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Role of public support for innovativeness: Case study of the elements of the Seventh Framework Program[2]

Summary

Public support for innovativeness, understood as a translation of innovation policies into actions, has been the subject of many studies; not all of them supporting its validity. The aim of this research is to evaluate the impact of selected elements of the Seventh Framework Program on innovativeness of the European Union. The research hypothesis states that each of the listed programs has a positive and a statistically significant impact on innovativeness within the EU. With the use of budget (panel) data serving as proxies for public innovation policy tied to each of the examined commitments, the innovation production function has been used to test the impact of the said policies on innovativeness as measured by a patent applications per capita; allowing for a 3- and a 2-year delay between the impulse and a response. The results are mixed as some of the studied areas of FP7 have a positive, some negative and some no statistically significant impact on innovation output of the European Union. It is hypothesized that the unconventional results can be explained by policy designs, e.g. a significant critical mass requirement, which are translated into recommendations for further innovation policy evaluation.

Keywords: R&D expenditure, public innovation policy, Innovation Union

JEL: O31, O38

1. Introduction

Increasing rate of technological progress has elevated the role of innovation as means of technology accumulation; therefore, making it the future chief factor of production.

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The aim of this study is to examine the role of public support for innovation by looking at the impact of the Seventh Framework Program (FP7) on innovativeness in the European Union (EU). The research hypothesis is that there is a statistically significant impact of individual FP7 programs on innovativeness in the EU.

The value added of this study is that it is the first to look at an impact of the FP7 program on a macroeconomic level, but from the perspective of individual programs, which allows to account for the heterogeneity of various policy areas. The paper also contributes to the discussion on the methods used in the evaluation of innovation-stimulating programs.

An econometric model with patent applications *per capita* as the dependent variable is used as the research tool. Data has been collected for the entire period of the duration of the project (2007–2013) for all 28 EU member countries. The model is an innovation production function with private and public expenditures on R&D and human capital (represented by share of labor force with tertiary education) as the key explanatory variables.

This text is structured as follows. First, a literature review is conducted to examine previous works' comments on the relationship between public policy towards R&D and innovation output and to find support for the empirical approach. Second, econometric procedure is described and its results are presented. Third, implications of the finding are discussed. The work ends with concluding remarks.

2. Literature review

Keeping in mind that both, R&D expenditures[3] and human capital[4] have been underlined by several researchers as determinants of innovation, these variables

[3] S. Stern, M.E. Porter, J.L. Furman, *The determinants of national innovative capacity 2000*, National Bureau of Economic Research, Working Paper Series no. 787; L. Raymond, J. St-Pierre, *R&D as a Determinant of Innovation in Manufacturing SMEs: An Attempt at Empirical Clarification*, "Technovation" 2010, vol. 30, pp. 48–56; A. Cuervo-Cazurra, C.A. Un, *Why some firms never invest in formal R&D*, "Strategic Management Journal" 2010, vol. 31, pp. 759–779; K.-F. Huang, T.-Ch. Cheng, *Determinants of Firm's Patenting or not Patenting Behaviors*, "Journal of Engineering and Technology Management" 2015, vol. 36, pp. 52–77.

[4] R.M. Mariz-Pérez, M.M. Teijeiro-Álvarez, M.T. García-Álvarez, *The Importance of Human Capital in Innovation: A System of Indicators*, "Soft Computing in Management and Business Econonomics" 2012, STUDFUZZ 287, pp. 31–44; S. Cabrilo, L.G. Nesic, S. Mitrovic,

aren't explored further in this review. Instead, the review focuses more on the empirical aspects of the examined studies.

Stern et al.[5] start their study with the theoretical model presented by Romer[6], eventually employing the national innovation capacity equation with US-granted patents with a 3-year lead being the dependent variable. Based on the obtained results, the authors conclude that public policy plays an important role as a determinant of innovation; however, (as will be shown to be the case in other studies) public support for R&D activities should go beyond focusing on R&D resource accumulation. These should include human capital investment and encouragement of innovation-based competition.

