Sources of Research Funding and Academic Productivity

Brunilda Xhepi, University of Tirana, Albania
Blendi Gerdoçi, University of Tirana, Albania
Dorena Dyrmishi, Albanian American Development Foundation, Albania

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Abstract
This study aims to explore the impact of different sources of funding on research productivity. Using a sample of 403 academics, we employ ordinal and logistic regressions to assess the different sources of funding, namely the universities, government, EU, private entities and development agencies, on three different outcomes, namely the number of articles published in the first and second quartile journals of according to Journal Citation Reports (JCR), the number of articles published in the third and fourth quartile and the binary choice whether to publish in the first and second quartile or other lower-ranking journals. The results show that EU and development agencies' funding positively affects the number of articles published in high-ranked journals. In contrast, the funding from development agencies is the only funding source that affects the number of articles published in low-ranked journals. EU is the only source of funding that affects the choice to publish in high vs lower-ranking journals. Implications for the policymakers are further discussed.

Keywords: Research Funding, Sources of Funding, Research Productivity

1. Introduction

During the two decades following the fall of communism, Albania experienced a substantial brain drain. According to the 2013 report of the World Bank (World Bank, 2013) more than half of the professors, researchers and intellectuals who were educated abroad did not return to the country. Furthermore, over half of all lecturers and researchers emigrated during the 1991–2005 period, constituting a significant loss for the academic community (University of Sussex, Uk, 2006). Albania in 2010 had only 245 researchers per million inhabitants, a figure that accounted for only 10% of the European average (World Bank, 2013). To fill this gap from 2011-to 2013, the Albanian government approved 4827 quotas for young lecturers to be recruited in various country universities. Such an increase in young academics resulted in a growing number of publications. However, the quality of many of these publications was dubious at best.

One of the barriers to improving research productivity is the low level of funding. According to the (UNESCO, 2015), Albania spends about 0.2% of its GDP on research and has the lowest per capita spending on research and innovation in southeast Europe. However, the funding situation for research in Albania does not seem optimal. Albania remains one of the countries with the lowest level of funding and the most limited access to generate alternative income that would help raise research standards, compared to all European countries, including our closest neighbors (Papadhopulli & Miço, 2019). In 2020, Albania spent less than 0.25% on R&D as a percentage of GDP - the lowest in the region – making it very difficult to produce knowledge, retain talent, create a quality higher education system, and enable the transition to a new, more sustainable, knowledge-based economic model (UNESCO, 2020).

The importance of funding for research productivity cannot be overstated enough. Some scholars suggest that funding is significantly related to the number of citations (Myers et al., 2011). Besides, the author indicates that the citation impact is positively related to the variety of funding and negatively related to funding intensity. Similarly, (Győrffy et al., 2020) suggest that there is a significant effect of funding on the quantity of high-quality publication (i.e., publication in the first quartile (Q1) ranked journals). Controversially, some other authors argue that there is no positive relationship between the number of grants and research quality (Mijaki & Yuko, 2018; Jung et al., 2017). Besides, the relationship can be better explained by the bias toward the reputation of the researcher rather than the research quality (Ebadi & Schiffauerova, 2015). Another prominent stream of research focuses on the impact of funding on research output. Some studies suggest a small positive impact of funding on scientific output (Arora & Gambardella, 2005), especially in the earlier stages of the researcher's career. Other authors qualify their findings by suggesting a positive correlation for the younger cohort, only within one discipline and not in interdisciplinary studies (Mijaki & Yuko, 2018). Finally, some scholars argue that not all academics need funding to conduct their academic research, indicating humanities and social science as research fields that do not require funding to conduct research (Grove, 2017). In conclusion, it can be argued that the findings concerning the relationship between funding and research quality and quantity are mixed and somewhat inconclusive.

