

# Impact of the funding structure on R&D in cases of European Union and Russian Federation

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## Abstract.

**Research background:** Many contemporary empirical studies and theories of economic growth have revealed the dependence of innovative development of countries on the adequacy of funding for innovation. However, much of the empirical literature has discussed the issue of innovativeness without assessing the impact of the structure of funding sources on the success of the innovation process.

**Purpose of the article:** The aim of this paper is to prove the hypothesis of the inefficiency of innovative systems in which the proportion of public investment is high compared to private investment. In Russia, the share of public R&D funding is 67%, and the EU average is 33%.

**Methods:** Based on the empirical research, we have compared the EU Horizon 2020 program with Russian VEB Ventures programs, conversion and digitalization programs of the Industrial Development Fund and found out how the structure of funding sources for these programs affects the success of their implementation.

**Findings & Value added:** The results of our research show that a large share of public funding is not the cause, but the result of low private innovation activity and a lack of private investment. Significant reasons for their shortage were identified: the economic feasibility of purchasing ready-made solutions on the global market instead of funding research; cheap labour; adverse business climate. Thus, a high share of public financing of innovations in a country can serve as an indicator of the existence of serious reasons for restraining innovative development.

**Keywords:** innovations; public funding; private funds; the Horizon 2020; research and development

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## 1 Introduction

A number of works show the defining role of innovations in the life of society. In the work of Josef Botlik is studied the impact of innovations on socioeconomic structure of the society. He comes to conclusion that innovations have direct impact on behavior of companies and employees. On one hand, automatization of processes reduces number of workplaces. On the other hand, incentives are being created to improve professional skills of employees and to create products with a higher level of additional value [1]. Researches come to conclusion that innovations, unparticular, creative innovation, significantly increase the competitiveness of traditional institutions and create a multiplier effect in the economy [2, 3]. Therefore, the public is interested in investing in the development of innovation activities.

If an innovation project does not experience any difficulties with financing then the probability of its success is much higher [4]. Juris and Cugova showed the impact of external and internal factors related to innovation activity of the company. As one of the main factors they highlight the lack of funding [5]. Developed financial institutions have a significant impact on the effectiveness of innovation systems. However, the availability of Finance is faced with the fiasco of the innovation market, especially at the initial stage of exploratory research. Innovation projects have a high degree of uncertainty of the result in general and commercial success in particular in most of the cases [6]. A significant risk for investors with rare exceptions makes traditional financing in the form of bank loans on market conditions inaccessible. According to Barbara Hoening the issue of financing of R&D is vitally important task for remaining in global competition towards innovation leading for each country [7].

The uncertainty factor of the result makes it necessary for the public to intervene. To overcome the barrier of uncertainty, the public is forced to implement public budget financing of the innovation system itself and act as a guarantor for loans, as well as implement a tax policy that encourages innovation projects. In that way public funding can bring significant benefits by playing a major role in preventing market failure at the stage of commercialization of R&D. Moreover, public funding serves as a stimulus for the implementation of socially important projects. Dirk Czarnitzki and Cindy Lopes-Bento used the example of Germany to show that projects with public funding are more active in registering patents and that these patents are more in demand than projects without public participation [8].

Interaction between the public and the private sector is an important factor in the effective development of the innovation and business environment. In contrast to the well-known effect of crowding out private investments by the public one, in the innovation sector public investments has a positive effect on the volume of private investments. