STATUS OF GLOBAL ECONOMIC POWERS (BRICS, EU28, JAPAN, USA): THE CASE FOR COMPETITIVENESS AND FACTORS INFLUENCING PROGRESS OR DECLINE

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Abstract: *Many of the competitiveness challenges we see today stem from the aftermath of the financial crisis. Today, productivity and growth are not picking up in advanced economies, and the consequences of low and even negative productivity growth in many emerging economies are now evident. Productivity of major world economies can be seen as the source of national performance and subsequent international competitiveness. The paper deals with an application of Data Envelopment Analysis (DEA) method to multi-criteria performance evaluation of countries considered as global economic powers. The aim of the paper is to analyse development of and measure level of productive potential achieved by BRICS countries, the European Union (EU) and its members, Japan and the United States of America (USA) with the help of specialised DEA approach – the Output-Oriented Malmquist Productivity Index in reference period 2007-2016. Using of DEA is convenient due to set of different factors determining productivity, such as Global Competitiveness Index (GCI). Results confirm the constantly strong position of the post-war triad (in order of the EU, USA, and Japan) compared to rapidly developing BRICS countries. It is also evident the growing tendency and corresponding comparison of BRICS performance with traditional economic powers, i.e. triad.*

Keywords: *Competitiveness, DEA, Economic Power, Efficiency, Global Competitiveness Index, Malmquist Productivity Index, Productivity.*

JEL Classification: *C61, C67, E60, F02, F62, O11, O47.*

Introduction

In the field of trade theory and policy, researchers since the time of Adam Smith debated whether openness and trade liberalisation provide the necessary ingredients for economic growth and subsequent for competitiveness. The effect of openness, trade liberalisation on economic growth as well as relationships between economic growth and competitiveness remain highly contentious issues. Openness to trade, investment and even the movement of people is vital for prosperity, peace and individual freedom. And there have been few better moments in history to reconfirm the role of trade as central to global growth, job creation and development. Today's economic circumstances are full of challenges. Global growth remains fragile after the 2008-2009 crisis, with few bright spots in the global economy. Potential output growth has declined in recent years across developed and developing economies owing to structural factors that led to lower productivity growth (WEF, 2015). Yet it is these advanced economies that have historically been the drivers of a more globally integrated world, leading eventually to a multipolar world with changing global

political-economic relations[1]. At the same time, there are signs of new energy in global integration and when viewed from a longer perspective, this energy is not surprising, forming part of a long trend towards more closely interlinked global markets. These developments have also intensified competition in global markets, which, in turn, implies a greater need to be competitive to generate additional market opportunities and economic links in the presence of many more participants vying for the same space. Competitiveness is thus high on political agenda. Competitiveness can be defined as the set of factors – policies, institutions, strategies and processes – that determine the level of sustainable productivity of an economy, be it the world, a continent (or macro region), nation, region or even a city (WEF, 2016). Competitiveness centres on productivity – the efficiency with which an economy uses available inputs to produce outputs. It determines the rate of return on investments, which fundamentally drives economic growth. Openness to the world – through trade, investment and the movement of people – is crucial to competitiveness. But openness on its own has its limits. To reap its benefits fully, it must be combined with productivity-enhancing reforms at home. This is the rationale for pursuing reforms to advance a twin focus on trade and competitiveness (WEF, 2015). Against this backdrop, what can openness to trade and investment contribute to a sustained global recovery? How can the potential gains through global value chains be harnessed? How do countries increase competitiveness to take better advantage of the global economy?

The paper focus is efficiency measurement based on the last decade editions of Global Competitiveness Index 2007-2016 and for this purpose using the Output-Oriented Malmquist Productivity Index (OO MPI) in Data Envelopment Analysis (DEA). Global economic powers are subject to analysis (BRICS countries, the European Union (EU) members and the EU28, Japan and the United States of America (USA)) and their tendencies in competitiveness are evaluated.

1 Background of Competitiveness and Performance Concepts

In recent years, the topics about measuring and evaluating of competitiveness have enjoyed economic interest. Competitiveness remains a concept that can be understood in different ways despite widespread acceptance of its importance (Krugman, 1994). Nowadays, competitiveness is monitored characteristic of national economies which is increasingly appearing in evaluating their performance and prosperity, welfare and living standards. The need for theoretical definition of competitiveness at macroeconomic level emerged with development of globalisation process in the world economy as a result of increased competition between countries. It should be emphasised here that openness to global markets and the internationalisation of economies play an increasing role in productivity and competitiveness enhancement. Therefore, competitiveness is one of the fundamental criteria for evaluating economic performance and reflects the success of area. Territories need highly performing units in order to meet their goals, to deliver the products and services they specialised in, and finally to achieve competitive advantage. Low performance and not achieving the goals might be experienced as dissatisfying or even as a failure. Moreover,

