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Regulations and economic growth: some empirical evidence based on the Bayesian model pooling[1]

Summary

The paper aims to assess the impact of regulations (measured by the Heritage Foundation index of economic freedom) on economic growth. The method of the analysis is based on growth regressions where economic freedom is included in the set of explanatory variables, along with some other control factors. The dependent variable is GDP per capita growth rate. In order to be robust to the selection of explanatory variables, the paper uses Bayesian model pooling applied to Blundell and Bond's GMM system estimator. Another innovative aspects are: the use of 'moving' panel data in which subsequent observations cover observations from partly overlapping periods as well as the inclusion of nonlinearities. The results show that the level of and the change in economic freedom both reveal a positive and nonlinear relationship with economic growth. A given increase in economic freedom has a greater impact on economic growth in those countries that are economically not (or partly) free.

Keywords: economic freedom, economic growth, Bayesian averaging, institutions, regulations

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1. Introduction

There have been numerous studies in macroeconomics whose target was to determine the impact of the regulatory framework on economic growth. The most recent empirical studies include e.g.: Pääkkönen[2], Williamson and Mathers[3], Goczek[4], Peev and Mueller[5]. The authors apply different sets of control variables, different subsamples, different lags or nonlinearities to check the robustness of the results. However, although the theoretical structural model and most of the empirical studies both indicate that economic freedom contributes to economic growth, some questions are not solved yet. Namely, whether the relationship is linear or nonlinear; what is the impact of the individual component indicators on economic growth (some areas of economic freedom may have stronger impact than another ones); or what is the strength of the impact (by how much economic growth accelerates due to more economic freedom)?

This study tries to solve some of these problems by using econometric methodology which is the main value added of the analysis. The paper is composed of six sections. Section 2, that appears after introduction, presents some empirical evidence on the relationship between economic freedom and economic growth. Sections 3 and 4 show the methodology and the data used. The results of the analysis are presented and discussed in section 5. Section 6 concludes.

2. Economic freedom and economic growth: empirical evidence

Economic freedom gives stimulus to the development of private sector, which is a very important determinant of a favorable business climate and affects the well-being of the society and economic efficiency. According to one of the existing definitions, the following four issues constitute the basis of economic

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[2] J. Pääkkönen, *Economic Freedom as Driver of Growth in Transition*, "Economic Systems" 2010, vol. 34, pp. 469–479.

[3] C.R. Williamson, R.L. Mathers, *Economic Freedom, Culture, and Growth*, "Public Choice" 2011, vol. 148, pp. 313–335.

[4] Ł. Goczek, *Analiza empiryczna regulacji gospodarki w kontekście innowacyjności i produktywności*, in: *Innowacje i implikacje interdyscyplinarne*, ed. Z. Zieliński, Kielce 2011, pp. 324–333.

[5] E. Peev, D.C. Mueller, *Democracy, Economic Freedom and Growth in Transition Economies*, "Kyklos" 2012, vol. 65, pp. 371–407.

freedom: (a) personal choice, (b) voluntary exchange coordinated by markets, (c) freedom to enter and compete in markets, (d) protection of persons and their property from aggression by others. Economic freedom cannot be described by a simple quantitative variable. To assess it, indicators published by specialized international organizations are used. The most popular and well-known indices of economic freedom are compiled by Heritage Foundation and Fraser Institute.

There are many studies that analyze the relationship between economic freedom and economic growth. De Haan et al.[6] show probably the widest review of empirical studies on the relationship between economic freedom and economic growth, describing in details more than 30 empirical studies published between 1994 and 2005. According to the authors, a number of recent studies suggest that economic freedom is important in explaining differences in economic performance, however most studies have serious drawbacks, including lacking sensitivity analysis and poor specifications of the growth model.

Pääkkönen[7] uses data for 25 transition economies during 1998–2005 to test the hypothesis that better institutions, measured in terms of economic freedom, contribute to growth. The author finds that as long as there are insufficient institutions or private capital, improvements in institutions and investment tend to boost productivity growth, government consumption has a negative impact on growth; and that growth researchers should test for the presence of nonlinearities which are present in the growth model in terms of interactions. The latter finding is a justification for the nonlinear approach.