When studying the wide topic of the determinants of national innovation capacity (defined by the researchers as "the ability of a country – as both a political and economic entity – to produce and commercialize a flow of new-to-the world technologies over the long term"[7]), Furman et al.[8] show that innovation output (here, international patents with a 3-year lead) can be represented by a production function with a relatively "small but nuanced" set of determinants. Authors show that for public policy towards innovation to be effective, it needs to go beyond the simple resource support and engage in actions that stimulate growth of human capital, provide innovation incentives and quality linkages between the innovation environment and industrial clusters.

Furman and Hayes[9] – just like Hu and Mathews[10] – also use the approach presented by Furman et al.[11] with UPSTO patents as the dependent variable; however, the researchers allow for only a 2-year lead. The authors highlight the rich literature on the risks of using patents as a measure of innovation (e.g., not all inventions are or have the capacity to be patented, there is a heterogeneity of

Study on human capital gaps for effective innovation strategies in the knowledge era, "Journal of Intellectual Capital" 2014, vol. 15, pp. 411–429; W.-M. Lu, Q.L. Kweh, Ch.-L. Huang, *Intellectual Capital and National Innovation System Performance*, "Knowledge-Based Systems" 2014, vol. 71, pp. 201–210.

5 S. Stern, M.E. Porter, J.L. Furman, op.cit.

6 P. Romer, *Endogenous Technological Change*, "Journal of Political Economy" 1990, vol. 98, pp. S71-S102.

7 J.L. Furman, M.E. Porter, S. Stern, *The determinants of national innovative capacity*, "Research Policy" 2002, vol. 31, p. 900.

8 Ibidem.

9 J.L. Furman, R. Hayes, *Catching up or standing still? National innovative productivity among 'follower' countries, 1978–1999*, "Research Policy" 2004, vol. 33, pp. 1329–1354.

10 M.-C. Hu, J.A. Mathews, *China's national innovative capacity*, "Research Policy" 2008, vol. 37, pp. 1465–1479.

11 J.L. Furman, M.E. Porter, S. Stern, op.cit.

patent quality), which leads them to a conclusion that there is no ultimate (best of) measure (variable) for representing innovation in an economy. Researchers also underline such benefits of the use of the production function log-log approach as simplicity in coefficient interpretation (as elasticities) and its resilience to outliers.

Hu and Mathews[12] – using a parallel methodological approach to that of Furman et al.[13] – studying innovation capacity in East Asian countries used patents granted by UPSTO with a 3-year lead as the measure for innovation output. Researchers have used an extended production function approach by including such elements as period and country specific effects, human capital, financial R&D inputs, accumulated technology, resource commitment and policy choices, innovation environment and the quality of linkages between innovation infrastructure and the environment. Among a wide range of results, interestingly the researchers point out that for public funding of R&D activities to have an impact it needs to be targeted, i.e. the government should take a leadership role. In other words, it is not the amount of public financial support, but its allocation that plays a crucial role as well aimed initiatives can lead to innovation clusters being created by the private sector.

Sandu and Ciocanel[14] used medium and high-tech products exports as the dependent variable in their panel estimation of EU economies. In terms of the impact of public R&D expenditures, the researchers have found that the impact has a 2-year delay with a hint that for short-term results to be visible public R&D expenditures need to support immediate-profit-oriented private research.

When studying possible heterogeneity of the determinants of innovation in firms across the product life cycle, Tavassoli[15] concludes that such factors as size of the firm, human capital, engagement in the international trade network are of key importance. Based on previously analyzed work, Tavassoli's findings show that public support can influence firms' innovation propensity by a well-directed public innovation policy.

[12] M.-C. Hu, J.A. Mathews, *National innovative capacity in East Asia*, "Research Policy" 2005, vol. 34, pp. 1322–1349.

[13] J.L. Furman, M.E. Porter, S. Stern, op.cit.

