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Article

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Effects of Subsidy on Publication Outputs. Can Small Research Grants Lead to Higher Quality Scientific Articles?

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Abstract

Universities play a crucial role in new knowledge production that is considered as key driver of economic growth. Hence, the support of university research is essential, usually provided by the public sector. This article presents an evaluation of small grants of universities through examining research projects in the field of economics implemented in years 2008-2018 in Slovakia. A negative binomial regression analysis was used to determine the effects of small grants on publication outputs of supported researchers. Impact of subsidy on the number of all publications and separately on the quantity of higher quality scientific articles was distinguished. Results show a slight positive impact of the volume of funds on overall publication outputs, even though other factors seem to be more important as the size of the research team, the proximity to the capital city as well as the quality of faculty at which the project is implemented. Conversely, the impact of the volume of funds on higher quality publication appears to be not significant. In this case, more substantial are factors indicating the previous reputation of the research team, ranking of faculty and general research environment. Our findings indicate that researchers with great publication activity are willing to report high quality scientific articles in forthcoming periods regardless the support. Ergo, less active scientists are not benefiting from small grant in terms of their publication improvement.

Keywords

project funding, small grants, economic research, universities, negative binomial regression

JEL Classification

H52, I28, G28

Introduction

Universities are key institutions in the production of new knowledge. They are the main performers of public research in OECD countries (OECD, 2014). The most natural output of universities research is scientific publication or scientific articles that capture new knowledge (Pavitt, 1991; Jacob, Lefgren, 2007; Popp, 2015). Because of the positive impact of knowledge generated by universities, it is mainly the public sector that participate on its funding. The two main forms of funding allocation are institutional and project funding (Millar and Senker 2000; Borrás and Edquist, 2013; EUA, 2015). As part of our research, we will focus on project financing. Project research funding is the second most widely used mechanism to support research (Millar and Senker 2000). It represents the allocation of funding to a researcher or research team on the basis of a submitted application in order to carry out defined research activities within a certain time limit and with a given budgetary constraint (Slipersæter et al., 2007; EUA, 2015). Such support assumes the existence of an agency that allocates funds based on the best project selection and in line with the defined objectives. The project funding mechanism for universities brings a competitive element into the distribution of funds and provides incentives for researchers to improve in quality and competitiveness (Auranen and Nieminen 2010; OECD 2014; EUA, 2015). However, it is necessary to pay particular attention to how to set it up as appropriately as possible so that it leads to the desired results. Most of the studies focused on project funding state a positive impact of the amount of support on the achieved results (Godin, 2003; Jacob and Lefgren, 2007; Beaudry and Allouai 2012; Popp, 2015; Rosenbloom et al. 2015; Ebadi, Schiffauerova 2016; Tahmooresnejad et al. 2015; Mongeon et al. 2016).

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Literature Review

The higher financial support is provided to the researchers, the greater the number of scientific articles published. The same is true for institutional funding where universities appear to be adjusting their behaviour to the established funding formulas. The more resources are allocated to research-driven outputs, the more universities publish (Butler, 2003, Vanecek 2013). However, there is a concern about reducing quality (Butler 2003, Vanecek 2013) or sending the articles to predatory journals (Pisár et al., 2017). In the current article, the main research question is whether this positive impact applies even to a relatively small amount of provided funds. The study examines the grants allocated to public universities during the years 2008 to 2014, especially the field of economics in the Slovak Republic. Selection of one field of science is consistent with other studies (Popp 2015; Rosenbloom et al. 2015; Ebadi, Schifauerova, 2016; Tahmoosnejd et al., 2015). As research in the field of economics is not primarily dependent on scientific infrastructure or materials - as in the case of technical, medical, or natural sciences, we do not expect any significant distortion of results due to high infrastructure support in the abovementioned scientific areas from structural funds. Supported infrastructure could potentially affect the growth of researchers' outcomes and increase the effects of project research funding. The lower need for hard infrastructure in research in economic sciences also increases the likelihood that even small grants can have a positive impact on quality scientific publications. The support allocated to projects from the VEGA scheme provided by the Scientific Grant Agency (SGA) will be evaluated. This scheme supported small projects ranging from EUR 1850 to EUR 60,000 in the years under review. If project funding supports more of smaller projects, it increases the likelihood of obtaining a grant for researchers and encourages them to apply for. Funding a smaller number of projects, in turn, increases the competitive environment, ensuring that funds are allocated to top research teams which will also be reflected in the knowledge produced. On the other hand, a too competitive environment can reduce productivity if researchers devote too much time and effort to processing a grant application that is not successful. Grant application refusal can also lead to research disruption resulting in inefficient spending of funds (Auranen and Nieminen 2010).

