Quality of Institutions for Global Knowledge-based Economy and Convergence Process in the European Union

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Abstract

The use of the potential of economic convergence is one of the key challenges of economic policy in the case of the European Union. Due to structural changes that have led to the growing role of knowledge-based economy (KBE), the analysis made in the paper is based on the assumption that the convergence process of the EU countries takes place in the reality of the KBE, thus in order to facilitate it, all the EU members should concentrate on building institutions that are adequate to the conditions of the KBE. In this context, the aim of the study is to verify the potential impact of the quality of institutional system of the EU countries on the convergence process. In this regard, the analytical framework of conditional β-convergence was used with econometric dynamic panel modeling. To measure the quality of institutional system the authors proposed an indicator, designed with TOPSIS method. For this purpose the data were obtained from the Fraser Institute database. Dynamic panel econometric analysis carried out for the European Union countries in the years 2004–2010 confirms that the high quality and adequacy of the institutional system to the conditions of the KBE supports convergence process in the EU.

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1. Introduction

The last two decades were a period of great political and economic change. In this regard the emergence of the concept of knowledge-based economy (KBE) is usually pointed out as one of the most important factors from the perspective of structural evolution of global economy (see OECD 1996; OECD 1999). It has significantly influenced all developed economies both at micro and macro level (see Ciborowski 2014, 57−72; Lechman 2014, 79−106; Balcerzak and Rogalska 2008, 71−87; Balcerzak 2009a, 279−290; 2009b, 95−105). The main characteristics of the KBE is an indication on new main determinants of economic growth in developed economies in comparison to the once typical for industrial economy (Madrak-Grochowska 2015). Traditionally, the processes of growth were mostly determined by economies of scale with constant returns and the ability to invest in physical capital (Tokarski 1998, 271−291; 2001a, 213−245). However, in developed economies for the last twenty years these factors can only be considered as a necessary condition for maintaining growth. The abundance of traditional factors of production is not any more a sufficient condition for keeping high growth rate, which could be seen in empirical research (OECD 1996, Piątkowski and Bart van Ark 2007, 3−26; Witkowski 2007, 43−60) and has significantly influenced the theory of growth (Welfe 2007, Tokarski 1996, 581−604; 2001b, 213−245).

The experience of developed countries for the last two decades has proved that the ability to use so-called knowledge capital is the necessary condition to maintain high rate of growth. This ability both at micro and macro level strongly depends on effectiveness of regulations and other factors influencing quality of institutions. The institutions' influence the speed of diffusion of new technologies and new ideas in the sphere of organization, production and creation of products, which in the dynamic market process using the Schumpeterian semantics (see Śledzik 2014, 67−77), affects the speed and macroeconomic effectiveness of creative destruction (OECD 2001; Bassanini, Scarpetta and Visco 2000; Balcerzak 2009c, 71−106; 2009d, 711−739). Thus, the aim of the study is to verify the potential impact of the quality of the institutional system for the KBE in the European Union countries on the process of convergence in the years 2004−2010.

The research concerning the determinants of productivity growth in developed countries that have been done for the last two decades pointed to the growing role of institutional factors influencing entrepreneurship and the competitive pressure in a given economy. These factors determine the number of enterprises that are able to achieve technological and organizational breakthroughs, which due to some spillover effects can result in higher total factor productivity growth (Bassanini, Scarpetta and Hemmings 2001; OECD 2000; DeLong and Summers 2001, 29–59). Thus, based on the empirical research for developed countries and institutional transaction cost theory (Williamson 1985; North 1994; Mokyr 2001,9−14;

Devine 1983, 347−372), it is possible to indicate four aspects of national institutional systems that in the case of the KBE can especially influence rate of productivity changes:

1) the effectiveness of regulations aimed at supporting entrepreneurship − a high level of entrepreneurship positively influences supply of new enterprises with high growth potential (see McKinsey Global Institute 2001),
2) the effectiveness of juridical system in keeping low level of transaction costs and supporting effectiveness of market mechanism – the elimination of barriers to structural changes and the diffusion of new technologies or organizational changes are all necessary condition for raising the rate of productivity growth (see McKinsey Global Institute 2002a),
3) competitive pressure and effectiveness of labour markets − a high level of competitive pressure is conducive to the phenomenon of Schumpeterian creative destruction and increases the rate of diffusion of the most effective technological solutions (see McKinsey Global Institute 2002b),
4) financial market institutions as a stimulator of development of enterprises with high growth potential − developed and relatively efficient financial markets are conducive to faster reallocation of capital from industries with low growth potential into new sectors with high development potential (OECD 2001; Balcerzak 2009e, 30−39).