[14] S. Sandu, B. Ciocanel, *Impact of R&D and innovation on high-tech exports*, "Procedia Economics and Finance" 2014, vol. 15, pp. 80–90.

[15] S. Tavassoli, *Innovation determinants over industry life cycle*, "Technological Forecasting & Social Change" 2015, vol. 91, pp. 18–32.

Baesu et al.[16], while studying innovation determinants of the high-tech sector in the EU, used a series of variables that represent public policy towards innovation or its importance in the general budget. These variables include expenditures on education (as a % of GDP and as a % of public expenditure) and government expenditure on R&D (as a % of total government expenditures). Researchers applied a fixed effects model, which allowed them to avoid the omitted variable bias and to account for the unobserved heterogeneity. Interestingly from the role of policy's impact on innovation output, when EPO and UPSTO patents were used as the dependent variable, the coefficients of the government expenditure on R&D were statistically insignificant, but significant for the model with community trademark applications as the left-hand side variable. These findings highlight the importance of the selection of the variable used to represent innovation, especially from the perspective of policy goal design.

The need for public policy to focus on human capital has also been highlighted by Bronzini and Piselli[17], Cabrilo et al.[18], while researchers like Buesa et al.[19] point to the role of public administration as specifically important in a developing innovation systems.

The first conclusion coming from the literature review is that regardless of the model used, R&D expenditure and human capital must be included as explanatory variables. The second conclusion is that, while understanding the associated limitations, patent applications are an acceptable proxy for the dependent variable. Third, there is a lag between the impulse (change in the independent variable) and a response (change in the dependent variable) and this lag generally takes the value of 3 years, but a 2-year lag should also be considered. Lastly, examined studies used a great number of explanatory variables to represent various concepts; however, keeping in mind that this study will already include 23 explanatory variables representing individual programs of the FP7 collective, a decision has been made to include only R&D expenditures (both, private and public) and human capital.

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[16] V. Baesu, C.-T. Albulescu, Z.-B. Farkas, A. Drăghici, *Determinants of high-tech sector innovation performance in the European Union: a review*, "Procedia Technology" 2015, vol. 19, pp. 371–378.

[17] R. Bronzini, P. Piselli, *Determinants of Long-run Regional Productivity with Geographical Spillovers: The Role of R&D, Human Capital and Public Infrastructure*, "Regional Science and Urban Economics" 2009, vol. 39, pp. 187–199.

[18] S. Cabrilo, L.G. Nesic, S. Mitrovic, op.cit.

[19] M. Buesa, J. Heijs, T. Baumert, *The Determinants of Regional Innovation in Europe: A Combined Factorial and Regression Knowledge Production Function Approach*, "Research Policy" 2010, vol. 39, pp. 722–735.

3. Econometric analysis

The aim of this section is to describe the econometric analysis conducted during this research. 10% is the level of statistical significance selected for this study.

The first challenge of this study was the significant degree of heterogeneity of the studied programs in terms of their design, structure, goals etc. as well as an existing degree of overlap between them. To homogenously represent the input of the examined commitments, the study uses budgets allocated to the implementation of each of the programs. This serves as a common denominator, which allows for a direct comparison of the magnitude of the impacts on the dependent variables coming from a unitary change on the input side across the studied commitment. The second challenge is derived from the structure of the flow of funding. Not all the EU28 countries received funding for every program for every year. This means that to preserve log-log functional form, or rather its linear transformation, when $log_{10}(0)$ was required, it was set to equal *0*.

Data has been collected for EU28 countries ($i = 1, 2, \ldots, 28$) across the 2008–2013 period ($t = 1, 2, \ldots, 6$). The dependent variable is represented by total patent applications (direct and PCT national phase entries) from WIPO[20], with data on R&D expenditures coming from Eurostat[21], on tertiary education and on population from the World Bank[22] and on FP7 programs budgets from the National Contact Point for Research Programmes of the European Union Institute of Fundamental Technological Research Polish Academy of Sciences[23].