Sources of funding are viewed as another factor that affects research productivity. (Mijaki & Yuko, 2018) divided sources into two main categories, namely external and internal funds. Internal funding consists of governmental core funding and university assets and external funding, which can be defined as public and private research funding that is not part of the

core funds (Mijaki & Yuko, 2018). There is ample evidence for the effect of funding on research output, but different sources affect more than others. Scientific output is positively correlated with internal and external funding (Haven et al., 2020), while for economics, only internal funding increases productivity (Mijaki & Yuko, 2018). Some scholars identify a causal relationship between external funding and scientific output (Myers et al.; Aagaard et al., 2019), but others do not find evidence that grants positively affect research productivity (Lanser & Dalen, 2013). Further, other studies evaluate that a dual funding system, i.e., multiple sources of funding, is a reason for success (Grove, 2017; Adams & Bekhradnia, 2004). The availability of many potential sources of funding leads researchers to shift from one source of funding if they are not successful with the application (Jacob & Lefgren, 2011). Based on these arguments on the importance of funding sources, our study focuses on five common funding sources: funding from the university, government agencies (via competition-based grants), the European Union programs, private entities, and development agencies. We also control for the effect of multiple sources of funding.

Besides the factors mentioned above, research productivity is affected by the personal attributes of the researcher (Jung, 2012; Albert et al., 2015). Age is among the attributes whose effect on productivity is debated. For example, some researchers argue that there is no correlation between age and publication performance (Győrffy et al., 2020), while others argue that age has a negative impact on the quality of research (Jung et al., 2017). Similarly, research suggests that personal attributes might affect funding too.

Young and inexperienced academics and researchers in the early career stage do not receive funding unless they collaborate with senior academics and researchers (Ebadi & Schiffauerova, 2015). There appears to be a positive relationship between funding and experience (Ebadi & Schiffauerova, 2015). Hence, in this study, we control for their confounding effect.

In Albania, research productivity in general and funding sources are under-researched areas. To the best of our knowledge, no studies have explored the dynamics of such phenomena. This study aims to differentiate the effect of different sources of funding on research productivity. Moreover, we investigate whether sources of funding impact the behavior of researchers concerning the quality of journals they want to publish, i.e., whether they publish in high- or low-ranking journals.

The rest of the paper is structured as follows: Section 2 presents the data and methods used. Section 3 presents the results of the regression analyses. Finally, section 4 includes theoretical discussions, limitations, and suggestions for future research.

2. Materials and Methods

2.1 Participants and data collection

Data were collected using an online survey targeting the entire population of academics working in 37 public and non-public Higher Education Institutions. We contacted around 6500 lecturers via email, although only 1038 accessed the online questionnaire. Out of the total number of respondents, only 712 filled out the questionnaire, while a smaller number of 403 completed the questionnaire. The missing data exceeded the threshold of 20%.

2.2 Outliers and bias examination

Z-score analysis showed that there are no outliers. We tested for the non-response bias by using wave analysis. No difference between early and late respondents was found in terms of respondent attributes such as gender ($\chi 2$ test, $p = 0.286$), university (private vs public ($\chi 2$ test, $p = 0.128$), university degree (PhD vs MSc) ($\chi 2$ test, $p = 0.499$), and title indicating the lack of non-response bias in our study.

2.3 Empirical model

Ordinal and logistic regression were used since the outcome variable is ordinal or binary.

2.4 Operationalization of variables

The five variables measuring the five sources of funding and the one measuring the whether multiple sources of funding are used or not have been operationalized using a binary variable (i.e., yes or no).

The first two outcomes, respectively, the number of articles published in the first and second quartile (respectively, Q1 and Q2) of the Journal Citation Reports (JCR) and the number of articles published in the third and fourth quartile (respectively, Q3 and Q4) of the Journal Citation Reports (JCR) were measured using a categorical variable (0 articles published was coded with 1, 1 to 3 = 2, 4 to 6 = 3, 7 to 9 =4, and more than 9 = 5). The last outcome, the binary choice of publishing in a Q1 and Q2 vs publishing in other low-ranked journals, was measured using a dichotomous variable, taking the value of 1 for the first choice and 0 for the second.

3. Results

Table 1 shows the results for three models. The first model shows the results of the effect of the independent variables on the number of articles published in the Q1 and Q2 quartiles of JCR. The second model shows the results of the effect of our predictors on the number of articles published in the Q3 and Q4 quartiles of the JCR. Finally, the last model shows the results of the same explanatory variables on the binary choice, whether to publish in Q1 and Q2 or low-quality journals.