Referring to the World Bank concept of pillars of the KBE these four institutional segments can be treated as the incentive pillar of the KBE (see Chen and Dahlman 2005, 2004, Madrak-Grochowska 2015).

The additional argumentation for selection of the above mentioned segments of national institutional system in the context of utilizing the potential of KBE is presented in Balcerzak and Pietrzak (2015a; 2015b; 2014) and Balcerzak (2015, 51−63).

Based on the above mentioned arguments it is obvious that the quality of institutions for KBE is a multidimensional phenomenon (see also Olczyk 2014, 21−43; Kuc 2012a, 5−23, 2012b, 5−19, Balcerzak 2011, 456−466). As a result in order to measure it TOPSIS method is applied. Based on the method it is possible to obtain the measure of development describing every aspect of the studied phenomenon by estimating its proximity to the positive ideal solution (for example maximum value of the variable) and its distance from negative ideal solution (for example minimum value of the variable). The final value of the aggregate measure is calculated as the arithmetic mean of the indicators obtained for all aspects under consideration. The formal presentation of the TOPSIS method applied in the research is available in Balcerzak and Pietrzak (2014; 2015c, 71−91).

The empirical research was done for the years 2004−2010. The short period of the analysis should be treated as a significant weakness of the research. However,

in spite of this fact the year 2004 was chosen deliberately, as it is the year of the biggest enlargement of European Union, which can be treated as one of the most important institutional changes in Europe. The year 2010 was the last year with data available for all four institutional segments. The analysis of quality of institutions for the KBE was done for 24 EU countries. Due to unavailability of data for Luxemburg, Malta and Cyprus they were excluded from the research. Croatia was also excluded from the analysis as it joined EU only in 2013. In order to utilize the comparable data on difficult to measure institutional factors, which is additionally is prepared with a uniform methodology, the data from Fraser Institute database created for the Economic Freedom of the World reports were utilized. A set of potential variables describing four institutional segments, influencing the economy's ability to utilize potential of the KBE, is presented in Table 1.

Table 1. The potential variables concerning quality of institutions from the perspective of KBE potential used for TOPSIS analysis

Y_1 – formal regulations influencing entrepreneurship
X_1^1 – Administrative requirements for entrepreneurs
X_2^1 – Bureaucracy costs for entrepreneurs
X_3^1 – The cost of starting a business
X_4^1 – Extra payments/bribes/favouritism
X_5^1 – Licensing restrictions
Y_2 – effectiveness of juridical system in keeping low level of transaction costs and supporting effectiveness of market mechanism
X_1^2 – Tax compliance
X_2^2 – Judicial independence
X_3^2 – Impartial courts
X_4^2 – Protection of property rights
X_5^2 – Integrity of the legal system
X_6^2 – Legal enforcement of contracts
X_7^2 – Regulatory restrictions on the sale of real property
Y_3 – competitive pressure and effectiveness of labour markets
X_1^3 – Revenue from trade taxes (% of trade sector)
X_2^3 – Mean tariff rate
X_3^3 – Standard deviation of tariff rates
X_4^3 – Non-tariff trade barriers
X_5^3 – Compliance costs of importing and exporting
X_6^3 – Regulatory trade barriers
X_7^3 – Foreign ownership/investment restrictions
X_8^3 – Capital controls
X_9^3 – Controls of the movement of capital and people
X_{10}^3 – Hiring regulations and minimum wage
X_{11}^3 – Hiring and firing regulations

X_{12}^3 – Centralized collective bargaining
X_{13}^3 – Hours Regulations
X_{14}^3 – Mandated cost of worker dismissal
Y_4 – financial markets institutions as a stimulator of development of enterprises with high growth potential
X_1^4 – Ownership of banks
X_2^4 – Private sector credit
X_3^4 – Interest rate controls/negative real interest rates

Source: own work.