Bergh and Karlsson[8] examine the relationship between government size and economic growth, controlling for economic freedom and globalization. The study covers 29 OECD countries and the 1970–1995 or 1970–2005 periods. The models are based on panel data in the form of 5-year intervals. Unexpectedly, the results for 1970–1995 show that the idea that economic freedom matters has little support. However, for a longer period of 1970–2005, the results change: the freedom to trade is robustly related to growth in one specification of the model.

The above mentioned papers are just a fraction of what can be found in the literature but even just this short review shows that different authors come to extremely different conclusions. However, there might be doubts about the

6 J. De Haan, S. Lundström, J.-E. Sturm, *Market-Oriented Institutions and Policies and Economic Growth: A Critical Survey*, "Journal of Economic Surveys" 2006, vol. 20, pp. 157–191.

7 J. Pääkkönen, op.cit.

8 A. Bergh, M. Karlsson, *Government Size and Growth: Accounting for Economic Freedom and Globalization*, "Public Choice" 2010, vol. 142, pp. 195–213.

robustness of the discussed analysis. That is why in this paper an approach which improves on the usually applied techniques is discussed.

3. Econometric methodology

Most contemporary economic growth studies are based on panel data. Both fixed effects (FE) and random effects estimators used in older studies are inconsistent while applied to autoregressive models (unless the length of the series is huge which improves on this FE estimator property). Instead one can use a selected dynamic estimator based on instrumental variables or the generalized method of moments (GMM). Out of a variety of GMM-based dynamic estimators for panel data, probably the system GMM estimator proposed by Blundell and Bond[9] is the most popular thanks to its good statistical properties and it is applied in this paper. The use of GMM also allows the regressors to be treated as endogeneous and instrumented adequately with the use of lags, which further reduces the risk of inconsistency. However, GMM is a typical large sample method: the positive properties of the above mentioned estimators would not essentially hold if the model was estimated with the use of just a few observations. This is an issue in growth models: on the one hand one would be interested in minimizing the length of a single observation and making it a month or a year in order to maximize the number of observations, which is required to maintain positive properties of GMM estimators. However, this way of proceeding is incorrect in case of typically long-horizon phenomena such as economic growth. Finding a compromise is truly difficult to attain especially when one considers a limited sample of countries (e.g. EU27 countries). Goczek[10] presents a review of the methods used in empirical growth research.

Finally there is a problem of model specification which basically covers two issues: what is the proper functional form of the growth model and which variables should be included in it. As far as the functional form is concerned, most authors in empirical research make use of the so called Barro regression at least as the starting point due to its relative simplicity and, first of all, economic

[9] R. Blundell, S. Bond, *Initial Conditions and Moment Restrictions in Dynamic Panel Data Models*, "Journal of Econometrics" 1998, vol. 87, pp. 115–143.

[10] Ł. Goczek, *Przegląd i ocena ekonometrycznych metod używanych w modelach empirycznych wzrostu gospodarczego*, "Gospodarka Narodowa" 2012, t. 10, s. 49–73.

motivation[11]. However, in case of at least some of the potential regressors it is not clear whether their influence on the rate of growth should be linear (or even monotonous). Since the complexity of the right hand side of the model yields the risk of finding a spurious relation and spoils the properties of GMM in result of lowering the number of degrees of freedom, it is vital to limit the process of expanding the functional form by including extra variables by considering only the truly likely to be relevant ones and avoiding unnecessary higher order degree polynomials and interactions.

The second issue related with model specification is the set of independent variables. There hardly exist sets of papers with the same sets of independent variables in growth models. Just as it is in the case of excessive interactions of higher order polynomials, it would not be a proper solution to experimentally consider all the possible growth factors that the data allow for. However, skipping relevant growth factors is likely to cause the omitted variables bias. Bayesian model averaging (BMA) proves to be powerful tool here, though in the case of higher number of considered regressors the procedure is highly time consuming even despite availability of modern numerical methods (Bernardelli proposes an example of fast and efficient algorithm of estimation of linear models[12]). It has been popularized in the context of growth regression by Sala-i-Martin, Doppelhofer and Miller[13] (SDM hereafter) who applied a simple version of BMA called Bayesian averaging of classical estimates (BACE). In this paper BMA is applied to Blundell and Bond's system GMM estimator and it is Kim[14] who has shown a way to properly approximate the posterior probability. The interested reader might refer to one of the papers incorporating this technique, such as

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[11] See e.g. R.J. Barro, X. Sala-i-Martin, *Economic Growth*, The MIT Press, Cambridge–London 2003.