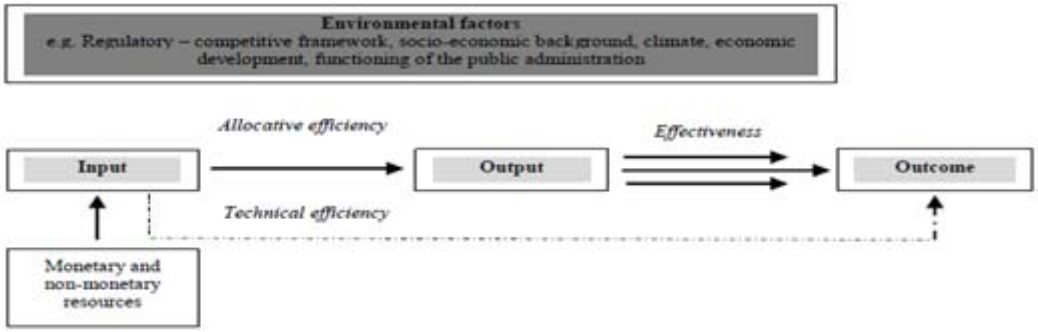
[1] Negotiations have intensified in several major groupings, including the Trans Pacific Partnership, the Transatlantic Trade and Investment Partnership between the European Union and the United States of America, the Regional Comprehensive Economic Partnership (RCEP) in Asia, the Pacific Alliance in Latin America and the Tripartite Free Trade Agreement in Africa (WEF, 2015).

performance, if it is recognised by others, is often rewarded by benefits, e.g. better market position, higher competitive advantages, financial condition etc. Differences in performance across territories are seen by government as important policy targets. For a number of years, government objectives have been set not only in terms of improving national productivity performance against other countries but also in creating conditions to allow less productive countries to reduce the 'gap' between themselves and the most productive ones.

Comparative analysis of performance in public sector is thus starting point for studying the role of efficiency/productivity and effectiveness, i.e. two aspects of performance regarding economic governance of resources utilization by public management for achieving medium/long-term objectives of economic recovery and sustainable development of national economies (Mihaiu, Opreana, Cristescu, 2010). Increasing productivity is generally considered to be the only sustainable way of improving living standards in the long term. Statistical evidence to help policy makers understand the routes to productivity growth, especially those which can be influenced by government, can help lead to better policy. Productivity is thus a central issue in analyses of economic growth, effects of fiscal policies, pricing of capital assets, level of investments, technology changes and production technology, etc. Based on Porter (1990), competitiveness is usually linked to productivity. Fig. 1 illustrates the conceptual framework of efficiency (inputs-outputs) and effectiveness (outputs-outcomes). Efficiency can be achieved under conditions of maximising results of an action in relation to resources used, and it is calculated by comparing effects (outputs) obtained in their efforts (inputs). In a competitive economy, therefore, issue of efficiency can be resolved by comparing these economic issues. Effectiveness is more difficult to assess than efficiency since the outcome is influenced by political choice and often linked to welfare or growth objectives. Drucker (2001) stated there is no efficiency without effectiveness, because it is more important to do well what you have proposed than to do well something else that was not necessarily a concern.

Based on the Institute for Management and Development (2012), competitiveness is "a field of economic knowledge, which analyses the facts and policies that shape the ability of a nation to create and maintain an environment that sustains more value creation for its enterprises and more prosperity for its people" (IMD, 2012: 502). In other words, competitiveness measures "how a nation manages the totality of its resources and competencies to increase the prosperity of its people" (IMD, 2012: 502). Understanding of competitiveness is thus closely linked with understanding of efficiency and effectiveness concepts, see Fig. 1.

Fig. 1: Performance Dimensions and their Relationship



Source: (Mandl, Dierx and Ilzkovitz, 2008)

2 WEF Approach to Competitiveness: World Mainstream Leader

Macroeconomic competitiveness is monitored by many institutions, however, two well-known international institutes, i.e. Institute for Management Development (IMD) and World Economic Forum (WEF) publish most reputable competitiveness reports. To compare a level of competitiveness of separated countries in the paper, we use the database performed by WEF. The first reason for choosing WEF approach is its long-term continuity and international recognition of stakeholders. Since 1979, WEF publishes Global Competitiveness Report (GCR) that produces annual Global Competitiveness Index (GCI) to rank national economies. GCR aims to serve as a neutral and objective tool for governments, the private sector, and civil society to work together on effective public-private collaboration to boost future prosperity (WEF, 2016). By benchmarking each year's progress on different factors and institutions that matter for future growth, GCR keeps competitiveness on the public agenda, provides a focal point for the discussion of long-term competitiveness policies, and helps to keep stakeholders accountable. The ability to compare economies on a variety of indicators helps them to assess gaps and priority areas and to construct joint, public-private agendas to address them – generally, the main approach of composite indices (CI[2]).