The model takes the form presented as eq. 1. In it, innovativeness (patent application *per capita*) is a function of government and business expenditures on R&D as a % of GDP (*Public_RnD* and *Private_RnD*, accordingly), share of labor force with tertiary education (*Ter*, in %) and the budgets of individual programs *per* 1 million inhabitants (*P*, where $m = 4, 5, \ldots, 27$, see Table 1). The *per capita* denominator is used to avoid the big-country bias. Inclusion of all the programs increases the probability of model's overspecification, but the design of the study requires emphasis on the *ceteris paribus* condition controlling for other FP7 programs.

20 https://www3.wipo.int/ipstats/index.htm?tab=patent (access: 03.03.2018).

21 http://ec.europa.eu/eurostat/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsc00001&language=en (access: 22.03.2018).

22 https://data.worldbank.org/indicator/SP.POP.TOTL (access: 03.03.2018).

23 National Contact Point for Research Programmes of the European Union Institute of Fundamental Technological Research Polish Academy of Sciences 2016, persons contacted: Marta Jurkowska, Bartosz Majewski.

$$Patents_{i,t+n} = \beta_0 + \beta_1 Public\_RnD_{i,t} + \beta_2 Private\_RnD_{i,t} + \beta_3 Ter_{i,t} + \\ + \sum_{m=4}^{27} \beta_m P_{m,i,t} + \alpha_i + \varepsilon_{i,t}. \quad (1)$$

Table 1. FP7 programs included in the study

Program FP7	Symbol
Cooperation	
Energy	ENERGY
Environment (including climate change)	ENV
General activities	GA
Health	HEALTH
ICT	ICT
Food, agriculture and fisheries, and biotechnology	KBBE
Nanosciences, nanotechnology, materials and new production technologies	NMP
Security	SECURITY
Joint Technology Initiatives	SP1-JTI
Space	SPACE
Socio-economic sciences and humanities	SSH
Transport (including Aeronautics)	TPT
People	
Marie-Curie Actions	PEOPLE
Capacities	
Support for the coherent development of research policies	COH
Activities in international cooperation	INCO
Research infrastructures	INFRA
Regions of knowledge	REGIONS
Research potential	REGPOT
Science in society	SIS
Research for the benefit of SMEs	SME
Ideas	
ERC	ERC
Euratom	
Nuclear fission and radiation protection – fission	FISSION
Fusion energy – fusion	FUSSION

Source: Author's own table based on consultations with National Contact Point for Research Programmes of the European Union Institute of Fundamental Technological Research Polish Academy of Sciences (2016).

The parameters of the model are estimated with Ordinary Least Squares with an inclusion of fixed cross-section effects (δ_i).

The model with $n = 3$ (estimated with Period weights PCSE standard errors and covariance as a coefficient covariance method) can be described by the following statistics (key ones included in Table). The results of the Redundant Fixed Effects test reject the null hypothesis of redundancy of the tested effects for cross-section effects (Cross-section F = 66.201, Cross-section Chi-square = 350,438; both with p-values = 0.000), but not for period effects (Period F = 0.284, Period Chi-Square = 1.685 with p-values of 0.755 and 0.431 accordingly). Both, the Bias-corrected scaled LM (p-value = 0.218) and the Pesaran CD (p-value = 0.357) suggest failure to reject the null hypothesis of no cross-section dependence (correlation) in residuals. There is no statistically significant correlation between the residuals and used explanatory variables (all p-values of Pearson correlation coefficients is greater than 0.1). The residuals do not have a normal distribution (p-value of the Jarue-Bera test = 0.000); however, keeping in mind the large number of observations (112), the one-sample t test statistics assigned to estimated coefficients are used. R-squared statistic states that the model explains 99.76% of the changes in the model's dependent variable, which is expected given panel data with fixed effects. Another possible reason may be the fact that explanatory variables representing FP7 are correlated with each other. This suggests a hypothesis that funding is clustered in some economies. Given that exclusion of explanatory variables, cross-sections or periods would distort the data set and lead to model's underspecification, and keeping in mind comments by Woodrige[24] on multicollinearity, this issue is recognized, but not dealt with any further. The model is statistically better in explaining the values of the dependent variable than its mean as the prob. (F-stat.) is equal to 0.000; hence, the null hypothesis of all the coefficients being equal to *0* is rejected. Lastly, Durbin-Watson statistic[25] equals 2.378, which suggests a negative autocorrelation.