At the same time, the SGA scheme does not require to set the scientific outputs before grant starts as well as does not primarily watch the quantity and quality of outputs afterwards. Tracking bibliometric indicators such as the number of publications does not encourage researchers to experiment and seek new solutions but rather to focus on research that guarantees a steady flow of funds regardless of the benefits to society (Geuna and Martin 2003). Researchers are motivated to publish scientific outputs frequently and in parts (EUA 2015). In addition, quantity over quality may be preferred (Butler, 2003). However, even a scheme without predetermined outcomes can bring the desired result in line with the Principal-Agent theory when leaving the responsibility and trust in the researchers can have a positive impact on the willingness and effort to be productive (Falk and Kosfeld 2006). Because researchers within this scheme are not pushed to have some scientific publications, it is possible to better evaluate the impact of all factors on the production of high-quality scientific articles.

Empirical evidence in the literature confirmed the impact of the amount of grants awarded on the results achieved. The aim of the following research was to analyse whether this statement also applies to small grants. A negative binomial regression model is applied to small grants allocated to public universities during the years 2008 to 2018 in the field of economics in the Slovak Republic under SGA research scheme, where the average financial support for one project was around ten thousand EUR. In the next chapter is the methodology presented and the empirical models introduced with a detailed data and variables description. Then follow the results of the empirical analysis with their discussion and debating the limitations of the study. The last section concludes.

Methods

To examine the effects of subsidy on publication outputs of the supported research team we applied an approach that is using assumptions of knowledge production function. Universities play an important role in knowledge creation and development, therefore the support of these institutions is essential. The question is whether this support helps researchers to publish in quality scientific journals and what other factors we must take in account. This issue is investigated by an evaluation study of small grants at universities in Slovakia. A negative binomial regression analysis was conducted to explore the effect of support on publication outputs of researchers taking into account several control variables. This section introduces the interconnection of the production function with the public support of university research. Then follows model specification and identification strategy with dataset description and characteristics of the variables used.

Production function and public support of university research

Knowledge that can be generated and used continuously are considered as factor that allow economies to grow continually (Tocan, 2012). In conceiving empirical models, the starting point is the new theory of economic growth, where the role of knowledge is emphasized. Romer (1990) works with the Cobb-Douglas production function (0.1).

$$Y = K^\alpha [(AL)]^{1-\alpha} \quad (0.1)$$

where $0 < \alpha < 1$.

Four variables enter the model here: output (Y), capital (K), labor (L), and technology or knowledge (A). Two sectors are assumed to exist: one producing goods and the other producing new knowledge. The production function of the growth model indicates that the rate of knowledge growth \dot{A} (0.2) depends on the number of workers involved in research and development L_A and the existing knowledge pool A. The parameter ϕ determines the dependence of the current knowledge pool on previous knowledge, thus capturing knowledge spillovers. According to Romer, while maintaining a constant number of researchers, new knowledge is linearly dependent on the existing amount of knowledge. The number of employees and capital are growing as the result of generating new knowledge. Thus, the overall output grows disproportionately reflecting growing returns to scale. This means that the economy has a continual potential to grow.

$$\dot{A} = \delta L_A^\alpha A^\phi \quad (0.2)$$

Hence, knowledge play a very important role in economic growth. They are especially scientific knowledge together with innovations and technologies that significantly contribute to economic growth (Ozor, 2014). Main actors in production of scientific knowledge are considered to be companies, universities, research institutions. To these actors belongs also the state as a regulator, provider of financial resources and coordinator of activities (Etzkowitz and Leydesdorff, 2000). Universities have traditionally been given an important role in creation and development of knowledge (Adams, Griliches, 1998; Gibbons, et al., 1994; Nowotny et al., 2001; Bentley et al., 2015). Thus, knowledge generated at universities produce positive externalities and benefits for the society as whole. It is therefore important to monitor how universities are supported in knowledge creation and to identify the factors that influence this process.

The public sector tends to be involved in supporting research and development, mainly due to market failures in this area. This is because the market of knowledge does not provide sufficient incentives to attract private sector investment (Romer, 2012; Hall, 2002; OECD 2014), which is largely due to the characteristics of knowledge. Knowledge are considered as public good, non-rival and inseparable from consumption (Hall and Reenen, 2000). However, public sector is interested in producing knowledge, as it brings greater benefits to society as whole than to a firm alone (Jaffe, 2002; Varmus, 2009; OECD, 2012). Several studies even confirm that public investment in research and development has a positive effect on private investment in this area (Jaffe, 1989; Toole, 1999). The general reason for public support for research and development is thus the effort to achieve socio-economic benefits for society as whole.

Model specification and identification strategy

The most natural output of researchers at universities, which capture new knowledge, are scientific publications, resp. articles (Pavitt, 1991; Riviera, 2013, Zhang, Bao and Sun, 2016; McAllister and Narin, 1983; Godin, 2003; Jacob and Lefgren, 2007; Popp, 2015; Rosenbloom, Ginther, Juhl, Heppert, 2015; Ebadi and Schiffauerova, 2016; Tahmooresnejad, Beaudry, Schiffauerova, 2015). A scientific publication represents the capture of a discovery or new knowledge in written form, i.e. codified knowledge. If published in a scientific journal, it also reflects the quality of scientist, as it has already undergone some evaluation by other experts who have recognized it as original and significant (Tijssen, 2015). The aim of the presented research will be therefore to monitor the effects of supporting the production of scientific publications at universities and to examine the factors that influence this process. We work with a set of research projects of universities in Slovakia that received support for research in the years between 2008 and 2014. We examine the effects of support, i.e. whether the implementation of support has an effect on the publication outputs of the project team.