The second reason for choosing WEF is its approach to perceiving competitiveness and suitability in terms of used quantitative method. In GCR, WEF defines competitiveness as the set of institutions, policies, and factors that determine level of productivity of a country. Level of productivity, in turn, sets level of prosperity that can be reached by an economy. Level of productivity also determines the rates of return obtained by investments in an economy, which in turn are the fundamental drivers of its growth rates. In other words, a more competitive economy is one that is likely to grow faster over time. This open-endedness is captured within the GCI by including a weighted average of many different components, each measuring a different aspect of competitiveness. The components are grouped into 12 categories, the pillars of competitiveness, which are not independent, they tend to reinforce each other, and a weakness in one area often has a negative impact on others (see Tab. 2, WEF, 2016). GCI pillars may be grouped according to the different dimensions (input versus output aspects) of competitiveness they describe. The terms 'inputs' and 'output' are meant to classify pillars into those which describe driving forces of competitiveness, also in terms of long-term potentiality, and those which are direct or indirect outputs of a competitive society and economy. It is not easy to make a decision on which GCI pillars are the economic drivers in terms of competitiveness (i.e. inputs) and which are the results of activities in the economy (i.e. outputs). For this purpose, we use the appropriate classification based on the EU Regional Competitiveness Index (RCI), created partly in line with GCI construction (Annoni, Kozovska, 2010), for detail see Tab. 2.

[2] CIs are useful in their ability to integrate large amounts of information into easily understood formats and are valued as a communication and political tool. They are often a compromise between scientific accuracy and the information available at a reasonable cost. However, CIs construction suffers from many methodological difficulties, with the result that they can be misleading and easily manipulated, i.e. may send misleading policy messages if poorly constructed or misinterpreted; may be misused, e.g. to support a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles; may disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action, if the construction process is not transparent; may lead to inappropriate policies if dimensions of performance, that are difficult to measure, are ignored.

3 DEA Method for Efficiency Evaluation

The main element of the paper is competitiveness at the centre of which is productivity – the efficiency with which an economy uses available inputs to produce outputs. In the paper, the main link in terms of theoretical background, institutional approach to data selection and methodological approach is thus productivity. In view of this, a suitable method for empirical analysis is Data Envelopment Analysis (DEA). DEA was first proposed by A. Charnes, W. W. Cooper and E. Rhodes (CCR model) in 1978 (Charnes, Cooper, Rhodes, 1978). DEA is multicriteria decision-making method and one of mathematical approaches for providing a relative efficiency assessment of a set of peer entities called Decision Making Units (DMUs), but their definition is generic and flexible. 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. Several DEA methods exist for measuring the EU efficiency and competitiveness, besides the basic DEA models, certain modifications exist (see e.g. Nurboja, Košak, 2017; Hančlová, Melecký, 2016; Melecký, Hančlová, 2015; Foddi, Usai, 2013). Recently, research effort has focused on an investigation of the causes of productivity change and its decomposition. Malmquist Productivity Index (MPI) become the standard approach in productivity measurement over time within the non-parametric research. MPI has been introduced firstly by Caves, Christensen, Diewert (1982). MPI was developed in consumer-production context, and enjoyed widespread use in territorial analysis (see e.g. Staníčková, Melecký, 2016).

In contrast to traditional DEA models which measure efficiency of a DMU, MPI enables to measure productivity change of a DMU between two time periods, t and t+1. MPI is defined as product of Catch-up and Frontier-shift terms. Catch-up or better Efficiency change term deals with degree to which a DMU improves or worsens its efficiency – technical efficiency change. Frontier-shift term shows change in efficient frontiers between two time periods – technological efficiency change. With respect to paper topic of competitiveness and orientation of policy-makers to objectives on this concept, we use output orientation of model, i.e. OO MPI measuring efficiency change in production units between successive periods t and t+1 is formulated via (1):

$$MPI_q\left(x_q^{t+1}, y_q^{t+1}, x_q^t, y_q^t\right) = E_q \cdot P_q, \qquad (1)$$

where x_q represent inputs and y_q represent outputs of evaluated DMU_q in periods t and t+1; E_q is change in relative efficiency of DMU_q in relation to other units (i.e. due to production possibility frontier) between time periods t and t+1; P_q describes the change in the production possibility frontier as a result of the technology development between time periods t and t+1. Components E_q and P_q are defined via (2) and (3) (Cooper, Seiford, Tone, 2007):

$$E_q = \frac{\phi_q^{t+1}\left(x_q^{t+1}, y_q^{t+1}\right)}{\phi_q^t\left(x_q^t, y_q^t\right)}, \qquad (2)$$

$$P_q = \left[\frac{\phi_q^t\left(x_q^{t+1}, y_q^{t+1}\right)}{\phi_q^{t+1}\left(x_q^{t+1}, y_q^{t+1}\right)} \cdot \frac{\phi_q^t\left(x_q^t, y_q^t\right)}{\phi_q^{t+1}\left(x_q^t, y_q^t\right)}\right]^{1/2}, \qquad (3)$$