All three models fit the data (model fit p-value < 0.0001). Further, the goodness of fit significance is higher than 0.05 for the first two models, while The Hosmer-Lemeshow test significance is above the threshold of 0.05 (p-value = 0.892). These tests indicate a perfect fit for our models. The test of parallel lines for the first two models is not significant (respectively 0 .944 and 0.334); thus, the effects of our predictors are proportional across the different thresholds.

The Nagelkerke Pseudo R-Square indicates that the first model explains around 18% of the variance, the second, almost 22% and the third, only 12% of the variance of our outcomes.

In the first model, EU and development agencies' funding are the two predictors among the five barriers that affect productivity measured as volumes of articles published in Q1 and Q2 journals. The coefficients are respectively, -0.779 (p-value = $0.033 < 0.05$) and -0.716 (p-value = $0.04 < 0.05$) for the lack of funding from these two sources. In the second model,

funding from development agencies predicts the number of articles published in Q3 and Q4 journals (Coeff. = -1.173, p-value = 0.001 < 0.01). Finally, in the third model, EU funding is the only funding source that affects scholars' behavior and their decision to publish in high-quality Q1 and Q2 journals or less reputable ones.

	Number of articles published in Q1 and Q2 Journals	Number of articles published in Q3 and Q4 Journals	Publishing in Q1 and Q2 Journals vs publishing in low-quality journals	
	Coeff. (s.e.)	Coeff. (s.e.)	Coeff. (s.e.)	Exp(B)
Public University	0.205 (0.239)	0.281 (0.257)	-0.140 (0.248)	0.87
Non-public University	0[a]	0[a]	N/A	N/A
Gender (female)	0.003 (0.210)	-0.339 (0.219)	-0.032 (0.223)	0.968
Gender (male)	0[a]	0[a]	N/A	N/A
Scientific title (not title)	-0.823** (0.405)	-1.487*** (0.407)	0.317 (0.202)	1.374
Scientific title (Assoc. Prof.)	0.183 (0.418)	-0.594 (0.415)	N/A	N/A
Scientific title (Prof. Dr.)	0[a]	0[a]	N/A	N/A
No P.h.D.	-0.633** (0.269)	-0.837*** (0.299)	0.782*** (0.267)	2.186
P.h.D.	0[a]	0[a]	N/A	N/A
PhD (Albanian University)	-0.051 (0.284)	0.086 (0.296)	0.126 (0.309)	1.135
PhD (abroad)	0[a]	0[a]	N/A	N/A
Experience (0-5 years)	0.051 (0.368)	0.354 (0.395)	0.004 (0.089)	1.004
Experience (6-10 years)	0.703** (0.349)	1.040*** (0.368)	N/A	N/A
Experience (11-15 years)	0.185 (0.344)	0.009 (0.369)	N/A	N/A
Experience (16-20 years)	0.552 (0.346)	0.650* (0.358)	N/A	N/A
Experience (more than 21 years)	0[a]	0[a]	N/A	N/A
No University funding	-0.262 (0.276)	-0.149578	0.495 (0.300)	1.641
University funding	0[a]	0[a]	N/A	N/A
No Government funding	-0.41934	-0.612 (0.488)	0.718 (0.582)	2.05
Government funding	0[a]	0[a]	N/A	N/A
No EU funding	-0.779** (0.366)	-0.396 (0.378)	0.870** (0.423)	2.387
EU funding	0[a]	0[a]	N/A	N/A
No Private funding	-0.625 (0.560)	-0.464 (0.578)	1.210* (0.685)	3.353
Private funding	0[a]	0[a]	N/A	N/A
No Development agencies funding	-0.716** (0.348)	-1.173*** (0.349)	0.365 (0.386)	1.44
Development agencies funding	0[a]	0[a]	N/A	N/A
No multiple sources of funding	0.687 (0.529)	0.300 (0.540)	-0.847 (0.600)	0.429
Multiple sources of funding	0[a]	0[a]	N/A	N/A

Note: '***' p < 0.01; '**'p < 0.05; '*'p< 0.1; coefficients (Coeff.); standard errors (s.e.).