When assessing the impact of support on the production of scientific articles the project level of measurement is used. That means that we examine the quantity of scientific articles that were produced from one project. This approach has some advantages over macro and micro studies. If we followed the aggregate indicator for the university (macro approach) or department, it would be the result of several research teams of different sizes and composition (Sandstrom, 2009). In addition, the research teams may also consist of other researchers who do not formally belong to the unit, which is also the case of SGA projects. Therefore, we cannot precisely identify the direct effects of funding and other factors on knowledge production. A micro approach at the level of an individual usually assigns a researcher part of the total amount allocated to the research team divided evenly by the number of researchers, which is often not in line with the actual drawdown. In addition, support for the individual also includes the cost of administration and facilities that can also lead to indirect support to another researcher, thereby distorting the measurement results (Rosenbloom et al., 2015). When measuring the impact of support at project level, we can precisely identify the size and composition of the project team involved in the production of knowledge. At the same time, we know the exact amount of project funding allowing to directly evaluate the impact of allocated funds on performance within the project, avoiding the problem of determining the exact allocation between members of the research team. At the project level, we can also monitor the outcomes of a given project based on the schema and project code in the outputs. At the same time, we can measure the impact of different variables on the success of grant. Although the outputs of the project are aggregated for all researchers who may have different merits in

publications, from the perspective of setting up a support policy that ultimately evaluates the aggregate outputs of the project, it is not necessary to approach the individual level. At the same time, we are unable to monitor the impact of another support scheme on project outputs at the project level. However, accurate capture is problematic at all levels of measurement, as we need to know the nature and exact volume of all grants that the selected unit of measurement has received over the reporting period. The project level also does not allow us to compare the supported and unsupported sample of beneficiaries, as we evaluate only the implemented projects and outputs from them. In general, however, when determining an unsupported sample of recipients, it is unclear whether they have benefited from support of their colleagues (Rosenbloom et al. 2015). From this point of view, measurement at project level seems to be the most acceptable.

As dependent variable, quantity of published articles will be evaluated that are related to subsidized projects started to be implemented between years 2008 and 2014. This variables in our model describe the occurrence of an event or behaviour during a given time period. Count variables are integers that cannot take a negative value. If the variable values reach a low arithmetic mean, standard methods such as linear regression may distort the results, since the distribution of the frequency in the statistical set is disproportionate. In such cases, primarily Poisson regression is used (Griliches et al. 1984; King 1989; Riphahn, Wambach, Million 2003), or negative binomial regression (Wang, Cockburn and Puterman 1998; Fleming, Sorenson, 2001; Maurseth and Verspagen 2002; Payne and Siow 2003; Ebadi and Schiffauerova 2016; Tahmooresnejad et al., 2015). Poisson distributions assume equality of mean and variance, which is rare in the data. If the dispersion y_i is greater than the average ($E(y_i | x_i) < \text{Var}(y_i | x_i)$), there is excessive data dispersion suggesting that a negative binomial regression is the appropriate alternative where equation applies.

$$\text{Var}[y_{it}|x_{it}] = E(y_{it}|x_{it}) (1 + \alpha[E(y_{it}|x_{it})]) \quad (0.3)$$

In the case of our dependent variables, there is excessive data dispersion, so we should use negative binomial regression. However, in accordance with other studies (Tahmooresnejad et al., 2015;), the α coefficient in each model is tested using the Likelihood Ratio Test, which tells us about the significance of α and confirms the correct use of negative binomial regression.

In the empirical models were used two modifications of dependent variable expressing publication outputs directly linked to the examined projects. Project participants directly declare in individual articles that the publication was produced within the given SGA project. The overall publishing activity of the project team was not addressed, only the one that was published within the examined projects. For this reason, we do not assign a control group, nor does it make sense to control for another type of support.

The first variable (TotalOutputs) represented the total number of publications related to the project. The second variation of dependent variable ((ArtNo) includes only these articles that are published in scientific journals listed in Web of Science and Scopus databases (categories of publication ADC, ADD, ADM, ADN in Slovak evaluation system). We chose these categories for several reasons. The first is the great importance of these categories in the assessment of scientists in Slovakia. Publishing in these categories is key in terms of institutional funding, when 70% of financial resources for publishing activities for universities are allocated according to the volume of these publications (MŠ SR, 2018). At the same time, these publications are key to the career growth of researchers in Slovakia. These outputs are also a prerequisite for colleges if they want to have accredited degree programs. Clearly, these are the categories that are at least "perceived" as the best, in Slovakia. At the same time, we are aware that even within these categories, it is possible to identify significant differences. However, if we were to break down these categories even in more detail, we would have a very small total number of quality publications and a very small number of projects with these outputs. Even with this breakdown, these publications make up only 4% of all project publications.