where the optimum value of variable ϕ_q expresses the need for proportional increase of outputs to achieve DMU_q efficiency in time t and t+1 corresponding to inputs x_q and outputs y_q of the given period. Function $\phi_q^t\left(x_q^t, y_q^t\right)$ represents the input-output relationship of DMU_q from period t and production function in time t. Function $\phi_q^{t+1}\left(x_q^t, y_q^t\right)$ expresses the input-output relationship of DMU_q from period t with production function in time t+1. Function $\phi_q^t\left(x_q^{t+1}, y_q^{t+1}\right)$ represents the input-output relationship of DMU_q from period t+1 with production function in period t. Function $\phi_q^{t+1}\left(x_q^{t+1}, y_q^{t+1}\right)$ represents the input-output relationship of DMU_q from period t+1 with production function in period t+1.

By modification of equations (2) and (3), following MPI_q equation (4) makes possible to measure change in technical efficiency and movement of frontier in terms of a specific DMU_q between periods t and t+1 (Färe et al., 1994):

$$MPI_q = \frac{\phi_q^{t+1}\left(x_q^{t+1}, y_q^{t+1}\right)}{\phi_q^t\left(x_q^t, y_q^t\right)} \left[\frac{\phi_q^t\left(x_q^{t+1}, y_q^{t+1}\right)}{\phi_q^{t+1}\left(x_q^{t+1}, y_q^{t+1}\right)} \cdot \frac{\phi_q^t\left(x_q^t, y_q^t\right)}{\phi_q^{t+1}\left(x_q^t, y_q^t\right)} \right]^{1/2} = ECH_q \cdot FS_q . \quad (4)$$

The first term E_q on the right-hand side measures the magnitude of technical efficiency change (ECH) between time periods t and t+1. The second term P_q measures shift in possibility frontier, i.e. technology frontier shift (FS), between time periods t and t+1. As a result, $MPI_q < 1$ indicates deterioration in total factor productivity of DMU_o from Period 1 to Period 2; result of $MPI_q = 1$ shows there is no change in total factor productivity and $MPI_q > 1$ shows progress in total factor productivity (for more details see (Cooper, Seiford, Tone, 2007) and Tab. 1, where characteristics and trends of MPI_q are shown).

Tab. 1: MPI Characteristics and Trends of Dimensions

MPI	Productivity	MPI Dimensions	Catch-up Frontier-shift	ECH (technical change) FS (technological change)
> 1	*Improving*	MPI	> 1	*Improving*
= 1	*Unchanging*	Catch-up	= 1	*Unchanging*
< 1	*Declining*	Frontier-shift	< 1	*Declining*

Source: (own elaboration, 2017)

Suppose there are n DMUs which consume m inputs to produce s outputs. If a performance measure (input/output) is added or deleted from consideration, it will influence the relative efficiencies. Empirically, when the number of performance measures is high in comparison with the number of DMUs, then most of DMUs are evaluated efficiently. Hence, the obtained results are not reliable. There is a rough rule of thumb (Cooper, Seiford, Tone, 2007) which expresses the relation between the number of DMUs and the number of performance measures as follows (5):

$$n \geq 3(m + s). \quad (5)$$

In the paper, the rule of thumb is met, because number of DMUs equals to sum of input and outputs, i.e. 36 ≥ 3 (6 + 6), 36 ≥ 3 (12), 36 ≥ 36.

ArcGIS, DEA Frontier, and IBM SPSS Statistics are software used for the calculations.

Territorial aspect of analysis is dedicated to current global economic powers, i.e. BRICS countries (Brazil-Russia-India-China-South Africa), the EU members[3] and the EU28 as a whole, and other countries from the triad to the EU, i.e. Japan and the USA. Importance of these global economic powers cannot be denied for their role in organisation of current international relations during the period of globalisation. This fact relates closely to the issue of international competitiveness and influence of these leaders on international market and business conditions. Balance of traditional world powers is thus changing and powers of the triad, i.e. the EU, Japan and the USA powers are being promoted by BRICS countries. Countries like China, India, Brazil or Russia are heard more and more often and in different contexts. The most obvious case if changed position of China. Japan has ceased to be the largest Asian economy and replaced by China. The country of rising sun in Asia is increasingly retreating. On the contrary, the "soft" or cultural power, or "hard" or economic power of China, is constantly growing. One thing is certain, distribution of powers and players on the world stage change. But what is relationship among global economic powers in challenging competitive environment?

Indicators represent twelve GCI pillars are crucial for evaluation of relationships among global economic powers via OO MPI. GCI pillars (indicators for DEA method) represent both sides of required indicators, i.e. input and output size. Indicators come from WEF database (WEF, 2017). Tab. 2 includes division of twelve GCI pillars in six inputs and six outputs, in line with time-series of analysis, i.e. years within period 2007-2016. Time period of analysis includes periods of growth dynamics and further enlargement of the EU, periods of economic downturn and stagnation, effects of the economic crisis and subsequent stagnation can be considered as the other milestones. In DEA analysis, calculations were made for year-on-year productivity changes between all years of period 2007-2016, i.e. dynamically across time. Background for DEA interpretation are results based on trend of year-on-year productivity changes in period 2007-2016 and total productivity change for the whole period.

