business R&D f. R&D in manufacturing industries g. R&D in services h. Innovation i. Venture capital 2. Information and communication technologies (ICT) <ol style="list-style-type: none"> a. ICT spending as a percentage of GNP b. Use of computers c. Internet and e-commerce d. ICT sector e. Innovation in ICT 3. S&T policies <ol style="list-style-type: none"> a. Public R&D/GNP b. Socio-economic objectives of R&D c. Share of public R&D d. R&D financial flows between sectors e. Public support to R&D f. Business R&D by size g. Tax subsidies 4. Globalization <ol style="list-style-type: none"> a. R&D abroad b. Patent ownership c. Technological alliances d. Co-signatures and co-inventions 5. Output and impact <ol style="list-style-type: none"> a. Scientific publications b. Patents c. Innovation d. Productivity e. Share of knowledge industries in added value f. High technology trade g. Technological balance of payments | <p>World Bank: <i>Knowledge Economy Index (KEI)</i></p> <ol style="list-style-type: none"> 1.The Economic Incentive and Institutional Regime: <ol style="list-style-type: none"> a. Tariff & Non-tariff Barriers b. Regulatory Quality c. Rule of Law 2.Education and Human Resources <ol style="list-style-type: none"> a. Adult Literacy Rate b. Secondary Enrolment c. Tertiary Enrolment 3. The Innovation System ** <ol style="list-style-type: none"> a. Researchers in R&D b. Patent Applications Granted c. Scientific and Technical Journal Articles 4. Information and Communication Technology (ICT) <ol style="list-style-type: none"> a. Telephones per 1,000 people b. Computers per 1,000 people c. Internet Users per 10,000 people <p>**These three variables are available as scaled by population and in absolute values.</p> |
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|--|---|
| <p>European Commission: <i>European Innovation Scoreboard:</i></p> <p>I. Innovation Inputs</p> <p>a. Innovation drivers</p> <ul style="list-style-type: none"> • New graduates per 1000 population aged 20-29 • Population with tertiary education per 100 population aged 25-64 • Broadband penetration rate • Participation in life-long learning per 100 population aged 25-64 • Youth education attainment level <p>b. Knowledge creation</p> <ul style="list-style-type: none"> • Public R&D expenditures • Business R&D expenditures • Share of medium-high-tech and high-tech R&D • Share of enterprises receiving public funding for innovation • Share of university R&D expenditures financed by business sector <p>c. Innovation & entrepreneurship</p> <ul style="list-style-type: none"> • SMEs innovating in-house • Innovative SMEs co-operating with others • Innovation expenditures • Early-stage venture capital • ICT expenditures • SMEs using non-technological change <p>II. Innovation Outputs:</p> <p>a. Application</p> <ul style="list-style-type: none"> • Employment in high-tech services • Exports of high technology products as a share of total exports • Sales of new-to-market products • Employment in medium-high and high-tech Manufacturing <p>b. Intellectual property</p> <ul style="list-style-type: none"> • New EPO patents per million population • New USPTO patents per million population • New Triad patents per million population • New community trademarks per million population • New community industrial designs per million population | <p>PRO – INNO EUROPE <i>European Regional Innovation Scoreboard</i></p> <p>ENABLERS</p> <ul style="list-style-type: none"> • Human resources <ul style="list-style-type: none"> 1.1.1 S&E and SSH graduates 1.1.2 S&E and SSH doctorate graduates 1.1.3 Tertiary education 1.1.4 Life-long learning 1.1.5 Youth education • Finance and support <ul style="list-style-type: none"> 1.2.1 Public R&D expenditures) 1.2.2 Venture capital 1.2.3 Private credit 1.2.4 Broadband access by firms <p>FIRM ACTIVITIES</p> <ul style="list-style-type: none"> • Firm investments <ul style="list-style-type: none"> 2.1.1 Business R&D expenditures 2.1.2 IT expenditures 2.1.3 Non-R&D innovation expenditures • Linkages & entrepreneurship <ul style="list-style-type: none"> 2.2.1 SMEs innovating in-house 2.2.2 Innovative SMEs collaborating with others 2.2.3 Firm renewal (SMEs entries + exits) 2.2.4 Public-private co-publications • Throughputs <ul style="list-style-type: none"> 2.3.1 EPO patents 2.3.2 Community trademarks 2.3.3 Community designs <p>OUTPUTS</p> <ul style="list-style-type: none"> • Innovators <ul style="list-style-type: none"> 3.1.1 Product and/or process innovators 3.1.2 Marketing and/or organisational innovators 3.1.3 Resource efficiency innovators <ul style="list-style-type: none"> 3.1.3a Reduced labour costs 3.1.3b Reduced use of materials and energy • Economic effects <ul style="list-style-type: none"> 3.2.1 Employment in medium-high & high-tech manufacturing 3.2.2 Employment in knowledge-intensive services 3.2.3 Medium and high-tech exports 3.2.4 Knowledge-intensive services exports 3.2.5 New-to-market sales 3.2.6 New-to-firm sales 3.2.7 Technology Balance of Payments flows |
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| <p><i>Synthesis Report to: The EC & DG Regio</i></p> <ol style="list-style-type: none"> 1. Higher education (% of population completed highereducation degree) 2. Knowledge workers (% of population that has a S&T education & is occupied in the research sector) 3. High-tech services (% of employment, (Knowledge intensive high-technology services) 4. Public R&D (Expenditures as % of GDP) 5. % Value-added services (% share of services in total gross value added at basic prices at NUTS level 2) 6. % Value-added industry (% share of manufacturing industry in total gross value added at basic prices at NUTS level 2 in Millions of euro) 7. Government (Employment in public administration as % in total employment) 8. Population density, per square Km 9. High-tech manufacturing (High-tech and medium/high-tech manufacturing employment, % of total employment) 10. % Value-added agriculture (% share of agriculture in total gross value added at basic prices at NUTS level 2 in millions of euro) 11. Business R&D (Business R&D expenditures as % of GDP) 12. S&T workers (% of population that has an occupation in S&T) 13. Youth (% share of population under 10 years of age) 14. Life-long learning (% of adults having recently enjoyed training or courses) 15. Activity rate females (% of total) | <p>Universität Trier (project funded under FP 6) <i>Knowledge Economy Indicators</i></p> <p>A1 Production and diffusion of information and communication technology (ICT)</p> <ul style="list-style-type: none"> A1a Economic impact of ICT sector A1b Internet use by firms A1c Internet use by individuals A1d Government information and communication technology (ICT) <p>A2 Human resources, skills and creativity</p> <ul style="list-style-type: none"> A2a General education A2b Human resource in science and technology (HRST) - education A2c Skills A2d Creativity A2e Mobility <p>A3 Knowledge production and diffusion</p> <ul style="list-style-type: none"> A3a Research and experimental development family A3b Bibliometrics A3c Knowledge flows A3d Total investment in intangibles <p>A4 Innovation, entrepreneurship and creative destruction</p> <ul style="list-style-type: none"> A4a Entrepreneurship A4b Demand for innovative products A4c Financing of innovation A4d Market innovation outputs A4e Organizational indicators <p>B1 Economic outputs</p> <ul style="list-style-type: none"> B1a Income B1b Productivity B1c Employment <p>B2 Social performance</p> <ul style="list-style-type: none"> B2a Environmental B2b Employment and economic welfare B2c Quality of life indicators <p>C1 Internationalisation</p> <ul style="list-style-type: none"> C1a Trade C1b Knowledge production and diffusion C1c Economic structure C1d Human resources |
|--|---|