The regression models (1) to (4) are related to the dependent variable TotalOutputs. As part of the policy impact assessment, we include basic variables in the model that, according to studies affect output production. In addition, we also use variables in the model that policy does not directly affect but may influence its effects. The first empirical model looks like follows:

$$\text{TotalOutput}_i = f(\text{Fund}_i + \text{TeamSize}_i + \text{avgArtNo}_i + \text{Last}_i + \text{dCoop}_i + \text{PrevProj}_i + \text{coefA}_i + \text{Enviro}_i) + \varepsilon \quad (1)$$

The volume of funding (Fund_i) belongs to the most important factor used in studies (Payne and Siow 2003; Godin 2003; Jacob, Lefgren 2007; Sandstrom, 2009; Popp 2015; Rosenbloom et al. 2015; Ebadi and Schiffauerova 2016; Tahmooresnejad et al. 2015). The impact of this variable is measured cumulatively over the entire project period, which is in line with the SGA procedure that evaluates the project's success in the year of its completion and submission of the final report. Another explanatory variable is the size of the research team (TeamSize_i) involved in the project (Plume, van Weijen 2014; Ebadi and Schiffauerova 2016). Regarding the team size a simpler coordination of activities with lower costs is expected in a smaller team. At the same time, Jongbloed and Lepori (2015) confirm that smaller teams are more flexible in research activities. On the contrary, larger teams can benefit from dividing the tasks among more people and have more time to deal with major projects, and ultimately more

scientific articles (Ebadi and Schiffauerova 2016). An important factor is also the existing knowledge of the research team. We can expect that the more knowledge researchers have, the more of new knowledge they can produce in the future. Studies capture the existing pool of knowledge through number of published articles and confirm that the higher the previous researcher's productivity, the more articles they publish today (Ebadi and Schiffauerova 2016). In order to capture the existing knowledge pool, which in turn reflects the quality of the research team and to some extent the dissemination of existing knowledge, we use the average number scientific articles of the research team published in Scopus and Web of Science databases three years before the project started to be implemented ($avgArtNo_i$), as well as studies (Tahmoonesnejad et al. 2015; Ebadi and Schiffauerova 2016; Lissini et al., 2011). The research productivity of the research team is one of the factors that public policy can take in account when evaluating a project proposal and reflects the quality of the research team. The control variables include the duration of the project ($Last_i$), where it can be assumed that longer project implementation provides enough time for publications. The model also measures dummy variables for previous principal investigator's experience with leading other SGA project over since 2004 ($PrevProj_i$), which partly reflects the researcher's reputation. If the research team is part of a better university, it is likely to have a better background and also feels more pressure for better outputs. In our model, we also control for the impact of the faculty quality through the dummy variable for the accreditation coefficient A and A- ($coefA_i$). As part of the evaluation of individual faculties by an independent peer review, which serves to finance higher education institutions, an independent commission assigned accreditation coefficients from A to D to the faculties, with A representing the highest level of quality. Another factor that may affect outputs is research collaboration. Collaboration, whether domestic or international, has a positive impact on the number of publications (De Solla Price, Beaver 1966; Lee, Bozeman 2005; Lissoni et al. 2011). We used dummy variable for general cooperation as well ($dCoop_i$) expressing all kind of cooperation with universities and institutions (external and internal)). As the last control variable, we used the average number of publications in the databases published by the authors from Slovakia in the field of economics during the duration of the project ($Enviro_i$). This variable represents the external environment, which may affect the overall publishing activity within the project, such as the method of institutional funding. Indeed, if the institutional funding is connected to scientific outputs, universities are motivated to publish more, including in the grants they receive. In fact, they are rewarded for their scientific publications in both forms of funding, thus we may observe an overlap of the effects of the policies.

As the literature suggests, cooperation with other institutions within a project may affect the results of research, therefore was in the second empirical model tested another variation of cooperation instead of the variable $dCoop_i$. We tested also other variable capturing cooperation - share of researchers involved in the project from another institution ($CoopInst_i$), as presented in the second regression model:

$$TotalOutput_i = f(Fund_i + TeamSize_i + avgArtNo_i + Last_i + PrevProj_i + coefA_i + Enviro_i + CoopInst_i) + \varepsilon \quad (2)$$

The third empirical model counts with another variation of the researchers' reputation instead of the variable $PrevProj_i$. The variable $PrevProj2_i$ that reflects previous principal investigator's experience with leading other SGA projects in last 3 years before the investigated project. The results of the project funding can also be influenced by the location of the university or a research team (Ebadi, Schiffauerova 2016) Therefore was added also in the third model the variable $dBrat_i$, indicating that universities located in the capital city are closer to the "hub" of knowledge and information, generally.

$$TotalOutput_i = f(Fund_i + TeamSize_i + avgArtNo_i + Last_i + dCoop_i + coefA_i + Enviro_i + PrevProj2_i + dBrat_i) + \varepsilon \quad (3)$$

Empirical model no.4 involves the variable $dBrat_i$ that seems to be important according to the previous model, however, this model returns the variable $PrevProj_i$ indicating the experience of the principal investigators' with leading SGA projects since year 2004.