Tab. 2: Background of Empirical Analysis by DEA

<table>
<tr><th>GCI pillars: Inputs (I 1-6)</th><th>DMUs</th><th>GCI pillars: Outputs (O 1-6)</th></tr>
<tr><td>1. Institutions</td><td rowspan="6">Global economic powers, i.e. 36 economic entities</td><td>1. Goods market efficiency</td></tr>
<tr><td>2. Infrastructure</td><td>2. Labour market efficiency</td></tr>
<tr><td>3. Macroeconomic environment</td><td>3. Financial market development</td></tr>
<tr><td>4. Health and primary education</td><td>4. Market size</td></tr>
<tr><td>5. Higher education and training</td><td>5. Business sophistication</td></tr>
<tr><td>6. Technological readiness</td><td>6. Innovation</td></tr>
<tr><td colspan="3">Time-series</td></tr>
<tr><td>GCI editions</td><td colspan="2">Annual changes</td><td>Total period change</td></tr>
<tr><td>10 editions from GCR 2007-2008 to GCR 2016-2017</td><td colspan="2">2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016</td><td>Total changes across years in period 2007-2016</td></tr>
</table>

Source: (own elaboration, 2017)

[3] Belgium, Netherlands, Luxembourg, France, Italy, Germany, United Kingdom, Ireland, Denmark, Greece, Spain, Portugal, Finland, Sweden, Austria, Czech Republic, Slovak Republic, Hungary, Poland, Latvia, Lithuania, Estonia, Slovenia, Malta, Cyprus, Bulgaria, Romania, Croatia.

4 Application of OO MPI: Case of Global Economic Powers

Performance is a major prerequisite for future development and success in broader comparison. In the paper, comparison of one dimension of performance is processed, i.e. partial efficiency changes and total productivity changes. Tab. 3 presents year-on-year efficiency changes gained by OO MPI for the whole reference period 2007-2016. Tab. 3 also shows reordered countries from the best to the worst, OO MPI scores and corresponding ranks. Results of traditional triad (EU[4]-Japan-USA) mark bold font and dark grey colour, results of BRICS group mark italic font and light grey colour. Based OO MPI scores, total productivity change ranges from 1.021 – the 1st position (Greece) to 0.977 – the last 36th position (Romania). Twelve countries recorded slowly positive and increasing trend in productivity change during the whole reference period (behind Greece, Cyprus, Portugal, Slovenia, Hungary, Spain, Finland, Ireland, Denmark, United Kingdom, EU28 and Netherland placed). Twenty-one countries achieved slowly negative and decreasing trend productivity change during the whole reference period (prior to Romania, they placed Luxembourg, Sweden, USA, Malta, Lithuania, Slovakia, Japan, Estonia, Austria, India, Croatia, Germany, Latvia, Czech Republic, South Africa, Brazil, China, Bulgaria, Poland and Russia). Only three countries recorded unchanging trend in productivity change during the whole reference period (France, Italy and Belgium). Differences in OO MPI scores are not large both in the case of efficient and inefficient countries. Average total change in productivity of triad countries achieves 0.998 and BRICS countries 0.986. Results thus confirm the constantly strong position of triad, but also the growing tendency BRICS performance.

Development potentials or weaknesses are inherent in the national diversity. Part of explanation of DEA efficiency results has to do with differences in competitiveness. Broader aspects enter into the overall evaluation of economics and these aspects are unnoticeable for DEA, i.e. part of qualitative evaluation in line with evaluation of overall performance. Performance is linked with respect to competitiveness sense: a good performance in the Innovation group (Input 6, Output 5-6) is expected to also be a good performance in the Efficiency group (Input 5, Output 1-2-3-4) and the Basic group (Input 1-2-3-4) as they are instrumental in increasing levels of competitiveness. The first Basic group represent the key basic drivers of all types of economies. As economy develops, other factors enter into play for its advancement in competitiveness and are grouped in the second Efficiency group of pillars. At the most advanced stage of development of economy, key drivers for improvement are pillars included in the third Innovation group. As countries move along the path of development, their socio-economic conditions change and different determinants become more important for the macroeconomic competitiveness. Thus, an economic entity in country with low level of competitiveness may not have similar opportunities as economic entity in highly competitive country. This fact remains and can be confirmed. What does it mean for efficiency? In the paper, DEA results efficiency are different from GCI results competitiveness. Why? Is a high level of competitiveness necessarily associated with a high level of efficiency and vice versa? It may not always be the case of evaluated countries, these conclusions reached also Fojtíková, Staníčková, Melecký (2017).