[12] M. Bernardelli, *Metoda szybkiej aktualizacji dekompozycji QR dla modeli liniowej regresji*, "Roczniki" Kolegium Analiz Ekonomicznych SGH, issue 27, Oficyna Wydawnicza SGH, Warszawa 2012, pp. 55–68.

[13] X. Sala-i-Martin, G. Doppelhofer, R. Miller, *Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach*, "American Economic Review" 2004, vol. 94, pp. 813–835.

[14] J.-Y. Kim, *Limited Information Likelihood and Bayesian Analysis*, "Journal of Econometrics" 2002, vol. 107, pp. 175–193.

Próchniak and Witkowski[15] or Moral-Benito[16], limiting the attention just to the papers devoted to economic growth.

The approach incorporated in this paper makes use of the techniques mentioned above so as to solve the discussed problems and expands on them in the following way. The classical Barro regression is firstly written in the context of panel data:

$$\Delta lnGDP_{it} = \beta_0 + \beta_1 lnGDP_{i,t-1} + x'_{it}\,\beta + \alpha_i + \varepsilon_{it}\,, \tag{1}$$

where $\Delta \ln GDP_{it}$ is the change of log GDP for i-th country over t-th period, β_0 is the constant, $\Delta \ln GDP_{i,t-1}$ is the one period lagged log GDP, x_{it} is a vector of the considered growth factors for i-th country over t-th period, α_i is the individual effect of the i-th country and ε_{it} is the error term. The dynamics of (1) requires it to be transformed to:

$$lnGDP_{it} = \beta_0 + (\beta_1 + 1) lnGDP_{i,t-1} + x'_{it}\,\beta + \alpha_i + \varepsilon_{it}\,, \tag{2}$$

which is then estimated with the above discussed technique. The vector x_{it} for each model contains a set of considered variables, including the institutional environment measures.

As it has been mentioned, it is vital to divide time series into relatively long subperiods since observing and explaining growth dynamics on the basis of e.g. annual observations is not economically sound. Depending on the authors, length of a single period in the applied research is usually designed to be a few years long (although papers where both shorter and longer periods are used are not uncommon either), ideally it might be expected to be between 5 and 10 years. The obvious consequence of such design of the data set is that due to the length of a single observation there are going to be very few observations per country if "traditional" methods are applied. We propose the following algorithm. Let the length of a single period be 5 years. Let t stand for the number of the year. Thus the first period in most research would cover observation from years $t = 1$ upto $t = 5$, then it would be followed by observation based on years $t = 6$ upto $t = 10$ and so on. Depending on the character of the variables and the complete-

[15] M. Próchniak, B. Witkowski, *Bayesian Model Averaging in Modelling GDP Convergence with the Use of Panel Data*, "Roczniki" Kolegium Analiz Ekonomicznych SGH, issue 26, Oficyna Wydawnicza SGH, Warszawa 2012, pp. 45–60.

[16] E. Moral-Benito, *Model Averaging in Economics*, "Bank of Spain Working Paper", no. 1123, Madrid 2011.

ness of the data set, an observation on a selected variable z for a single period would either be evaluated as a mean z from the years covered by the period of interest, the value of z for the last (or possibly first) observation or eventually the difference between the value of z in the first and the last year covered by the period of interest. However in order to increase the number of observations without shortening the length of a single one, we propose the use of overlapping observations. Still assuming that the length of a single period in the data is 5 years, that would mean using observations from years $t = 1$ upto $t = 5$ for the first period, however from years $t=2$ upto $t=6$ for the second period, from years $t = 3$ upto $t = 7$ for the third period, etc. More generally, assuming that the length of a single period is s years, an observation from period τ is based on the data from years τ upto $\tau + s - 1$.

At first this might seem like artificially created redundant observations which only seem to constitute long time series, but in reality contain each piece of information s times. That, however, is not true. It can be easily noticed in formula (1) that the dependent variable in the initial form of the model as well as in (2) that the dependent variable in the finally estimated version of the model for each observation is different. The value of GDP for the i-th country in year t is used to create exactly two observations: once as a starting one ("old", "former") and once as "current" GDP, just as it is in the case of panel based on non-overlapping observations. Thus the proposed procedure does not lower the relative variance of the dependent variable by construction and does not lead to inefficiency. We believe that this way we make the most efficient use of the available data.