The next model serves two purposes. First, it accounts for the fact that some researchers suggest 2 and some 3 lags between the impulse and the response. Second, it serves as a robustness check of the first model (Table). The model with $n = 2$ has also been estimated with fixed effects due to the results of the Redundant Fixed Effects test (for cross-section effects: F = 79.172, Chi-square = 412.78 with

[24] J.M. Wooldridge, *Introductory Econometrics. A Modern Approach*, South-Western Cengage Learning, Mason 2009.

[25] Used e.g. S. Sandu, B. Ciocanel, op.cit.

p-values = 0.000; for period effects: F = 0.426, Chi-square = 2.574 with p-values equal to 0.735 and 0.462 accordingly) with White diagonal standard errors and covariance. Similarly to the first model both, Bias-corrected scaled LM (p-value = 0.602) and Pesaran CD (p-value = 0.442) suggest acceptance of the null of no cross-section dependence in residuals. Residuals are not statistically significantly correlated with used explanatory variables (all p-values of estimated Pearson correlation coefficients are greater than 0.1) and are not normally distributed (p-value for Jarque-Bera = 0.000). R-squared equals 0.995 with prob. (F-stat) = 0.000 and Durbin-Watson statistic equal to 2.08.

There are some differences between the results of the two model in terms of the signs and the statistical significance of the estimated coefficients between the two models. For the first model ($n = 3$), obtained results show that only a handful of estimated coefficients is statistically significant. These are (coefficient's value, p-value): private expenditures on R&D (0.273, 0.008), share of labor force with tertiary education (0.958, 0.002), *Fission* (0.065, 0.032), *Health* (–0.081, 0.007), *ICT* (0.071, 0.030), *SiS* –0.089, 0.016) and *SSH* (0.063, 0.033). In the second model ($n = 2$) the following coefficients are statistically significant: share of labor force with tertiary education (0.255, 0.08), *Environment* (–0.062, 0.017), *Fission* (0.062, 0.022), *SP1_JTI* (–0.036, 0.047) and *SSH* (0.048, 0.016).

The surprising lack of a statistical significance of the coefficient of government spending on R&D is not an isolated result[26]. The positive coefficients of private expenditures on R&D and of the variable human capital are as expected.

Table 2. Results of models coefficients' estimation

No. of leads:	3	2
Method:	Panel Least Squares	
Sample (adjusted):	2008 2010	2008 2011
Periods included:	3	4
Cross-sections included:	28	28
Total panel (balanced) observations:	84	112
Coefficient covariance method:	Period weights (PCSE) standard errors & covariance (d.f. corrected)	White diagonal standard errors & covariance (d.f. corrected)

[26] For example see: X. González, J. Jaumandreu, C. Pazó, *Barriers to innovation and subsidy effectiveness*, "The RAND Journal of Economics" 2005, vol. 36, pp. 930–950; M.A. Weresa, T.M. Napiórkowski, *FDI and Innovation in Central European Countries*, „Przedsiębiorczość i Zarządzanie" (in print).