$$TotalOutput_i = f(Fund_i + TeamSize_i + avgArtNo_i + Last_i + dCoop_i + coefA_i + Enviro_i + PrevProj_i + dBrat_i) + \varepsilon \quad (4)$$

In empirical models (5) to (8) appears as dependent variable $ArtNo_i$ representing the number of publications in WoS and Scopus databases. Design of these models logically follows the previous models. Model no. 5 represents as an explanatory variable the support and adding control variables as the size of the research team in the projects and their previous publication history, duration of the project, general level of cooperation, principal investigators' experience with SGA projects since year 2004, quality coefficient of the faculty where the project i was implemented and the average publication level of the project team during the project. Model 5 looks like as follows:

$$ArtNo_i = f(Fund_i + TeamSize_i + avgArtNo_i + Last_i + dCoop_i + PrevProj_i + coefA_i + Enviro_i) + \varepsilon \quad (5)$$

Following the previous logic, in the model no. 6 is incorporated another variation of the cooperation of the project team. The variable $dCoop_i$ was replaced by $CoopInst_i$. The empirical evidence of studies investigating the effects

of support suggests to consider the location of the subsidized subject that may have influence the success of support. Therefore, was in the model 7 added the variable $dBrati_i$. This model incorporates another variation of the reputation of the principal investigator of the project i . The last empirical model no. 8 keeps the variable $dBrati_i$ and taking back the variable $PrevProj_i$. that is representing the principal investigators experience with leading SGA projects since year 2004. The following table provides more detailed information about each variable used in the models.

Table 1. List of Variables and Description.

| Abbreviation | Description and unit | Source | Coverage |
|---------------------------|---|---|-----------|
| TotalOutputs _i | number of all publications related to the project i , article | Scientific Grant Agency | 2008-2018 |
| ArtNoi | number of publications in WoS and Scopus related to the project i , article | Scientific Grant Agency | 2008-2018 |
| Fundi | volume of support, EUR | Scientific Grant Agency | 2008-2018 |
| TeamSize _i | size of the research team, persons | Scientific Grant Agency | 2008-2018 |
| avgArtNoi | number scientific articles of the research team published in Scopus and Web od Science databases three years before the project started to be implemented, article | Central Register of Publication Activity (CREPC) | 2005-2013 |
| Lasti | the duration of the project, years | Scientific Grant Agency | 2008-2018 |
| dBrati | dummy variable for the location of the institution where the project is implemented, 1 = location in Bratislava, the capital city, 0 = location not in Bratislava | Scientific Grant Agency | 2008-2018 |
| CoopInsti | dummy variable for external domestic and international cooperation with universities and institutions in the project i , 0 = no cooperation, 1 = cooperation with other universities and institutions | Scientific Grant Agency | 2008-2018 |
| dCoopi | dummy variable for all kind of cooperation with universities and institutions (external and internal) in the project i , 0 = no cooperation, 1 = cooperation with other universities and institutions | Scientific Grant Agency | 2008-2018 |
| PrevProj _i | dummy variable for previous principal investigator's experience with leading other SGA project over since 2004, 0 = no previous projects, 1 = experience with previous projects | Scientific Grant Agency | 2004-2018 |
| PrevProj2 _i | dummy variable for previous principal investigator's experience with leading other SGA project in last 3 years before the investigated project, 0 = no previous projects, 1 = experience with previous projects | Scientific Grant Agency | 2005-2013 |
| coefAi | dummy variable, 1 = if the accreditation coefficient of the faculty is the highest "A"; 0 = if the accreditation coefficient of the faculty is "B, C, D"; | Accreditation Commission, an advisory body to the Government of the Slovak Republic | 2015 |
| Enviroi | average number of publications in the databases WoS and Scopus published by the authors from Slovakia in the field of economics during the duration of the project, article | Web of Science Database, Scopus Database | 2008-2018 |

Dataset characteristics

The SGA scheme is aimed at providing smaller research grants in several areas of research. The total volume of resources of the scheme makes up approximately 6% of public funds at the state level provided to universities. Researchers can apply for funding for new projects every year, and this scheme has been in place for more than 20 years. Due to the lower volume of grants, this scheme has the largest share of approved applications out of the total number of submitted projects compared to other schemes within the Slovak Republic. The agencies' evaluation of projects takes to account in particular the quality of the submitted proposal, budgetary efficiency and quality of the research team, with emphasis on reputation of the project leader (principal investigator). The outputs of the evaluated projects are cumulatively reported for the whole period and based on the final reports submitted by the principal investigator at the end of the project. The outputs are then assessed by the Agency's rapporteurs who assess whether the outputs are relevant (have project reference, content link to the project) and decide whether they will be accepted as a project result.

In terms of data availability and the need to limit project timeframe, we evaluate projects starting in 2008 to 2014.