4. Data

The Heritage Foundation[17] index of economic freedom is an arithmetic average of the 10 category indices: business freedom, trade freedom, fiscal freedom, government spending, monetary freedom, investment freedom, financial freedom, property rights, freedom from corruption, and labor freedom. All the indicators range between 0 and 100. Higher value is the desirable outcome because it represents a greater scope of economic freedom.

[17] Heritage Foundation, *Index of Economic Freedom*, 2013, http://www.heritage. org/index/.

The four models (in the BMA sense) reveal different specifications of how the Heritage Foundation index of economic freedom is included. Model 1 includes the level of the overall index of economic freedom while model 3 encompasses its changes referring to the year $t-5$. Models 2 and 4 are the same as 1 and 3 respectively, however the data used come from the EU countries only.

The analysis is based on panel data transformed into five-year intervals as described in the previous section. Model 1 covers 134 countries and the 1992–2012 period (meaning that the first observation covers the change in GDP between 1992 and 1997) while model 2 covers 27 EU countries over the same period. Models 3 and 4 encompass the 1995–2012 period. The study is based on a partly balanced panel. This means that if a given observation is included, there are no missing values of any of the explanatory variables. But the panel is not fully balanced and the number of observations differs for the individual countries. For example, model 1 is based on 1856 observations (about 14 on average per country) while model 2 is based on 408 observations (about 15 per country). Control variables are taken as averages for the years covered by a given observation (some interpolations were carried out if necessary).

Economic growth is measured by GDP per capita at purchasing power parity (PPP) in constant prices and it is calculated as follows: e.g. for the 1998–2012 subperiod it is the difference between the log GDP per capita levels in 1997 and 2012. The selection of control variables is in line with empirical studies: 16 control variables (not including economic freedom) are tested as growth factors. Those are: lagged log GDP per capita at PPP (2005 constant prices) – *lngdp0*; government consumption expenditure (% of GDP) – *gov_cons*; investment (% of GDP) – *inv*; openness ((exports + imports) / GDP) – *open*; average years of total schooling (population ages 15+) – *school_tot*; percentage of population (ages 15+) with completed tertiary education – *school_ter*; education expenditure (% of GNI) – *edu_exp*; net FDI inflow (% of GDP) – *fdi*; annual change (in % points) of the domestic credit provided by banking sector in % of GDP – *cred*; inflation (annual %) – *inf*; log of life expectancy at birth (years) – *life*; log of fertility rate (births per woman) – *fert*; population ages 15–64 (% of total) – *pop_15_64*; log of population density (people per sq. km of land area) – *pop_den*; population growth (annual %) – *pop_gr* and log of population – *pop_tot*.

All the models include the overall Heritage Foundation index of economic freedom (its level or its change). Since nonlinearities are tested in this study, all the indices of economic freedom are included in the regression in a nonlinear form represented by a quadratic function. Since it is believed that there does exist the beta-convergence, initial GDP per capita also appears in each estimated equation. The variables are taken from Penn World Table[18], World Bank[19], and IMF[20]. Life expectancy, fertility rate and all the population variables are treated as exogenous. All the remaining variables are assumed to be endogenous which reflects our own opinion but it is also in line with the other empirical studies.

5. Results

The results of the analysis are shown in Table 1 and Figures 1 and 2. Table 1 presents estimated coefficients obtained with the use of BMA approach along with pseudo *t*-statistics for the four model specifications. Figures 1 and 2 plot the nonlinear relationship between the level of or the change in economic freedom and economic growth using the estimated coefficients given in Table 1 (the estimates for EF and EF^2 are used in Figure 1 while those for ΔEF and $(\Delta EF)^2$ – in Figure 2). The range of arguments on the horizontal axis refers to the observable range of values of a given variable in a given sample of countries; however, to eliminate the interpretation which would refer to non-existing (or hardly ever existing) values of EF and ΔEF the axes are further constrained to range between the 5th and 95th percentiles in the empirical distribution of EF and ΔEF.