Variable	Coefficient	Prob.	Coefficient	Prob.
C	–6.626	0.000	–4.060	0.000
LOG (RND_GOV_GDP)	–0.063	0.493	0.080	0.310
LOG (RND_PRIV_GDP)	0.273	0.008	–0.053	0.382
LOG (TER)	0.958	0.002	0.255	0.080
LOG_COH_POP	–0.232	0.705	–0.086	0.680
LOG_ENERGY_POP	0.026	0.186	0.004	0.850
LOG_ENV_POP	0.025	0.459	–0.062	0.017
LOG_ERC_POP	–0.009	0.780	–0.024	0.500
LOG_FISSION_POP	0.065	0.032	0.062	0.022
LOG_FUSION_POP	–0.369	0.618	0.017	0.550
LOG_GA_POP	0.015	0.373	0.004	0.728
LOG_HEALTH_POP	–0.081	0.007	0.013	0.439
LOG_ICT_POP	0.071	0.030	0.011	0.309
LOG_INCO_POP	–0.043	0.148	0.014	0.442
LOG_INFRA_POP	0.029	0.153	0.000	0.990
LOG_KBBE_POP	0.000	0.991	0.002	0.932
LOG_NMP_POP	0.003	0.941	–0.023	0.284
LOG_PEOPLE_POP	0.010	0.745	0.005	0.871
LOG_REGIONS_POP	0.033	0.245	–0.017	0.425
LOG_REGPOT_POP	0.034	0.241	0.021	0.228
LOG_SECURITY_POP	0.010	0.685	–0.031	0.217
LOG_SIS_POP	–0.089*	0.016	0.013	0.478
LOG_SME_POP	0.003	0.930	0.035	0.144
LOG_SP1_JTI_POP	–0.014	0.470	–0.036	0.047
LOG_SPACE_POP	0.059	0.122	0.007	0.749
LOG_SSH_POP	0.063	0.033	0.049	0.016
LOG_TPT_POP	0.035	0.191	–0.020	0.476
Effects Specification:	Cross-section fixed (dummy variables)			
R-squared	0.998		0.996	
Adjusted R-squared	0.993		0.991	
F-statistic	230.146		244.569	
Prob (F-statistic)	0.000		0.000	
Durbin-Watson stat	2.391		2.085	

Source: Author's own table based on output from EViews 10.

Unexpectedly, most of the coefficients of the explanatory variables representing studied programs are found not to be statistically significant and some statistically significant coefficients of the said programs have negative signs.

This can be explained by a couple of factors. For example, a given program may not be aimed at patents as its direct goal or it may require significant critical mass (which takes time) for the results to surface. For example, projects in the area of small and medium companies (SME) are focused more on increasing SMEs competitiveness and efficiency by outsourcing certain activities, for which the SMEs lacks in-house capability and turning research into innovation[27]. Such network-building capabilities require time to set-up. In addition, there is time required for turning research into innovation and then its commercialization. Hence, pushing the lag between the impulse and the response beyond the assumed 3-year period. Similarly, for SPACE, the stock on knowledge as well as a very high cost (both, in time and funds) is required for each incremental step in true space innovation. Hence, a conclusion can be reached that, similar to the case of SMEs, space innovation to materialize needs more than the assumed 3-year period.

4. Implications

The general implication of this study is that parametrization of innovativeness be done with great caution.

First, as has been shown with a literature review, the measured impact of a policy / tool can depend on the measure used to represent the dependent variable (e.g., patent applications vs. trademarks applications). Second, the results, i.e. direction and statistical significance, of the evaluation are sensitive to the time lag allowed between the impulse and the response. This is clearly seen in case of individual FP7 programs where one of the key elements determining the extend of the lag is the size of the critical mass required. Third, public financial support for R&D tends to be inefficient unless it is properly directed / allocated (as has been shown by works covered as a part of literature review). This issue, to a degree, is mitigated by the heterogeneity of FP7 programs. However, if the earlier-mentioned factors take place, even a directed policy may yield no impact. Four, there is a great degree of heterogeneity of the impact of like

[27] European Union, *DECISION No 1982/2006/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007–2013)*, “Official Journal of the European Union 30.12.2006” 2006.

policies across various economies, which can be attributed to their unlike levels of technological and human capital stock[28] – which to some degree has been managed with the use of cross-section fixed effects. Next, the results proved to be sensitive to the time-frame taken under consideration. This is hypothesized to be a derivative of the fact that not all countries receive funding for all the programs every year. These conclusions add to the fact that "[v]ariables that are expected to determine different components of the innovation process are so numerous that the selection (and omission) of variables is very likely to influence results of empirical studies"[29].