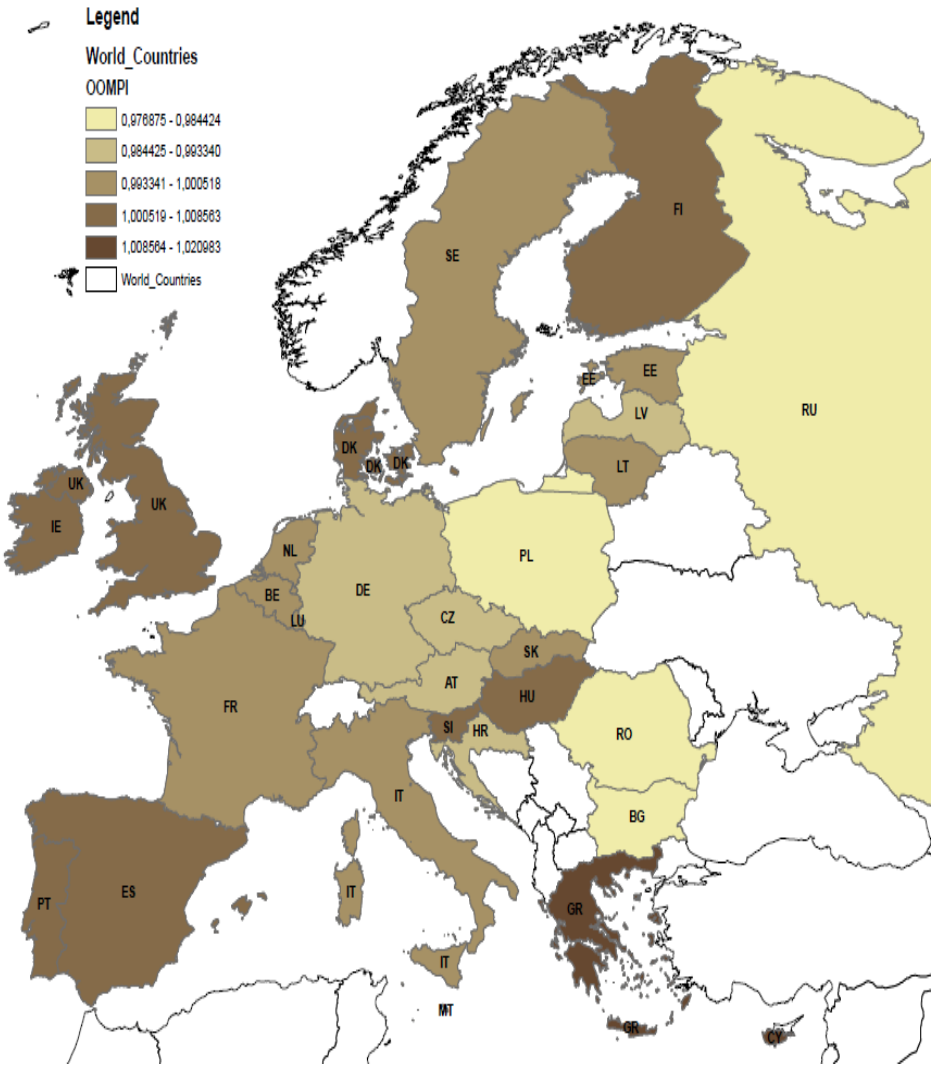
[4] For better illustration of differences among all the EU members, Fig. 2 graphically presents results of MPI in this integration unit for the whole reference period 2007-2016. It illustrates MPI scores division among individual countries based on colour range – the highest and higher MPI score, the darker colour shade; the lowest and lower MPI score, the lighter colour shade.