Table 1. Estimation results

regressor	model 1		model 2		model 3		model 4	
	beta	pseudo *t*	beta	pseudo *t*	beta	pseudo *t*	beta	pseudo *t*
EF	0.0286	8.37	0.0718	14.36	–	–	–	–
$(EF)^2$	–0.0002	–5.69	–0.0005	–12.69	–	–	–	–
ΔEF	–	–	–	–	0.0025	7.85	0.0063	6.94
$(\Delta EF)^2$	–	–	–	–	–0.0003	–6.55	–0.0003	–3.01
lngdp0	0.8281	117.21	0.7734	80.40	0.8225	146.16	0.7070	55.74
gov_cons	–0.0031	–3.68	–0.0233	–10.93	–0.0103	–10.96	–0.0235	–9.19
inv	0.0045	14.45	0.0187	31.98	0.0034	8.59	0.0157	20.40

[18] A. Heston, R. Summers, B. Aten, *Penn World Table Version 7.1*, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, November 2012, http://pwt.econ.upenn.edu/.

[19] World Bank, *World Development Indicators* and *Education Statistics*, 2013, http://databank.worldbank.org/data/databases.aspx.

[20] IMF, *World Economic Outlook Database*, October 2012, http://www.imf.org/.

regressor	model 1		model 2		model 3		model 4	
	beta	pseudo *t*	beta	pseudo *t*	beta	pseudo *t*	beta	pseudo *t*
open	0.0005	10.32	–0.0003	–5.54	0.0004	8.80	0.0000	–0.30
school_tot	0.0321	12.49	–0.0411	–11.10	0.0376	12.32	–0.0250	–5.81
school_ter	0.0006	1.27	–0.0073	–8.95	0.0008	1.60	–0.0064	–7.10
edu_exp	–0.0414	–20.69	0.0226	6.67	–0.0330	–15.30	0.0130	2.75
fdi	0.0041	17.46	0.0027	13.83	0.0035	15.31	0.0033	13.94
cred	0.0031	12.04	0.0059	15.49	0.0028	10.07	0.0057	12.69
inf	–0.0005	–10.21	–0.0011	–14.81	–0.0010	–25.97	–0.0013	–7.84
life	0.8036	27.77	–0.6578	–3.62	0.7296	26.41	–1.2265	–5.76
fert	–0.5024	–54.62	0.0763	4.58	–0.6441	–43.37	0.0561	2.55
pop_15_64	0.0090	19.12	–0.0134	–12.62	0.0113	25.11	–0.0288	–17.74
pop_den	–0.0314	–24.91	0.0048	2.44	–0.0254	–30.27	–0.0029	–1.30
pop_gr	0.0600	42.70	0.0890	20.27	0.0759	37.06	0.1553	22.99
pop_tot	–0.0107	–15.03	0.0123	8.75	–0.0106	–13.78	0.0110	7.09

EF – index of economic freedom. The remaining variables are defined in the text.
Source: own calculations.

According to models 1 and 2, the level of economic freedom nonlinearly contributes to economic growth as reflected by statistically significantly different from zero estimates for both samples of countries. The results for pseudo *t* statistics demonstrate that economic freedom, *ceteris paribus*, affects the pace of economic growth. However, the direction of this relationship (positive or negative) cannot be directly seen from Table 1. Hence, it is necessary to recall the range of values taken by a given variable and then to show whether a given relationship is positive or negative (or both) in the sample.

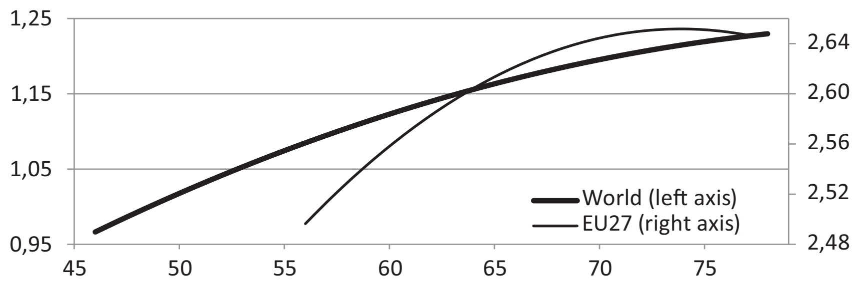

Figure 1. The impact of the level of economic freedom on economic growth
Source: own calculations.