As SGA projects have a maximum duration of 4 years, the selected sample of projects was completed in 2018 at the latest, allowing us to track outputs. Specifically, 423 projects of the field of economics implemented at public universities enter the analysis. To identify the members of research teams, the database sent by SGA was used with information on the names and projects, academic degrees and organizations. Data on some researchers were additionally searched through the SK CRIS website, which is the Science and Research Information System of the Slovak Republic, which belongs under the Ministry of Education of the Slovak Republic and which provides information on project investigators in Slovakia. The total number of researchers in 423 projects of the field of economics is 3,061 for the given period. Subsequently were collected data on their publishing activity for the years 2007 - 2018. The Central Register of Publication Activity (CREPC) was used which records the published and available outputs of all university employees. CREPC allows to search the publishing activity of people based on name, year of birth, and institution on which the person operates. Duplicate names were controlled based on the institution and academic degree. All publications were checked for duplicate values.

Results

In the descriptive statistics of the variables in Table 2, we can see that the maximum number of articles published from the project was 14. On the other hand, out of all projects, 0 quality articles were published in 221 cases, which is also reflected in the low average value of the variable. In comparison, the total number of publications was significantly higher, with the average value per project reaching 27.8 outputs. Also, based on the low standard deviation, the number of publications produced is close to the average value. The average financial support for the project was 10.8 thousand € with a maximum amount of 60.7 thousand € for the project. Projects consisted on average of 11 researchers but some extreme values may be seen. The maximum number of researchers in the project was 35 followed by a project with 32 researchers. Other projects had 25 researchers and less. The previous average publishing activity (AvgArtNo) shows very low values up to a maximum of 1.66 high-quality publication per researcher. The average is 0.12 publications. We can also see that the projects were realized in the range of 2 to 4 years defined by the agency rules. The average project lasted for 2.7 years.

Table 2. Descriptive statistics of variables for the model of economic sciences.

| Variables | N | Average | Standard Dev. | Minimum | Maximum |
|--------------|-----|----------|---------------|---------|---------|
| ArtNo | 423 | 1,18 | 1,89 | 0 | 14 |
| TotalOutputs | 423 | 27.80 | 20.73 | 0 | 104 |
| Fund | 423 | 10811,12 | 9272,23 | 497,97 | 60784 |
| TeamSize | 423 | 11,14 | 4,99 | 1 | 35 |
| AvgArtNo | 423 | 0,13 | 0,23 | 0 | 1,67 |
| Last | 423 | 2,80 | 0,48 | 2 | 4 |

About 51 % of all projects were based on collaboration with others whether from the same university or other institutions (dCoop). Significant changes can be seen in the experience with the project in general (PrevProj), where 62% of projects with projects starting in 2014 are those in which the main researchers had experience with the management of another project since 2004. For the faculties with accreditation coefficients at level A or A- it can be seen that their share on all projects is 31 - 53 %, with the most of such projects starting in 2009 and 2012. Results of negative binomial regression capturing the influence of variables on the production of all articles are shown at Table 3.

Table 3. Results of negative binomial regression capturing the influence of variables on the production of all publications within the projects of economy with the beginning of implementation between 2008 – 2014.

| | Model 1 b/se | Model 2 b/se | Model 3 b/se | Model 4 b/se |
|---------------|------------------------|------------------------|------------------------|------------------------|
| Total Outputs | | | | |
| Fund | 0.000014*** (0.000) | 0.000015*** (0.000) | 0.000013** (0.000) | 0.000013** (0.000) |
| TeamSize | 0.036733*** (0.007) | 0.036928*** (0.007) | 0.037994*** (0.007) | 0.037854*** (0.007) |
| AvgArtNo | -0.233043 (0.146) | -0.219459 (0.147) | -0.100010 (0.151) | -0.095523 (0.151) |
| Last | 0.203046* | 0.188300* | 0.187318* | 0.190186* |

| | | | | |
|-----------|--------------|--------------|--------------|--------------|
| | (0.079) | (0.079) | (0.079) | (0.079) |
| dCoop | 0.084917 | | 0.099912 | 0.099501 |
| | (0.065) | | (0.065) | (0.065) |
| PrevProj | 0.081515 | 0.076795 | | 0.060159 |
| | (0.067) | (0.068) | | (0.067) |
| coef A | -0.314715*** | -0.321765*** | -0.273346*** | -0.270323*** |
| | (0.068) | (0.067) | (0.068) | (0.068) |
| Enviro | 0.000000 | -0.000002 | 0.000103 | 0.000060 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| CoopInst | | -0.049302 | | |
| | | (0.258) | | |
| PrevProj2 | | | 0.027992 | |
| | | | (0.069) | |
| dBrat | | | 0.231831*** | 0.229597*** |
| | | | (0.069) | (0.069) |
| Constant | 2.206776*** | 2.295015*** | 2.082248*** | 2.076849*** |
| | (0.222) | (0.217) | (0.224) | (0.223) |
| Inalpha | | | | |
| Constant | -0.923847*** | -0.919683*** | -0.952602*** | -0.954374*** |
| | (0.076) | (0.076) | (0.077) | (0.077) |
| N | 423 | 423 | 423 | 423 |
| aic | 3513.4 | 3515.1 | 3505.0 | 3504.4 |