Tab. 3: Results of OO MPI: Annual Changes and Total Change for 2007-2016

Country	Output-Oriented Malmquist Productivity Index										Final ranking		
	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	Total change	Rank	Code	Total change
Austria	1.000	0.977	0.953	1.012	1.029	0.979	0.988	1.002	1.000	0.993	1	GR	1.021
Belgium	0.966	1.026	1.005	0.970	1.029	0.989	1.003	0.999	1.013	1.000	2	CY	1.015
Brazil	0.980	0.992	0.935	0.983	0.988	0.982	1.000	1.024	0.998	0.987	3	PT	1.009
Bulgaria	0.992	1.009	0.892	0.996	0.982	0.972	0.984	0.989	1.007	0.980	4	SI	1.007
China	0.933	0.996	0.978	0.985	1.010	1.018	0.971	1.002	0.968	0.984	5	HU	1.004
Croatia	0.974	0.971	0.951	1.007	1.023	0.990	1.017	0.997	0.995	0.992	6	ES	1.004
Cyprus	0.996	1.003	1.060	0.963	1.083	1.016	1.048	0.939	1.024	1.015	7	FI	1.004
Czech Republic	0.998	1.011	0.956	1.022	0.983	0.989	0.981	0.973	1.001	0.991	8	IE	1.003
Denmark	1.011	1.012	0.998	1.003	0.999	0.996	0.984	1.023	0.995	1.002	9	DK	1.002
Estonia	0.993	1.024	0.951	1.010	1.040	0.986	0.969	0.992	0.986	0.995	10	UK	1.002
Finland	0.973	0.990	1.040	1.009	0.999	1.010	0.989	1.009	1.013	1.004	**11**	**EU**	**1.001**
France	0.987	1.017	0.946	1.069	1.008	0.957	1.018	1.005	0.994	1.000	12	NL	1.001
Germany	0.977	1.001	0.953	0.985	0.998	1.009	0.993	1.007	0.999	0.991	13	FR	1.000
Greece	1.012	1.022	1.006	1.038	1.184	0.918	0.981	0.988	1.039	1.021	14	IT	1.000
Hungary	0.995	0.995	0.978	1.010	1.009	0.993	1.009	1.006	1.037	1.004	15	BE	1.000
India	0.980	1.004	0.950	1.009	0.998	1.005	1.031	0.969	0.984	0.992	16	LU	0.999
Ireland	0.986	1.016	0.984	1.013	1.115	0.975	1.020	0.945	0.976	1.003	17	SE	0.999
Italy	1.006	1.039	0.938	1.001	0.993	0.997	1.035	0.998	0.992	1.000	**18**	**USA**	**0.999**
Japan	0.988	1.037	1.008	0.985	1.018	1.002	1.008	0.973	0.939	0.995	19	MT	0.997
Latvia	1.013	1.037	0.965	1.001	0.992	0.967	0.966	0.996	0.982	0.991	20	LT	0.997
Lithuania	0.987	1.006	0.977	1.002	1.004	0.990	1.012	1.002	0.992	0.997	21	SK	0.996
Luxembourg	0.971	1.005	0.995	0.981	1.010	0.977	1.013	1.016	1.023	0.999	**22**	**JP**	**0.995**
Malta	0.977	1.039	0.951	0.960	1.043	1.017	1.000	0.975	1.011	0.997	23	EE	0.995
Netherlands	1.024	1.000	0.970	0.992	1.023	0.981	1.004	1.005	1.005	1.001	24	AT	0.993
Poland	1.017	1.016	0.857	0.975	1.006	0.959	0.996	0.966	1.013	0.979	*25*	*IND*	*0.992*
Portugal	0.983	1.009	1.004	1.007	1.010	0.986	1.062	1.015	1.003	1.009	26	HR	0.992
Romania	1.017	0.998	0.847	0.986	1.011	0.979	0.971	1.006	0.977	0.977	27	DE	0.991
Russian Federation	0.948	0.997	0.950	0.990	0.949	0.980	0.980	1.011	0.993	0.978	28	LV	0.991
Slovak Republic	1.004	1.002	0.959	1.015	0.991	1.021	0.992	0.972	1.006	0.996	29	CZ	0.991
Slovenia	0.979	1.011	1.006	0.984	1.038	0.982	1.068	1.006	0.987	1.007	*30*	*ZA*	*0.989*
South Africa	1.006	1.050	0.929	1.015	1.009	1.028	0.947	0.915	0.999	0.989	*31*	*BR*	*0.987*
Spain	0.989	1.013	0.960	1.002	1.049	1.016	1.041	0.984	0.979	1.004	*32*	*CN*	*0.984*
Sweden	0.985	0.989	1.010	1.029	0.970	0.992	1.001	1.004	1.007	0.999	33	BG	0.980
United Kingdom	0.969	1.005	0.976	1.014	1.089	0.999	0.978	0.989	0.998	1.002	34	PL	0.979
United States of America	0.983	1.052	0.987	0.991	1.028	1.003	1.001	0.970	0.973	0.999	*35*	*RU*	*0.978*
European Union	0.993	1.012	0.978	1.001	1.018	0.994	1.015	0.997	1.003	1.001	36	RO	0.977

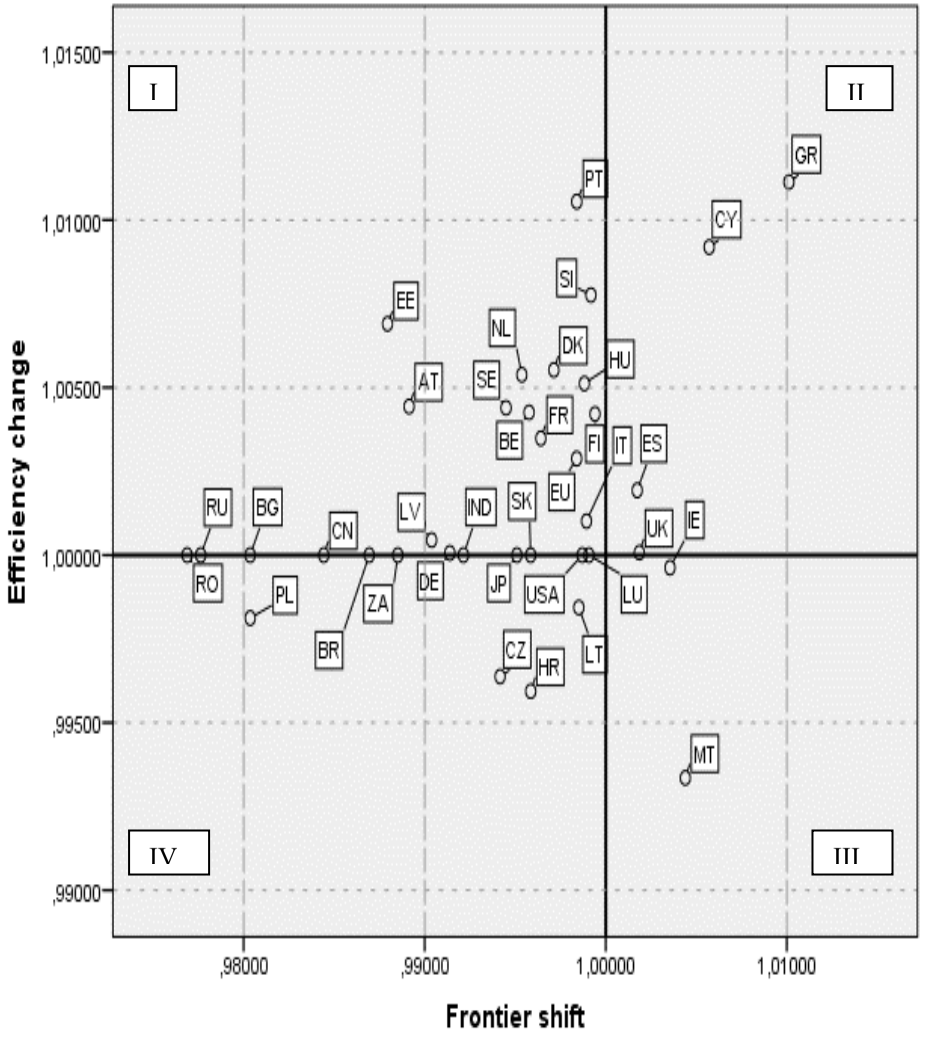
Source: (own calculation in DEA-Frontier; own elaboration, 2017)

Fig. 2: OO MPI Division for EU28 Countries for 2007-2016



Source: (own visualization in ArcGIS, 2017)

Fig. 3: Efficiency-change and Frontier-shift for 2007-2016



Source: (own calculation in IBM SPSS Statistics; own elaboration, 2017)

Concordance of results, in GCR, e.g. country achieves lower GCI score, and in DEA higher MPI score and seems to operate more efficiently in the reference period (e.g. GR, CY, PT, and ES). Such conclusion is relevant by comparing values of inputs and outputs in DEA, and the fact that outputs are achieved with given inputs. If input-output ratio is low on both sides, countries could be considered as efficient in transformation process. These results are not linked with overall competitiveness evaluation which does not depend primarily on efficiency, but on effectiveness of whole economic processes (see Fig. 1). This fact is typical for productivity calculated by MPI and also for its two dimensions, i.e. Catch-up (technical efficiency change, ECH) and Frontier-shift (technological efficiency change, FS). Fig. 3 illustrates results of MPI dimensions, i.e. classification of countries with respect to effects of ECH and FS. Scatterplot is possible to divide via vertical axis (ECH) and horizontal axis (FS); axis mean status quo in efficiency change. Countries are placed based on ECH-FS total change during 2007-2016 in four quadrants: I: countries reached better productivity relatively to other ones, but did not notice technological shift of economy; II: countries with the best relative results; III countries positively shifted productivity; IV: countries with the worst relative results; and Border-lines placement: 1^{st} – 4^{th} quadrant border (countries noticed ECH equals to one but FS is lower than one), 2^{nd} – 3^{rd} quadrant border (countries achieved ECH equals to one but FS is higher than one).

Conclusion

The dynamics of economic, social, political and cultural change in the contemporary world are increasingly shaped by the pursuit and promotion of competitiveness. Competitiveness of economies in integrated world determines how well they convert the potential created by access to global markets into opportunities for their economic subjects. The world economy is changing in the face of growing competition as consequence of globalisation processes. These processes result in changing position of global economic powers, emergence of new powers, and thus in new distribution of global forces. It leads to importance of deeper study of factors affecting competitiveness and influencing the growth with respect to competitors and market players. As part of the follow-up research, due to the interconnectedness of world economies as a result of globalisation processes, it is desirable to analyse macroeconomic competitiveness not only for economic objectives but the other ones. Competitiveness is multifactor conditional, it is necessary to include social, environmental, institutional, etc. aspects. In reality, improving competitiveness simply means to create conditions that allow economy to allocate scarce resources where opportunities arise as external and internal conditions change. Understanding of how policies interact to affect competitiveness, at macroeconomic level is important.

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