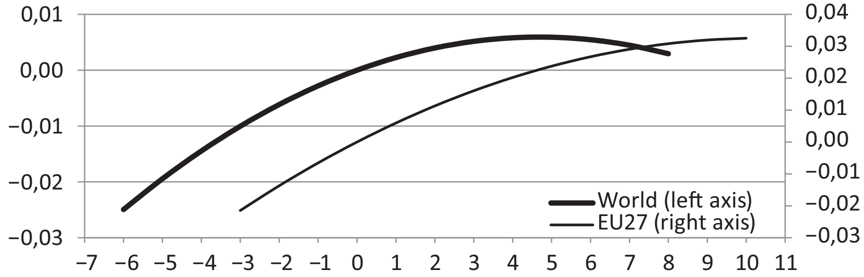

Figure 2. The impact of the change in economic freedom on economic growth

Source: own calculations.

The relationship between the level of economic freedom and economic growth is shown in Figure 1. This relationship is represented by a concave and upward sloping function (although in the case of EU27 group the function is also partly downward sloping). Thus first, the study shows that economic freedom contributes to economic growth which means that countries with greater scope of economic freedom record on average the more rapid output growth. This relationship is clearly nonlinear. The most beneficial effect on economic growth appears in the countries with low scope of economic freedom: making the country more economically free has greater benefit in terms of output acceleration if the level of economic freedom is low. Yet, for the EU27 countries it may be seen that once a certain high level of economic freedom is reached, further raises in economic freedom do not notably contribute to more rapid economic growth.

The results for models 3 and 4 where the change in the index of economic freedom is examined also point to a nonlinear and statistically significant association between changes in economic freedom and the pace of economic growth. Figure 2 demonstrates that the relationship between the change in economic freedom and economic growth is represented, as in the case of the level of economic freedom, by a concave and upward sloping function (with minor exceptions). The graph shows that even a small rise in economic freedom is sufficient to get an acceleration of economic growth since any (x,y) point in the graph represents that the expected *ceteris paribus* extra rate of growth in result of the increase in EF by x points equals y as compared to the situation when no change in EF is observed. Moreover, the higher the increase in economic freedom is, the more dynamic the acceleration of GDP growth is. However, economic growth accelerates less than proportionally: the *ceteris paribus* increase of the index of economic freedom by e.g. 2 points leads to less than twice as high acceleration of economic growth as compared with the situation when the index of economic freedom raises by 1 point.

While better institutions, regulations, and economic freedom positively affect economic growth, most beneficial effects concern those countries which have poorly developed institutions. Indeed, even a small improvement of regulatory environment in a least developed country (in terms of institutions) may have much larger positive impact on economic growth as compared with a country in which institutions are well developed. This is in line with the assumption of diminishing marginal products of inputs. That is good news for the authorities of many underdeveloped countries: rapid acceleration of economic growth may be achieved there simply by institutional reforms aiming at increasing the scope of economic freedom. This important finding could not be achieved in the model which would not account for nonlinearities. The BMA approach applied in this study implies that these results are unlikely to be a simple coincidence; oppositely, they rater show an evident regularity because they are achieved for a huge sample of countries.

Table 1 provides also some interesting information on the other economic growth determinants. All the models confirm the existence of conditional β-convergence. In the growth model applied in the study, however, the level of GDP per capita instead of its growth rate is the explained variable – in such a case the necessary condition for convergence to exist is that the estimated coefficient on initial income level be statistically significantly less than 1. Data in Table 1 suggest that this is true. For each model the estimates are less than 1, ranging from 0.7070 to 0.8281. Subtracting 1 from these values and applying some mathematics[21], yields the following β-convergence coefficients: $\beta = 3.8\%$ or 3.9% for the world and $\beta = 5.1\%$ or 6.9% for the EU27 countries. These results are in line with the other studies on convergence on the basis of Bayesian methods – for example, Próchniak and Witkowski[22] report β-convergence coefficients at the level of about 5% for the EU27 countries.

The study reveals that government expenditures on consumption do not contribute to faster economic growth – the estimated coefficients are negative and statistically significantly different than zero in each model specification. This shows that excessively strong expansionary fiscal policy focused on increasing consumption is counterproductive in terms of output acceleration (at least in the

[21] See e.g. M. Próchniak, B. Witkowski, *Time Stability of the Beta Convergence among EU Countries: Bayesian Model Averaging Perspective*, "Economic Modelling" 2013, vol. 30, pp. 323.