Based on the information quality criteria for potential diagnostic variables that should be implemented in multivariate analysis, relating to the minimum level of accepted variation (it was assumed that coefficient of variation in the case of potential variables should at least should fulfill criterion V>0.2), the potential variables: X_5^1, X_1^2, X_6^2, X_7^2, X_1^3, X_2^3, X_{13}^3, X_{14}^3, X_3^4 were eliminated. At the next stage the remaining diagnostic variables were normalized with classic standardization formula. Then a positive and negative ideal solution with maximum and minimum values respectively for all variables in the years 2004−2010 were set. Thus, a constant positive and negative ideal solutions for the analyzed years were set (see more Balcerzak, Pietrzak 2014). This is a condition for obtaining the time series that can be considered as an input data for future econometric research. Finally, with the application of the Euclidean metric a distance from positive to negative ideal solution for each of the four aspects was estimated. This enabled the calculation of partial taxonomic measures of development for the aspects. In the end, the value of an aggregate taxonomic measure of development (TMD) for all the four aspects altogether was evaluated. It was an arithmetic average based on the four previously calculated partial measures. The results are presented in Table 2. The data for replication of the described procedure is available in Balcerzak and Pietrzak (2014).

Table 2. The values of taxonomic measure of development for quality of institutions for the KBE in the year 2004 and 2010

2004		2010	
Country	**TMD**	**Country**	**TMD**
Denmark	0,846	Denmark	0,874
Finland	0,828	Finland	0,827
Netherlands	0,755	Sweden	0,799
Sweden	0,741	Netherlands	0,783
Ireland	0,740	United Kingdom	0,752
United Kingdom	0,737	Ireland	0,752
Austria	0,694	Estonia	0,653

2004		2010	
Country	**TMD**	**Country**	**TMD**
Belgium	0,625	France	0,645
France	0,604	Belgium	0,644
Germany	0,596	Austria	0,633
Estonia	0,594	Germany	0,615
Spain	0,543	Spain	0,543
Slovakia	0,542	Slovenia	0,517
Lithuania	0,500	Slovakia	0,515
Czech Republic	0,491	Lithuania	0,506
Hungary	0,482	Latvia	0,499
Portugal	0,482	Czech Republic	0,493
Latvia	0,477	Hungary	0,480
Slovenia	0,476	Portugal	0,469
Italy	0,448	Italy	0,452
Bulgaria	0,396	Bulgaria	0,429
Greece	0,382	Poland	0,426
Poland	0,378	Greece	0,384
Romania	0,353	Romania	0,377

Source: own estimation based on data from Fraser Institute.

2. Econometric analysis with the application of β-convergence framework

The aim of the article is to verify the potential impact of the quality of institutions in the context of the KBE in the European Union countries on the process of convergence. As a result the parameters of the dynamic panel models for the period 2004−2010 were estimated, which enabled identification of *β-convergence* process (Próchiak and Witkowski 2012, 25−58; 2013, 6−26; Lechman 2012, 95−109; Pietrzak 2012, 167−185).

The β-convergence process takes place when in a given group of countries in an analyzed period a common level of income per capita is reached within the long term steady state. In the first stage the unconditional β-convergence process in the EU countries was verified. The hypothesis of unconditional β-convergence is tested by estimating parameters of dynamic panel model given with the equation 2 (Baltagi 1995, 135−155).

$$\ln(\mathbf{Y}_{it} / \mathbf{Y}_{it-1}) = \beta_0 - \beta_1 \ln \mathbf{Y}_{it-1} + \boldsymbol{\eta}_i + \boldsymbol{\varepsilon}_{it} \quad (1),$$

$$\ln \mathbf{Y}_{it} = \beta_0 + \gamma \ln \mathbf{Y}_{it-1} + \boldsymbol{\eta}_i + \boldsymbol{\varepsilon}_{it} \quad (2),$$

$$\gamma = (1 - \beta_1) \quad (3),$$

Where: Y_{it} is the vector of GDP per capita in purchasing power standards, β_0, β_1, γ are the structural parameters of the model, η_i is the vector of individual effects of a panel model, ε_{it} is the vector of disturbances. All the variables are determined for i-country in the period t.