Note: * p<0.05, ** p<0.01, *** p<0.001

The results show that the volume of funding (Fund) has a positive and statistically significant effect on the overall volume of publication outputs of the project, even in the case of small grants. The effect of the grant is significant, but very small. Any additional EUR of support implies 0.000014 additional publications. A high percentage of applications are supported at the expense of quality. In this respect, it would be more sensible to support fewer project proposals, but better ones with higher amounts of support. We also see a significant impact of variables directly related to the project scheme such as last of the projects (Last) or team size (TeamSize). We can say that longer, more funded projects with a larger number of involved researchers also lead to a higher overall volume of publications. Cooperation (dCoop) and previous experiences with SGA scheme (PrevProj) has positive, but statistically not significant, impact. Previous publishing activity in better journals (AvgArtNo) has a negative but statistically insignificant impact. The variables measuring the quality of the faculty (coefA) and whether the main research workplace is from Bratislava (dBrat) are also statistically significant. The results of the last three named variables are interesting especially in the context of the results of other models, presented in Table 4. In these models, the dependent variable is the number of higher quality publication outputs.

Table 4. Results of negative binomial regression capturing the influence of variables on the production of articles in WoS and Scopus databases within the projects of economy with the beginning of implementation between 2008 – 2014.

| | Model 5 | Model 6 | Model 7 | Model 8 |
|----------|-------------|-------------|-------------|-------------|
| | b/se | b/se | b/se | b/se |
| ArtNo | | | | |
| Fund | 0.000012 | 0.000013 | 0.000012 | 0.000014 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| TeamSize | 0.008462 | 0.008636 | 0.003473 | 0.005003 |
| | (0.015) | (0.015) | (0.015) | (0.015) |
| AvgArtNo | 1.316548*** | 1.319030*** | 1.134507*** | 1.171672*** |
| | (0.256) | (0.257) | (0.259) | (0.261) |
| Last | 0.282498 | 0.279469 | 0.335656* | 0.305066 |

| | | | | |
|-----------|--------------|--------------|--------------|--------------|
| | (0.163) | (0.163) | (0.163) | (0.162) |
| dCoop | 0.253474 | | 0.244306 | 0.221466 |
| | (0.136) | | (0.136) | (0.135) |
| PrevProj | 0.094252 | 0.105618 | | 0.129672 |
| | (0.138) | (0.139) | | (0.138) |
| coef A | 0.380815** | 0.362673** | 0.314118* | 0.329331* |
| | (0.136) | (0.136) | (0.137) | (0.137) |
| Enviro | 0.002822*** | 0.002823*** | 0.002772*** | 0.002702*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| CoopInst | | 0.750061 | | |
| | | (0.509) | | |
| PrevProj2 | | | 0.277243 | |
| | | | (0.143) | |
| dBrat | | | -0.315306* | -0.285442 |
| | | | (0.151) | (0.151) |
| Constant | -2.826293*** | -2.749209*** | -2.768094*** | -2.652766*** |
| | (0.472) | (0.467) | (0.480) | (0.475) |
| Inalpha | | | | |
| Constant | -0.224230 | -0.218400 | -0.290566 | -0.274936 |
| | (0.181) | (0.181) | (0.188) | (0.187) |
| N | 423 | 423 | 423 | 423 |
| aic | 1165.7 | 1167.0 | 1161.3 | 1164.2 |

Note: * p<0.05, ** p<0.01, *** p<0.001

Unlike the previous model, the statistically significant variables are quite different. As we see, the volume of funding has slightly positive, but not statistically significant impact on the production of higher quality articles (in term of articles in WoS and Scopus) in the economic sciences. The size of the research team or duration of the project does not play a significant role in the production of quality articles, but still has some positive impact. The length of the project was even statistically significant in one of the models. Longer projects naturally provide more time to prepare better outputs, which can make project length one of the possible important factors. Three variables had a statistically significant effect, namely the previous publishing activity (AvgArtNo), the total number of published outputs in Slovakia in given years (Enviro) and the quality of the faculty of the main researcher (coefA). This confirms that the external environment around the researcher was of the greatest importance for successful results related to higher quality publication. Better results have been achieved by researchers who have previously published in investigated databases and at the same time worked at the faculties that achieve the best research results within the country. In addition, the quality of the faculty of the main researcher was statistically significant, but negative, in affecting the total number of publications from the projects. This confirms the assumption that researchers from higher quality faculties tend to focus on better, albeit less numerous, outputs than researchers from lower quality faculties. The influence of the external environment is thus much stronger in the case of higher quality publications than in the case of the total number of outputs, when in models focused on the total number of outputs none of these variables had a statistically significant positive effect on the total number of publications.

