USING DEA FOR REGIONAL MERGING ZONES BASED ON GEOGRAPHIC MODELS OF THE EUROPEAN ECONOMY

Michaela Staníčková, Lukáš Melecký

Abstract: *For centuries, the "Blue Banana", metropolitan axis running from London to Milan, has been Europe's breeding place for innovation and growth. Recently, the "Sunbelt" from Milan to Valencia and the "Yellow Banana" from Paris to Warsaw have been identified as future European growth poles beside or even beyond the Blue Banana. Europe's competitiveness depends on a multiplicity of actions that can optimise the potentials within its territory, especially regions. Nowadays, regions are increasingly becoming the drivers of the economy. All regions possess development opportunities – however, use these options enough and hence the competitiveness of European regions must be efficient enough. It is well-known that there are significant differences among the European Union regions which weaken its competitiveness. What are differences in territorial efficiencies with respect to the structure of Europe's economic-geographical system? The paper is focused on using SBMT VRS DEA model for dividing NUTS 2 regions from geographic models of the European economy into efficient and inefficient ones. The main aim of the paper is to find the efficient frontier and identify optimal benchmark for inefficient regions as a strategy for enhancing their economic structure.*

Keywords: *Competitiveness, Efficiency, Geographic model, NUTS 2 region, SBMT VRS DEA model, Super-efficiency.*

JEL Classification: *C61, C67, O18, R11, R13, R15, R58.*

Introduction

Nowadays, the European Union (EU) is going through one of the most difficult periods since its establishment, with multiple challenges facing the region's policy-makers. Recent years have seen a myriad of economic and social difficulties, i.e. stagnating economic growth, rising unemployment leading to social tensions, continuing financial troubles and sovereign debt crises in several countries, exacerbated by the fact that the future outlook remains uncertain. The financial crisis will slowly drive apart the constituent members of the EU and the Eurozone. Several European countries already are forming regional subgroups based on corresponding economic, political and security concerns. As these groupings form and solidify, they will mark the first appreciable structural change in the EU.

In order to explore the likelihood of changes in the structure of Europe's geo-economy, Hospers [10] has developed a tentative framework ("vision") of spatial structural change arguing that areas with sectoral and institutional diversity provide the flexibility needed to absorb new techno-economic developments and to develop "new combinations". For the paper purpose in the case of Slack Based Model based on Tone (SBMT) in Data Envelopment Analysis (DEA) efficiency evaluation of European core areas and their growth tendencies, three basic geographic models of the European economy were used, i.e. Blue Banana, Sunbelt and Yellow Banana, and also with respect to Pentagon and Regional Competitiveness Index (RCI2013) approach.

Due to its diversified structure of the Blue Banana area (created by Pentagon areas and RCI2013 merged regions too) rather than the Sunbelt and the Yellow Banana we assumed in hypothesis the Blue Banana and surrounding Pentagon/RCI2013 areas may have the best starting-position to grow in the next decades. We thus believe that a localised European policy of "regional realism" ultimately may help the most in bringing about a less unbalanced growth of Europe's geo-economy. In many ways, the EU situation prompts many countries to seek alternative economic, political and security arrangements, particularly by looking to form and develop regional groupings.

1 Structural Change in the EU Geo-Economy: Models Comparison

An international organization, like the EU, can be likened to a club of countries. The purpose of such a club is to achieve by common action certain goals which are impossible or hard to reach by the individual countries. The necessary condition for members to join the club is the expectation about the achievement of a net positive result from membership, but not all countries are able to create the positive impacts (especially in the case of the single market) from this membership in the same pave. Nations and regions are increasingly thrown upon the particularities of their geo-economic structure to make a difference in the single market. Studying the long-term consequences of the EU therefore requires a closer inspection of Europe's economic landscape. Although Europe seems to be unified only by its diversity, we can still detect a more or less homogeneous economic zones. The European Spatial Development Perspective (ESDP) identifies a European core area, delimited by the London, Paris, Milan, Munich and Hamburg metropolitan areas and designated as the "Pentagon" [9]. Within this zone, one can observe a concentration of people, wealth production and command functions. The ESDP moreover claims that the main driving force behind the Pentagon's development is its status as global economic integration area. In consequence, the solution to improving the territorial balance in Europe would be to develop alternative zones of global economic integration through an increased level of integration between existing metropolitan areas, i.e. the idea of multiple "Pentagons" across Europe. Running from London over the Benelux and the Rhine area towards Milan – this axis "Blue Banana", has often been identified as the area that traditionally has shown the greatest development potential in Europe's geo-economy. Some suppose that the Blue Banana eventually must give way to the "Sunbelt", an arch-shaped axis in the Southern Europe along the Mediterranean coast from Milan to Valencia. Others expect the rise of "Yellow Banana" stretching from Paris to Warsaw and further into Eastern Europe.