In the literature the analysis of convergence is significantly enriched with the concept of conditional *β*-convergence. In that case it is assumed that every country tends to reach his own steady state, which means that the level of income in the steady state for every economy is determined by some fundamental macroeconomic conditions (Mankiw, Romer and Weil 1992, 407−437; Levine and Renelt 1992, 942−963). This means that conditional *β*-convergence is only possible provided that the countries are similar in terms of economic variables that determine the output in the steady state. The hypothesis of conditional *β*-convergence is tested by estimating parameters of dynamic panel model given with the equation 4. In that case, again, the dependent variable was GDP per capita in purchasing power standards. The independent variable is the measure of quality of institutions for the KBE that was obtained as a result of procedure presented in previous section. The quality of institutions for the KBE is treated here as the fundamental macroeconomic factor influencing the development of the European economies. In order to confirm the positive influence of the quality of institutions on convergence process the parameter α_1 should be positive and statistically significant.

$$\ln \mathbf{Y}_{it} = \beta_0 + \gamma \ln \mathbf{Y}_{it-1} + \alpha_1 \mathbf{X}_{1,it} + \boldsymbol{\eta}_i + \boldsymbol{\varepsilon}_{it} \quad (4),$$

$$\gamma = (1 - \beta_1) \quad (5),$$

Where: $\mathbf{Y}_{it}$ is the vector of GDP per capita in purchasing power standards, β_0, β_1, α_1, γ are the structural parameters of the model, η_i is the vector of individual effects of a panel model, ε_{it} is the vector of disturbances. All the variables are determined for i-country in the period t, variable X_1 is the potential variable determining the output in the steady state, here it is TMD of quality of institutions for the KBE. All the variables are determined for i-country in the period t.

In the case of both estimated equations obtaining the statistically significant value of parameter γ fulfilling the condition $\gamma < 1$, which means that the value of parameter β_1 is positive, which positively verifies the hypothesis of unconditional and conditional *β*-convergence for the analyzed countries. The lower the value of γ, the higher positive value of parameter β_1, and the faster the process of convergence. As

a result the value of parameter γ enables estimation of the average annual speed of convergence and the time that is needed for reaching the half of the distance between the starting level of output and the output in the steady state (Barro and Sala-i-Martin 1995). The average speed of convergence is described with the equation 6.

$$b = -\ln(\gamma)/T\,, \tag{6}$$

and the time that is needed for reaching the half way between the average starting level of GDP and the GDP in the steady state is given with equation (7):

$$\tau = -\ln(2)/\ln(\gamma). \tag{7}$$

The convergence models are the examples of dynamic models, as a result of estimating the parameters of the models 2 and 4. The system GMM generalized method of moments estimator was applied (Blundell and Bond 1998, 321−340), which is a development of first-difference GMM estimator (Holtz-Eakin, Newey and Rosen 1988, 1371−1395; Arellano and Bond 1991, 277−297; Ahn and Schmidt 1995, 5–27). The idea of system GMM estimator is a process of estimating of both equations in first differences and equations in levels. The results of two-step estimation with asymptotic standard errors for unconditional *β*-convergence and conditional *β*-convergence are presented respectively in the table 3 and 4. The calculations were made with the application of the GRETL software (version 1.9.7).

Table 3. The estimated unconditional *β*-convergence model for the EU countries in the years 2004−2010

Parameter	Parameter estimate	P-value
γ	0,80	≈0.000
Statistical test		
Sargan Test	23,8	0,20
AR (1)	-3,15	0,0016
AR (2)	-2,62	0,0089

Source: own estimation based on Eurostat data.