Discussion

This section provides a discussion on the main findings of the presented research as well as considers the limitations of the study. As we see, the volume of funding has slightly positive, but not significant impact on the production of higher quality articles in the economic sciences. On the contrary, the quantity of funds has statistically significant impact on the total number of publications. These results are in line to the results of Godin (2003), Jacob and Lefgren (2007), Popp (2015), Rosenbloom et al. (2015), Ebadi and Schiffauerova (2016), Tahmooresnejad et al. (2015), Beaudry, Allaoui (2012), Mongeon et al. (2016), which point to the significant impact of the volume of funding on the production of scientific articles. However, these studies usually work with infrastructure-dependent science areas and larger volumes of support with an average value of more than 100,000 EUR (Jacob and Lefgren 2007; Bloch et al., 2014; Popp, 2015). The average value of projects in the presented research was only 10,811.12 €. This shows that even with small grants scheme the volume of funding has an impact on total publication outputs.

However, we also tried to build models focused on publications of higher quality. Here, the impact of the volume of funding proved to be significantly less important than for overall outputs. This suggests that to motivate researchers to do better research, it is probably necessary to reach a certain "threshold level" of funding to ensure that the project is crucial for the researcher and focuses on the best possible outputs. If the total amount of funding is low, researchers are likely to apply for other grant schemes or collaborate with practice and publish only minor outputs in a given project (for example, a large part of the outputs under the scheme are conference proceedings of conferences organized by researchers' universities). This could also explain the results concerning the work of researchers from the Bratislava region (dBrat) We see that this effect is positive for overall outputs and negative for better outputs. It is in the Bratislava region that the best universities, which are involved in international projects or projects of cooperation with practice, are concentrated. These researchers can then take the SGA grant scheme only as a supplement, to which their published outputs in this scheme correspond.

The size of the overall support may also be the reason why cooperation on projects (dCoop) is statistically insignificant in our models, contradictory to De Solla Price and Beaver (1966), Lee and Bozeman (2005) or Lissoni et al. (2011), which identify collaboration as an important factor. Our grants are provided to a larger number of beneficiaries with a budget on average of 10.8 thousand €. In case of cooperation, average budget for partner is less than EUR 3 thousand, which probably make cooperation more formal as real. Also, the same lack of motivation mentioned above applied also for partner researchers. This could be the reasons for the low importance of collaboration in our models.

The strong influence of the external environment on higher quality outputs (Enviro, CoefA) is also interesting, which shows that the more it was published in higher quality journals in the given years, the more these outputs were also published within the researched grant scheme. This could indicate the impact of institutional funding on these projects and the complementarity of these funding schemes. In Slovakia, institutional funding has shifted more towards result-oriented funding with publication in the WoS and Scopus databases over the years studied, leading to a gradual overall increase of these publications. As there was no need to specify the forms of outputs in advance under the SGA scheme itself, the researchers reflected on the requirements of institutional funding for more outputs in the Scopus and Web of Science databases by increasing the volume of these outputs also under the SGA scheme.

The average previous publishing activity of the research team, the quality of the faculty presented by the accreditation coefficient and the impact of institutional funding, have proved to be significant factors for higher quality publications. These results are expected and consistent with other studies (Ebadi and Schiffauerova 2016). We think, that specially in these small grants scheme, it turns out that the production of high-quality scientific outputs is more dependent on the quality of the research team and the workplace itself than other factors. Both of these factors were statistically significant when publishing higher quality publications. On the contrary, they played no role in influencing the total number of publications within the projects. This suggests that researchers with better previous research activities, working at better universities, tend to focus on quality outputs rather than on the total number of outputs, even with small volume of grants obtaining. This indicates that if future outputs are not considered in the selection process of suitable projects for funding, it is appropriate that the evaluation criteria in small grants schemes are focus on the previous quality of the outputs of research team and quality of research institution.

Conclusion

This article deals with evaluating the impact of small grants on higher quality publication outputs. First of all, it should be noted that the total number of publications that we consider to be "higher quality" is very low in the total number of publications, accounting for only about 4% of all project outputs. On the contrary, more than 70% of the outputs are local conference proceedings or non-peer-reviewed journals, so publications that did not have to go through a rigorous peer review process. This suggests that with low financial resources, researchers will focus more on the easier-to-reach quantity of outputs.

This is also confirmed by the results of research of individual factors that influence the publication outputs achieved within the projects. The results of the models show that the amount of funding allocated does not significantly affect the production of higher quality scientific articles in the field of economics. On the contrary, the volume of funds has positive significant, but very small, influence on the total number of publications. This suggests that to motivate researchers to do better research, it is probably necessary to reach a certain "threshold level" of funding to ensure that the project is crucial for the researcher and they have sufficient time and resources to focus on more significant results and publications. Our research has shown significant differences in factors affecting total publication outputs and higher quality articles. In the first case, factors related to the scheme itself, such as the volume of funding or the size of the research team, had a greater impact; in the second case it was mainly the quality of the researchers' previous outputs and the external environment in which the researchers operated.

At the same time, the research raises some other issues that may have a significant impact on the proper functioning of these grant schemes. The most interesting is the question of the mutual interaction of project funding

and institutional support for smaller grants. The small grants set up in this way then have no effect on improving research outputs, especially the more relevant one. The research also indicates the need to work on identifying better outputs within the implemented projects, the achievement of which within the projects differs considerably in comparison with the total number of outputs.

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