Knowledge Based Economy Development Index (KDI)

1. Computer Infrastructure

- a) Share of worldwide computers in use
- b) Computers per 1,000 population
- c) Share of total worldwide millions of instructions per second (MIPS)
- d) Computer power per capita
- e) Connections to the Internet

2. Info-structure

- a) Investment in telecommunication
- b) Main telephones in use per 1,000 population
- c) Cellular mobile telephone subscribers per 1,000 population
- d) Television sets per 1,000 population
- e) Radios per 1,000 population
- f) Fax machines per 1,000 population
- g) International call cost
- h) Newspaper circulation

3. Education and Training

- a) Total expenditure on education per capita
- b) Literacy rate
- c) Student-teacher ratio (primary)
- d) Student teacher ratio (secondary)
- e) Secondary enrolment
- f) Higher education enrolment

4. Research and Development (R&D) and Technology

- a) High-technology exports as a proportion of manufacturing exports
- b) Number of scientists and engineers in R&D
- c) Total expenditure on R and D personnel nationwide per capita
- d) Total expenditure on R and D as a percentage of GDP
- e) Average annual number of patents granted to residents
- f) Business expenditure on R and D per capita

Appendix 2.

Calculation of the weights of the KBE indicators used for the KBE General Index

| List of indicators (organisation) | n°1 (OECD) | n°2 (WB) | n°3 (EIS) | n°4 (ERIS) | n°5 (EC&DGR) | n°60 (Uni.Trier) | n°7 (KDI) | Amount of organisations taking a given indicator into account | $\Sigma \alpha$ | t_i | weight (w_i) |
|-----------------------------------|------------|----------|-----------|------------|--------------|------------------|-----------|---|-----------------|-------|------------------|
| $\alpha = 1/m$ | 0.030 | 0.083 | 0.040 | 0.032 | 0.067 | 0.036 | 0.038 | | 0.327 | | |
| Indicator 1: HRST | x | | x | x | x | x | x | 6 | 0.243 | 0.745 | 4.68 |
| Indicator 2: TKIS | | | x | x | x | x | x | 5 | 0.213 | 0.652 | 4.10 |
| Indicator 3: EDU | x | x | x | x | | x | x | 6 | 0.260 | 0.796 | 5.00 |
| Indicator 4: GERD | x | | x | x | x | | x | 5 | 0.208 | 0.636 | 3.99 |
| Indicator 5: EPO | x | x | x | x | | | | 4 | 0.186 | 0.569 | 3.57 |

WB – World Bank, EIS – European Innovation Scoreboard, ERIS – European Regional Innovation Scoreboard, EC&DGR – European Commission and the DG Regio, Uni.Trier – Universität Trier, KDI – Knowledge Development Index; HRST Human Resources in Science and Technology, TKIS - Employment in technology and knowledge-intensive sectors, EDU - Pupils and students in whole of education, GERD - Total intramural R&D expenditure, EPO - Patent applications to the EPO: hi-tech, ICT and biotechnology.

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