Table 4. The estimated conditional *β*-convergence model for the EU countries in the years 2004−2010

Parameter	Parameter estimate	P-value
γ	0,77	≈0.000
α_1	0,42	≈0.000
Statistical test		
Sargan Test	22,7	0,28
AR (1)	-2,86	0,004
AR (2)	-2,63	0,008

Source: own estimation based on Eurostat data.

The Sargant test enables testing of over-identifying restrictions (Blundell, Bond and Windmeijer 2000, 53−91). In the case of both models the obtained statistics of the test are equal to 23.8 and 22.7, thus the null hypothesis that the over-identifying restrictions should be included cannot be rejected.

In the case of both models the serial autocorrelation was tested. For both models the first-order serial correlation was negative and statistically significant. The second-order serial correlation was statically significant too.

The statistic of the test for first-order serial correlation equals -3.15 (model 1) and -2.86 (model 2) – one rejects the null hypothesis that there is no first-order serial correlation in both cases. The statistic of the test for second-order serial correlation equals -2.62 (model 1) and -2.63 (model 2) – hence the null hypothesis of no second-order serial correlation in both models should be rejected (Baltagi 1995, 158). There is a statistically significant negative serial autocorrelation; the conditions for consistent and efficient GMM estimator are not fulfilled. As it has been already pointed out, the main reason for this situation can be attributed to relatively short period of the analysis (see Balcerzak, Pietrzak and Rogalska 2014, 389−407).

In the case of both models parameters γ are statistically significant and lower than 1, which enables us to estimate the value of parameter β_1 at the level 0.20 for the unconditional β-convergence and 0.23 for conditional β-convergence. Thus in both cases the hypothesis of β-convergence is verified.

The average annual speed of convergence equals 22% of the distance (model 1) and 26% (model 2) of the distance provided similar level of quality of institutions. It means that the time needed for reaching the half way between average starting output and the output in the steady state is 3.10 years for the first model and 2.65 years for the second model. These values additionally confirm that the period of the analysis is relatively short, it can be expected that in the case of longer period of the analysis this speed would be lower.

In the case of conditional β-convergence model the parameter α_1 is statistically significant. It means that variable X_1 significantly determine the convergence process for analyzed EU countries. The positive estimate of the parameter α_1 suggests positive influence of quality of institutions in the context of the KBE on convergence process. Additionally, when one compares the speed of unconditional and conditional β-convergence, it can be seen that the quality of institutions for the KBE can increase the convergence speed. However, it must be remembered that the estimated speed of convergence for model 2 is only conditional. It means that only with provided the unified quality of institutions for KBE for all the analyzed countries, it is possible to obtain the estimated speed of convergence process.

3. Conclusions

The research conducted in the article was based on the assumption that the European countries aiming at reducing their development gap must improve quality of their institutions. Then in the case of relatively developed economies of the European Union the condition for achieving high quality of institutions is their adequacy to the KBE. As a result the aim of the analysis was to verify the potential impact of the quality of institutional system for the KBE in the European Union countries on the process of convergence.

Dynamic panel econometric analysis carried out in the years 2004−2010 confirms that the quality and adequacy of the institutional system to the conditions of the KBE support convergence process in case of the European economies.

The analysis of quality of institutions was based on the institutional perspective, precisely speaking the transaction cost theory framework. As a result, from the methodological point of view, it can be seen that the qualitative approach of New Institutional Economics and quantitative perspective of mainstream economics should be treated as complementary.

From the perspective of policy supporting cohesion and stability of the European economies, thus forming the guidelines for regulatory changes, it can be said that the reforms adjusting formal institutions to the conditions of the KBE should be treated as a priority. This is especially important in the case of new member states of the EU that on average, with the exception of Estonia, are characterized by relatively low quality of institutions for the KBE. The institutional reforms should lead to reducing the transaction costs for enterprises able to implement technological and organizational changes, which in the process of Schumpeterian creative destruction can result in higher total factor productivity. The improvement of quality of institutions for KBE can help to increase the speed of convergence process in Europe, and thus to improve the global competitiveness of European economy as a whole.

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