The Pentagon is a well-known model due to the ESDP as "the core area of the EU, the pentagon defined by the metropolises of London, Paris, Milan, Munich and Hamburg." Later the formation got attributes '20-40-50 pentagon' which is due to the data of the formation, i.e. this area represents 20 % of the total area and contains about 40 % of EU citizens producing about 50 % of the EU's total GDP. As Hospers described [10, p. 77-78], the Blue Banana differs from other European locations in both demographic, economic, infrastructural and cultural-educational aspects. This area is densely populated and highly urbanised and comprises many large or medium-sized cities, e.g. London, Amsterdam, Brussels, Dortmund, Frankfurt, Basle, Zurich and Milan. Statistics show that the regions within the Blue Banana have higher per capita incomes and lower employment rates than the rest of Europe. Besides, this zone contains large industrial concentrations as well as strongly developed service centres, particularly in the fields of business services, banking and public administration. The Blue Banana has a well-developed physical

and telecommunications infrastructure as well as dense traffic networks. Finally, within Europe this area attracts attention because of its relatively large supply of cultural and educational facilities. But since the nineties, analysts have argued that the Blue Banana might gradually lose its dominant position in Europe. In their view, there are other growth areas in the making – in particular two zones have been identified as future growth poles in the European economy: the Sunbelt in the southern part of Europe and the Yellow Banana in the East. The Sunbelt running along the Mediterranean coast from Milan to Valencia; this arch-shaped belt with cities such as Nice, Marseille and Barcelona is said to be emerging on the basis of high-tech and service activities combined with a qualified work force and a pleasant working and living climate. Alternatively, the reunification of West and East Germany and the EU enlargement with Central and Eastern Europe countries have provoked some authors to expect the rise of the Yellow Banana from Paris via Cologne and Berlin to Warsaw; this axis has been identified as future European growth pole and may even stretch further eastward to the Baltic region.

If anything, these speculations suggest that we should look beyond the Blue Banana in studying Europe's development potentials. In this case, also the EU has developed its own approach to regional constitution in the case of performance analysis. The literature raises two issues related to selection of the appropriate regional level. The first, competitiveness should be calculated for functional economic regions. The second is that region should have an important political and administrative role. In most countries, however, functional regions are not administrative and vice-versa. Thus in practice, these two recommendations can be rarely combined. To improve the understanding of territorial competitiveness at regional level, the EU has developed the RCI approach which shows the strengths and weaknesses of each of EU NUTS 2 regions and these are the territorial objects of efficiency analysis. NUTS 2 regions are administrative or statistical regions which do not take into account functional economic links. For example, London and Paris are both cities of approximately the same size (7.7 and 6.7 million inhabitants). Paris is included in NUTS 2 region of Ile de France with 12 million inhabitants. This has the benefit that it includes the commuter belt around Paris. Greater London, on the contrary, is split into two NUTS 2 regions: Inner London (3 million) and Outer London (4.7 million) although both fall under the same mayor. In addition, these two NUTS 2 regions do not cover the commuter belt around London [12]. This problem arises for a number of cities: London, Brussels, Prague, Berlin, Amsterdam and Vienna. It is thus no random that these regions, resp. regions around these major cities, were subject of merging within RCI2013. Therefore, one important question has been asked in RCI2013, i.e. what are the consequences of not merging regions which have strong functional economic links:

- It does not take into account the qualifications of the people working in the city but living in a neighbouring region. Educational attainment is measured where people live, not where work.
- It distorts GDP per head. Distortion is due to commuting patterns – people work in city, but not live in city contribute to GDP but not the population.

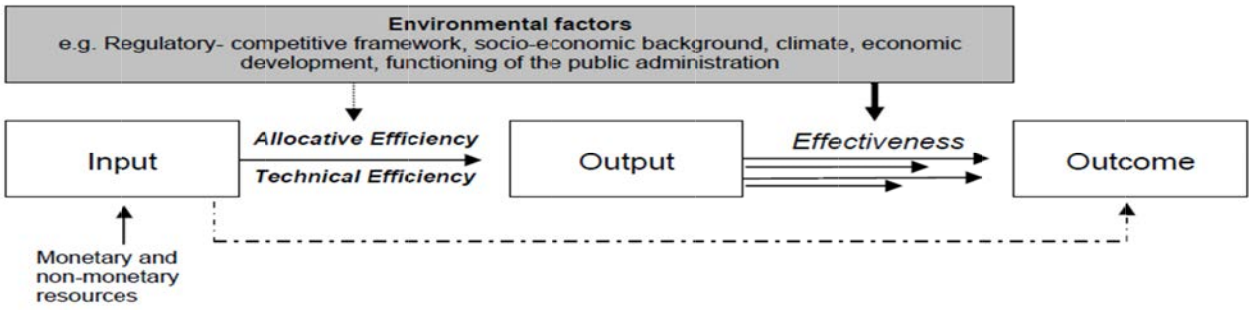
In RCI2013 construction, some regions are merged with surrounding areas to correct for commuting patterns following the new city definition. With respect to RCI2010, more capital regions are merged with their surrounding regions: Wien (AT), Brussels (BE), Praha (CZ), Berlin (DE), Amsterdam (NL) and London (UK) and with respect to revision of NUTS classification some regions in Finland (FI) were merged. But how are NUTS 2 regions selected to merge? If a region has at least 40 % of its population inside the

commuting zone (commuting zone of a city consists of all contiguous municipalities that send 15 % or more of their working residents to the city), it is added to region which contained the city. This criterion is applied to all NUTS 2 regions, but only a few NUTS 2 regions with the capital had neighbouring regions with a high-share of its population in the commuting zone of the capital.

2 Methods for Assessing Structure of Regional Competitiveness Growth

In last few years the topic about regional competitiveness stands in the front of economic interest. Current economic fundamentals are threatened by shifting of production activities to places with better conditions. In the global economy regions are increasingly becoming the drivers of the economy. Successful implementation of economic policies at the regional level requires information on the specific factors that determine the pattern of regional growth and competitiveness. Nowadays competitiveness is one of the fundamental criteria for evaluating performance and reflects the success in broader comparison. Territories need highly performing units in order to meet their goals, to deliver the products and services they specialized in, and finally to achieve competitive advantage. Comparative analysis of performance in public sector is starting point for studying the role of its two dimensions – efficiency and effectiveness, regarding economic governance of resources utilization by public management for achieving medium/long-term objectives of economic recovery and sustainable development of economies. Increasing productivity is generally considered to be the only sustainable way of improving living standards in the long term period. Concept of competitiveness is linked with performance, because competitiveness measures ‘‘how a nation manages the totality of its resources and competencies to increase the prosperity of its people’ [13]. This understanding of competitiveness is closely linked with efficiency and effectiveness theory, see Fig. 1.

Fig. 1: The Relationship between Efficiency and Effectiveness



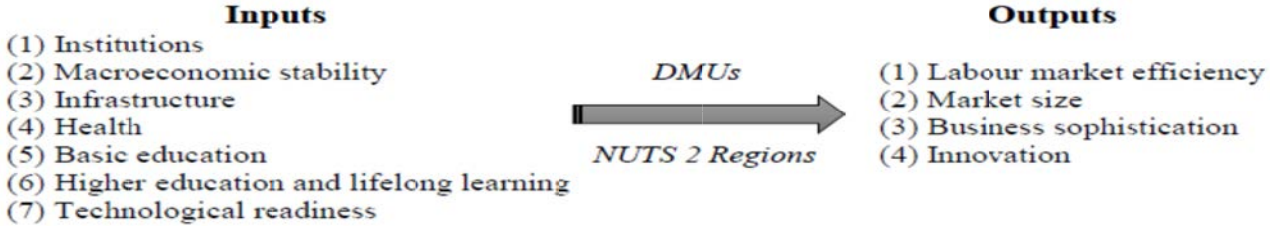
Source: [11, p. 3]

In this paper, we evaluate the efficiency of strength economic axis, resp. how powerful in economic growth and efficient in competitiveness are these core areas (based on following approaches: Pentagon, Blue Banana, Sunbelt, Yellow Banana, RCI2013) which are crucial for the European economy according to the theory of geographic models. Several quantitative approaches to measuring economic growth, convergence and competitiveness of European territorial units exists. Corrado et al. [6] develop an approach that identifies both the number and the composition of convergence clubs using pair-wise stationarity tests on time-series data, but for a variety of conditioning variables. Using these variables, Corrado et al. [6] test for regional “convergence-clusters” across the EU regions against a number of hypothetical, a priori determined clusters. However, an application of this methodology across all the regions of the 27 countries of the EU is entirely feasible, since it requires an extensive time-series data for variables such as R&D labour and so

forth; a requirement that it is difficult to fulfil, especially for the "new" member states. Using cross-section methodologies, on the other hand, can overcome the problem of small data sets for particular conditional variables [1]. Durlauf and Johnson [7] apply a "tree-regression" method using cross-section data sets and a conditional convergence equation is estimated excluding those economies that do not fulfil certain criteria, defined ex-ante. Application of such a methodology seems to be biased in identifying a predetermined convergence club. Moreover, applying a "tree-regression" method in a regional context fails to take into account the spatial dimension of the growth and convergence process [8]. Another approach in territorial analysis is based on Multicriteria Decision Making Methods (MCDM), e.g. Poledníková [12] uses MCDM for comparison of regions´ ranking in the case of Visegrad Four, or Staníčková and Melecký [14] use DEA method for measuring efficiency level of transform inputs into outputs (in relation to competitiveness) of the EU countries and especially regions.

Efficiency analysis starts from building database based on RCI approach. RCI is computed as weighted score of three sub-indices, i.e. SubInd1: RCI-Basic, SubInd2: RCI-Efficiency and SubInd3: RCI-Innovation, and covers thus a wide range of issues related to competitiveness. RCI is based on pillars describing both inputs and outputs of territorial competitiveness, grouped into three sets describing basic, efficiency and innovative factors of competitiveness, i.e. mentioned sub-indices. Inputs and outputs describe driving forces of competitiveness, and direct or indirect outcomes of a competitive economy [3], see Fig. 2. RCI seems to be convenient to using DEA, with respect to its division on input and output nature of database.

Fig. 2: Input and Output Scheme of Regional Efficiency Evaluation



Source: [3]; own elaboration, 2015

3 SBMT VRS DEA Models for Solving Regional Efficiency

Statistical evidence to help policy makers understand the routes to performance growth, especially those which can be influenced by government, can help lead to better policy. DEA originating from Farrell's work and popularized by Charnes, Cooper and Rhodes [4] evaluates efficiency of a set of homogenous group called Decision Making Units (DMUs) which convert multiple inputs into multiple outputs, but definition of DMU is generic and flexible. There are several methods for measuring efficiency, besides the basic DEA models, certain modifications exist. The aim of DEA is to examine DMU into two categories – efficient and inefficient. DEA is convenient to determine the efficiency of DMU, which are mutually comparable – using the same inputs, producing the same outputs, but their performances are different. Efficient DMUs have equivalent efficiency score, but they don't have necessarily the same performance. DMU is efficient if the observed data correspond to testing DMU on the imaginary efficient frontier. Intent of frontier estimation is to deduce the production function in form of efficient frontier. If DMUs are plotted in their input/output space, then efficient frontier that provides a tight

envelope around all of DMUs can be determined. The main function of this envelope is to get as close as possible to each DMU without passing by any others.

The first step in efficiency analysis is Returns to Scale (RTS) estimation. Why is necessary to decide RTS orientation? Various types of DEA models can be used, depending upon the problem at hand. Used DEA model can be distinguished by scale and orientation of model. If one cannot assume that economies of scale do not change, then a variable returns to scale (VRS) type of DEA model, is an appropriate choice (as opposed to a constant returns to scale (CRS) model). If in order to achieve better efficiency, governments' priorities are to adjust their outputs (before inputs), then an output oriented (OO) DEA model, rather than an input oriented (IO) model, is appropriate. There are also no IO or OO models, but distance from efficient frontier is solved – what will be type of DEA model for this paper, see Tab. 1. Territorial background of analysis is applied at 36 NUTS 2 region level within EU Member States where geographic models have axis (see Tab. 2), as was mentioned in chapter one; NUTS 2 regions are specified in Tab. 2.

Tab. 1: RTS Estimation to EU NUTS 2 Regions and Models Specification

Geographic Model	*NUTS 2*	*RTS*	*DEA Model*
Pentagon	London-Paris Axis	VRS	1st stage: SBMT VRS DEA Model of Efficiency 2nd stage: SBMT VRS DEA Model of Super-Efficiency 3rd stage: NUTS 2 classification
Blue Banana	London-Milan Axis		
Sunbelt	Milan-Valencia Axis		
Yellow Banana	Paris-Warsaw Axis		
RCI2013	Merging Regions		

Source: Annoni and Kozovska (2010), Hospers (2003); own elaboration, 2015

Suppose there are n DMUs which consume m inputs to produce s outputs. There is a rough rule of thumb [5] which expresses the relation between the number of DMUs and the number of performance measures. Toloo et al. checked more than 40 papers that contain practical applications and statistically, they found out that in nearly all of the cases the number of inputs and outputs do not exceed 6 [15]. A simple calculation shows that when $m \leq 6$ and $s \leq 6$, then $3(m + s) \geq m \times s$. As a result, in this paper following formula (1) is applied:

$$n \geq 3(m + s). \tag{1}$$

In the paper, the rule of thumb is for NUTS 2 regions and inputs and outputs met: $36 \geq 3$ $(7 + 4)$, $36 \geq 3$ (11), $36 \geq 33$.

For calculations of EU NUTS 2 regions efficiency across core economic axis, SBMT not-focusing on input and output assuming VRS is used (2) [16]:

$$\min \rho = \frac{1 - \frac{1}{m}\sum_{i=1}^{m} (s_i^- / x_{iq})}{1 + \frac{1}{r}\sum_{k=1}^{r} (s_k^+ / y_{kq})}, \tag{2}$$

subject to

$$\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = x_{iq},$$

$$\sum_{j=1}^{n} y_{kj}\lambda_j - s_k^+ = y_{kq},$$

$$\lambda_j, s_k^+, s_i^- \geq 0,$$

$$j = 1,2,...,n,\ j \neq q; k = 1,2,...,r; i = 1,2,...,m,$$

where x_{ij} is the value of *i-th* input unit U_j; y_{kj} is the value of *k-th* output unit U_j; x_{iq} is the value of *k-th* input unit U_q; y_{kq} is the value of *k-th* output unit U_q. Additional variables s_k^+ and si^- measure the distance of inputs and outputs of virtual unit $\mathbf{X\lambda}$ and $\mathbf{Y\lambda}$ from inputs and outputs of evaluated unit U_q. Expression in the numerator, resp. the denominator of the objective function (2) measures the average distance of inputs, resp. outputs from the efficient frontier. For efficient units, the value of the objective function equals to one, units with the value of the objective function less than one are inefficient. For VRS applies condition of convexity $\mathbf{e^T\lambda = 1}$.

For possibility of efficient units' classification, SBMT Model of Super-Efficiency not-focusing on input and output assuming VRS is used [16]. In this model, evaluated unit U_q is removed from the set of units and is searched virtual unit U^* with inputs x^* with inputs and outputs y^*, which will be efficient after this removal. Inputs and outputs of unit U^* will not be better in comparison with unit U_q. Value of Super-Efficiency is defined as the distance of inputs and outputs from both units U_q and U^*. As measure of distance, metric δ is used, as follows (3):

$$\min \delta = \frac{\frac{1}{m}\sum_{i=1}^{m}(x_i^* / x_{iq})}{\frac{1}{r}\sum_{k=1}^{r}(y_k^* / y_{kq})}, \tag{3}$$

subject to

$$\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = x_i^*,$$

$$\sum_{j=1}^{n} y_{kj}\lambda_j - s_k^+ = y_k^*,$$

$$x_i^* \geq x_{iq},$$

$$y_k^* \leq y_{kq},$$

$$\lambda_q = 0,$$

$$\lambda_j, s_k^+, s_i^- \geq 0,$$

$$j = 1,2,...,n,\ j \neq q; k = 1,2,...,r; i = 1,2,...,m,$$

where all symbols have the same interpretation as (2). The numerator in the metric δ can be interpreted as the average rate of input increase of units U^* compared with inputs of unit U_q. For optimal value of the objective function holds $\delta^* \geq 1$. For inefficient units $\delta^* = 1$, for efficient units $\delta^* > 1$ and the higher value corresponds to higher value of Super-Efficiency. For VRS applies condition of convexity $\mathbf{e^T\lambda = 1}$.

4 Comparison of Efficiency among the EU Core Economic Axis

Using SBMT VRS model of efficiency and SBMT VRS model of Super-Efficiency is measured level of efficiency in NUTS 2 regions represent the EU strength economic axis including Pentagon, Blue Banana, Sunbelt, Yellow Banana and RCI2013 merging regions. Based on results of SBMT VRS model of efficiency, evaluated NUTS 2 regions are divided into two groups – efficient and inefficient regions (see Tab. 2). Coefficient of efficiency (CE) equals to one for efficient NUTS 2 regions and is less than one for inefficient ones (the lower CE, the less inefficient unit). Total number of evaluated NUTS 2 regions is

36 – 29 units were identified as efficient and 7 as inefficient, but what are the differences among them? Efficient NUTS 2 regions are those on the main core economic axis according to RCI2013 and in line with Pentagon and Blue Banana too. Less efficient, resp. inefficient NUTS 2 regions are outside the main axis – these units are (in most cases) part of Yellow Banana and Sunbelt.

The main questions of efficiency analysis were following: How powerful in economic growth and efficient in competitiveness are the main core areas (Pentagon, Blue Banana, Sunbelt, Yellow Banana, and RCI2013)? Which NUTS 2 regions are the most crucial for the European economy? Will be DEA NUTS 2 regions classification in line with the importance of areas based on the theory of geographic models? For their answering SBMT VRS model of Super-Efficiency was used and final ranking was ordered based on Coefficient of Super-Efficiency (CSE) (see Tab. 2). Evaluated NUTS 2 regions are based on CSE classified from the most to the least efficient.

The category of the most efficient NUTS 2 regions (1^{st} – 14^{th} positions: CSE is greater than 2,000) contains large and wealthy urban conglomerations with high shares of employment in the service sector. These areas have a diversified economic and institutional structure and advanced educational and infrastructure facilities. Compared with these contemporary growth poles, intermediate efficient NUTS 2 regions (15^{th} – 29^{th} positions: CSE is greater than 1.000) are less dynamic: they often have to cope with adaptation problems. Overspecialisation in manufacturing together with a rigid institutional structure have created lock-in situations that hamper the restructuring towards a service economy, what could be also the case of inefficient NUTS 2 regions (30^{th} – 36^{th} positions: CE is less than 1.000), they have experienced no major difficulties in making the switch-over to an industrial or services economy.

This classification of geo-economic areas makes clear that the pattern of economic activity in Europe is unevenly distributed. Results of efficiency analysis show a more polycentric pattern with strong capital and metropolitan regions in many parts of Europe. Some capital regions are surrounded by similarly competitive regions, but in many countries, regions neighbouring the capital are less competitive. Despite the increasing level of mobility of economic sources, i.e. inputs to find out better condition for economic activities, access to places, and services is still difficult, what has an impact on economic development of regional areas distant from the main economic centres of the country, especially major cities and their surrounding areas. Efficiency results underline that competitiveness has a strong regional dimension, which national level analysis does not capture [2].