The concluding implication is that evaluation of the impact of public innovation policies should be done with caution and that a direct measurement of a well-defined impact (e.g., with a use of input-output analysis: number of patents per a unit of funding) could provide a more direct (yet lacking the component of value added) measurement[30].

5. Conclusions

The aim of this study was to examine the role of public support for innovation on a case study of FP7's impact on innovativeness in the EU with the research hypothesis of the impact being statistically significant and positive. To test the research hypothesis an econometric model derived from the two-factor production function has been used. The results coming from the model are mixed.

The results of the study show that the there is a degree of discrepancy between the theoretical and the empirical impact of the studied public policy. In other words, higher public funding (even if it is focused on a particular area of a program) does not always translate into higher innovation output as measured by patent application. Possible justifications for this are presented in the paper.

The key limitation of this study is that the results appear to be generally sensitive to a series of factors not related with the usual suspects (e.g., inclusion or

[28] See P. Aghion, P. Howitt, *A model of growth through creative destruction*, "Econometrica" 1992, vol. 60, pp. 323–351.

[29] A. Zemplinerová, E. Hromádková, *Determinants of Firm's Innovation*, "Prague Economic Papers" 2012, vol. 21, p. 489.

[30] Like information is presented, e.g., in FP7 annual review reports, where a positive output in a form of patents is presented, *albeit* it is heterogenous across the individual programs (European Comission, 2015).

exclusion of a certain explanatory variable or the form, in which the variable is included in the model). The second limitation of the study comes from the heterogeneity of the panel's cross-sections, which was mended with the use of cross-section fixed effects while understanding the drawbacks of such a solution. Another possible limitation that needs to be kept in mind is the danger of model's overspecification.

Hopefully this study will be treated as an exercise, a jumping off point for further research, e.g., on the impact of the lag allowed between the impulse (e.g., allocation of funds) and the response (e.g., change in the number of patent applications) as well as other disturbance factors mentioned in the text.

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Rola wsparcia publicznego w stymulowaniu innowacyjności – analiza przypadku programów „Siódmego programu ramowego"

Streszczenie

Celem omawianego badania jest analiza wpływu polityki innowacyjnej implementowanej w ramach „Siódmego programu ramowego" (FP7) na poziom innowacyjności w Unii Europejskiej. Hipoteza badawcza brzmi: każdy z 23 indywidualnych programów wliczanych do inicjatywy miał statystycznie istotny wpływ na poziom innowacyjności w UE. Aplikacje patentowe *per capita* służą jako zmienna zależna w modelu, w którym zmiennymi zależnymi są wyłonione na podstawie przeglądu literatury publiczne i prywatne wydatki na działalność B+R oraz zasób siły roboczej, a także budżety indywidualnych programów FP7. Sam model przyjmuje formę funkcji produkcji. Również na podstawie literatury zastosowano 3- i 2-letnie opóźnienie pomiędzy zmianą w zmiennej niezależnej a zmianą w zmiennej zależnej. Parametry modelu zostały oszacowane MNK ze stałymi efektami przekrojowymi, które pozwalają na kontrolowanie heterogeniczności pomiędzy przekrojami. Wyniki oszacowania pokazują, że większość z analizowanych programów nie przekłada się pozytywnie na poziom innowacyjności. Postawiono hipotezę, że wyniki te są pochodną projektów poszczególnych programów lub nieosiągnięcia przez te projekty w badanym okresie wymaganej masy krytycznej. Autor podaje również wnioski dotyczące wrażliwości wyników oraz implikacje dla ewaluacji przyszłych programów podobnych do FP7.

Słowa kluczowe: wydatki na B+R, polityka innowacyjna, Innovation Union