[22] M. Próchniak, B. Witkowski, *Bayesian Model Averaging…*, op.cit.

medium and long run). On the other hand, the analysis demonstrates highly beneficial effects of investment, including FDI, on economic growth. Both investment rate and FDI inflow are statistically significant variables in each model specification. Openness rate seems to influence economic growth across the world but inside the EU such a relationship is not confirmed. It may be explained by the fact that the EU consists of largely open economies and the marginal effect of possessing slightly higher openness rate is low from the point of view of economic growth and is rather determined by the size of the country (small economies tend to be more open). When examining the whole world, however, the openness rate reveals a positive impact on economic growth.

It is necessary to point out the negative impact of inflation and a positive impact of financial sector development on economic growth. Estimated coefficient standing for inflation turns out to be negative and statistically significant in all the four model specifications meaning that inflation hampers economic growth. When interpreting this outcome one should take into account that although high (notably, a two- or three-digit) inflation is detrimental to economic development, deflation is not a good outcome either. It is likely that if nonlinear impact of inflation on economic growth was accounted for, there would be the most favorable inflation rate from the point of view of economic growth at a specified low positive level – probably that corresponding with official inflation target of most central banks.

Among the exogenous variables referring to population and fertility (life expectancy has already been discussed), the results often are different for the whole world and the EU27. This means that demographical aspects affect differently the process of economic development in the world and in the EU. For example, the share of working age population is positively related with economic growth in the countries of the world while fertility rate exhibits a negative impact. However, for the EU27 countries the opposite tendencies were observed. This likely shows that demographical aspects such as higher share of working age population and lower fertility are much more important when the whole world is examined than in the case of only the EU.

Comparing these results with the literature, it turns out that this study reinforces findings obtained e.g. by Pääkkönen[23]. He concludes that in the case of insufficient institutions or private capital, improvements in institutions and investment tend to boost productivity growth. This is in line with our results – the countries that have insufficient institutions are those with low scope of

[23] J. Pääkkönen, op.cit.

economic freedom and in such a case improving institutions or making the country more economically free leads to higher economic growth. Our paper goes even further because it shows that economic freedom impacts economic growth in a nonlinear direct way – unlike Pääkkönen who revealed that nonlinear impact of economic freedom was realized through interactions with i.a. investment or government consumption, this paper confirms a direct nonlinear relationship. Similarly to Pääkkönen, the current research also finds that government consumption has a negative impact on GDP growth.

This paper also supplements the study conducted by Peev and Mueller[24]. They find that democracy can also have an adverse effect on economic growth, by producing larger public sectors and public deficits, which lead to higher taxes and a greater fiscal drag on the economy. From the current study it turns out that economic freedom – like democracy – may have also an adverse impact on GDP growth and the transmission channel may, but needn't, be different. For example, according to Peev and Mueller, strong democratic institutions are associated with greater economic freedoms and larger public sectors and public deficits; although stronger economic freedoms lead to more rapid economic growth, large public sectors and public deficits have adverse effects on output dynamics.

Finally, it is necessary to emphasize that the method applied in the current study corresponds to the findings obtained by Goczek[25]. He concludes that, in the case of econometric modeling, the preferable estimation method of dynamic models of economic growth for panel data is the generalized method of moments (GMM).

6. Conclusions

The results discussed in this study demonstrate that the level of and the change in economic freedom reveal a positive and nonlinear association with the rate of economic growth. The countries with greater scope of economic freedom record on average more rapid GDP growth but a given increase in economic freedom has a higher impact on economic growth in those countries that are economically not (or partly) free. Moreover, it turns out that the higher the increase of

[24] E. Peev, D.C. Mueller, op.cit.

[25] Ł. Goczek, *Przegląd i ocena ekonometrycznych…*, op.cit.

economic freedom is, the more rapid economic growth is but the acceleration of GDP growth due to the increase in economic freedom is less than proportional.

This study is an initial step to the examination of the impact of institutions on economic growth. In order to fully analyze the institutional influence, it is necessary to continue this type of analysis by using more indicators and applying new economic and econometric models.

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