Tab. 2: Efficiency and Super-Efficiency SBMT Results for NUTS 2 Regions

NUTS 2 REGIONS		SBMT CE*	SBMT CSE*	FINAL RANKING		
				Rank	CSE	Region
AT12	Niederösterreich	1.000	2.248	**1.**	**2.986**	**UKI1**
AT13	Wien	1.000	2.302	**2.**	**2.881**	**UKI2**
BE10	Région de Bruxelles-Capitale	1.000	2.752	**3.**	**2.856**	**UKH3**
BE24	Prov. Vlaams-Brabant	1.000	2.689	**4.**	**2.840**	**UKH2**
BE31	Prov. Brabant Wallon	1.000	2.502	**5.**	**2.752**	**BE10**
CZ01	Praha	1.000	2.159	**6.**	**2.689**	**BE24**
CZ02	Střední Čechy	1.000	2.098	**7.**	**2.502**	**BE31**
DE11	Stuttgart	0.639	0.639	**8.**	**2.302**	**AT13**
DE21	Oberbayern	1.000	1.067	**9.**	**2.248**	**AT12**
DE30	Berlin	0.559	0.559	**10.**	**2.159**	**CZ01**
DE41	Brandenburg - Nordost	0.546	0.546	**11.**	**2.098**	**CZ02**
DE42	Brandenburg - Südwest	0.548	0.548	**12.**	**2.071**	**FI13**
DE60	Hamburg	1.000	1.003	**13.**	**2.034**	**PL12**
DE71	Darmstadt	1.000	1.031	**14.**	**2.016**	**FI1A**
DEA1	Düsseldorf	1.000	1.037	**15.**	**1.238**	**LU00**
DEA2	Köln	0.135	0.135	**16.**	**1.206**	**ITC3**
ES51	Cataluña	0.336	0.336	**17.**	**1.170**	**ITC4**
ES52	Comunidad Valenciana	1.000	1.091	**18.**	**1.139**	**FR10**
FI13	Itä-Suomi	1.000	2.071	**19.**	**1.102**	**ITD3**
FI1A	Pohjois-Suomi	1.000	2.016	**20.**	**1.091**	**ES52**
FR10	Île de France	1.000	1.139	**21.**	**1.067**	**DE21**
FR42	Alsace	0.013	0.013	**22.**	**1.053**	**FR82**
FR82	Provence-Alpes-Côte d'Azur	1.000	1.053	**23.**	**1.037**	**DEA1**
ITC3	Liguria	1.000	1.206	**24.**	**1.031**	**DE71**
ITC4	Lombardia	1.000	1.170	**25.**	**1.027**	**NL31**
ITD3	Veneto	1.000	1.102	**26.**	**1.015**	**UKD5**
LU00	Luxembourg (Grand-Duché)	1.000	1.238	**27.**	**1.010**	**UKD3**
NL23	Flevoland	1.000	1.008	**28.**	**1.008**	**NL23**
NL31	Utrecht	1.000	1.027	**29.**	**1.003**	**DE60**
PL12	Mazowieckie	1.000	2.034	*30.*	*0.639*	*DE11*
UKD3	Greater Manchester	1.000	1.010	*31.*	*0.559*	*DE30*
UKD5	Merseyside	1.000	1.015	*32.*	*0.548*	*DE42*
UKH2	Bedfordshire and Hertfordshire	1.000	2.840	*33.*	*0.546*	*DE41*
UKH3	Essex	1.000	2.856	*34.*	*0.336*	*ES51*
UKI1	Inner London	1.000	2.986	*35.*	*0.135*	*DEA2*
UKI2	Outer London	1.000	2.881	*36.*	*0.013*	*FR42*

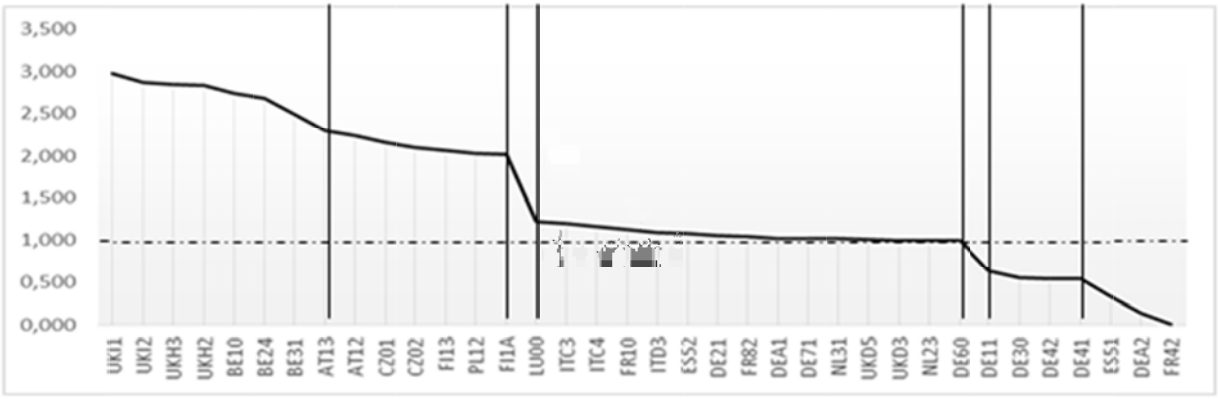
**Results of CE for SBMT and CSE for SBMT are listed to NUTS 2 regions according to their order in left column NUTS 2 regions. Part "Final ranking" of NUTS 2 regions is based on CSE values.*