Table 1: Model results

Our analysis shows that having a scientific title (Prof. Dr) makes the difference, with the coefficient for "no scientific title" being negative and significant for the first two models

(respectively, Coeff. = -0.823, p-value = .042 < 0.01 and Coeff. = -1.487, p-value < 0.001), but not the third. However, there are no significant differences between the scientific title "Prof. Dr." and "Prof. Assoc." Similarly, individuals with a PhD tend to perform better compared to those without it; the coefficient for the latter is negative and significant across the three models (respectively, Coeff. = -0.633, p-value = .019 < 0.05 for the lack of a Ph.D., Coeff. = -0.837, p-value = .005 < 0.01 for the lack of Ph.D. and Coeff. = 2.186, p-value = .003 < 0.01 for obtained Ph.D.). However, having a PhD abroad does not affect any of the outcomes in the three models. Further, experience appears to have a certain effect, at least for the first two of our models, indicating that the experienced researchers but still young (6-10 years of experience) perform better than the older generation (respectively, Coeff. = 0.703, p-value = .044 < 0.05 and Coeff. = 1.040, p-value = .005 < 0.01. Finally, gender and being part of a public university do not affect productivity.

4. Conclusions, Implications, Limitations and Further Research

This study is the first attempt in Albania to investigate the relationship between funding and research output by accounting for the quality of research. We found that EU and development agencies' funding affects the research output published in Q1 and Q2 journals. Further, funding from development agencies has a positive effect on the number of articles published in Q3 and Q4 journals. Such results are in line with some of the previous research that suggests that external sources impact the output (Myers et al., 2011; Aagaard et al., 2019). Finally, we found that the effects of EU funding extend to the choice made by researchers whether to publish in high-ranking journals (i.e., Q1 and Q2) or low-ranking ones indicating that a clear tendency of researchers funded by EU grants to increase the quality of their research. Quite surprisingly, our results on the effect of internal funding on research output are either not significant or not robust. There is an indication of a positive effect on the number of publications in low-ranking journals, but the significance level is low (p-value > 0.05 and <0.1). Such results are in contrast with findings of (Myers et al., 2011; Aagaard et al., 2019). These findings suggest perhaps that the criteria applied for grant applications do not include publications, as it is a common practice worldwide. Finally, contrary to the claims of (Grove, 2017; Adams & Bekhradnia, 2004), we found no evidence of the impact of multiple sources of funding on productivity.

Not having a scientific title or a PhD degree has a negative effect on productivity, indicating the vital role that career advancement criterion (i.e., the requirement to publish) has on research productivity. However, in line with the findings of (Arora & Gambardella, 2005), the relatively young but already experienced scholars (i.e., 6 to 10 years of experience) perform better than their older generation counterparts. Further, having a Ph.D. degree positively affects productivity across the three models. Finally, other factors such as gender, having obtained a PhD from a university abroad, and working in a public university do not affect research productivity. The results are consistent throughout the three models.

Our study has important implications for policy-making at the institutional level and, more generally, at higher-level decision-making (e.g., government). First, more efforts should be made to ensure the application of higher standards for internal funding, being that of Government agencies or universities. While anecdotic evidence suggests that there have been some efforts in the last years, much remains to be done in the future to increase accountability and transparency of the process. Our study suggests that research funding from the EU appears to be a synonym for quality. Therefore, the approach, including the criteria used by the EU, should serve as a template for these institutions in designing and

implementing grant research schemes. Second, the vital role that development agencies' funding has suggested that the collaboration between universities and these organizations should be institutionalized and not left to individual initiatives and consultancies provided by Albanian researchers.

This paper comes with several limitations. First, we did not account for the Matthew effect, i.e., a researcher that has been funded in the past will continue to be preferred for funding in the future (Győrffy et al., 2020; Ebadi & Schiffauerova, 2015; Arora & Gambardella, 2005; Bol et al., 2018). Second, we did not account for the variability introduced by other academic barriers (see Tien, H.T., & Hai, N.T., 2011), the academic discipline (see Jung, 2012) and (Albert et al., 2015), research collaboration (see Nguyen, 2015), participation in academic associations (see Valsangkar et al., 2016), and a responsible research climate (see Haven et al., 2020). Third, we measured our outcome as a categorical variable leading to loss of variability. Similarly, using a binary dependent variable in the third model leads to a loss of details. Fourth, we focused on one of the outcomes of research (i.e., publications) neglecting other possible outcomes (e.g., patents, new products, conference papers) that might have justified funding.

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