Source: own elaboration, 2015

Following Fig. 3 shows development of efficiency level for evaluated NUTS 2 regions based on SBMT VRS model of efficiency. One horizontal axis on the value 1.000 represents the boundary between efficiency and inefficiency – within our sample is in the case

of NUTS 2 region DE60 Hamburg. Six vertical axis imagine breaking points for substantial decrease among efficiency levels of evaluated NUTS 2 regions.

Fig. 3: Development of Efficiency Level for Evaluated NUTS 2 Regions



Source: own elaboration, 2015

For each unit identified as inefficient, DEA creates group of so called Peer-Units which suggest strategy for the optimal combination of inputs and outputs to enhancing their efficiency. For this strategy, efficient units are used as benchmark because these units move on the efficient frontier and thus their combination of inputs and outputs seems to be optimal – no need to change. In Tab. 3 is possible to seen inefficient NUTS 2 regions and for each of them the benchmark NUTS 2 regions which are efficient and seems to be convenient background for calculation of changes in values for original inputs and outputs – optimal strategy how to improve efficiency.

Tab. 3: Optimal Peer-Units for Improving Inefficient NUTS 2 Regions

Inefficient NUTS 2 Region		**Benchmark NUTS 2 Regions to Change Level of Inputs and Outputs**	
DE11	Stuttgart	FR10 ITC4	Île de France Lombardia
DE30	Berlin	ITC3 ITC4 PL12	Liguria Lombardia Mazowieckie
DE41	Brandenburg - Nordost	ITC3 ITC4 PL12	Liguria Lombardia Mazowieckie
DE42	Brandenburg - Südwest	ITC3 ITC4 PL12	Liguria Lombardia Mazowieckie
DEA2	Köln	DEA1 FR10 ITC4 PL12	Düsseldorf Île de France Lombardia Mazowieckie
ES51	Cataluña	ITD3 PL12	Veneto Mazowieckie
FR42	Alsace	FR10 ITC4 PL12	Île de France Lombardia Mazowieckie

Source: own elaboration, 2015

Conclusion

An efficient economic integration arrangement should generate higher total welfare than any other arrangement. It´s possible to expect that the EU core economic axis such as Pentagon, Blue Banana, Sunbelt, Yellow Banana and RCI2013 merging regions will be also the European growth axis in the next decades. This is not to say that there are no chances for other NUTS 2 regions in the European economy. As Hospers [10] also introduced, in addition to Blue Banana new growth poles might emerge in Europe. The future prospects of new areas depend upon their capacity to solve transition problems and to make use of the rising demand for services. From this perspective, Sunbelt may indeed have growth potential. The pleasant climate and attractive environment of this area along the Mediterranean coast offers opportunities to expand tourist, cultural and leisure services. Like peripheral agricultural areas in the Mediterranean, most regions in Central and Eastern Europe still have to cope with economic and institutional inertia effects resulting from the past. Therefore, these inefficient areas will be the objects of the next research. Via construction the Peer-Units, strategy of optimal settings of inputs and outputs will be suggested for enhancing their efficient options and economic positions within the EU axis.

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Contact Address

Ing. Michaela Staníčková, Ph.D., Ing. Lukáš Melecký, Ph.D.
VŠB - TU Ostrava, Faculty of Economics, Department of European Integration
Sokolská třída 33, 701 21 Ostrava, Czech Republic
Email: michaela.stanickova@vsb.cz, lukas.melecky@vsb.cz
Phone number: +420 597 322 237, +420 597 322 277

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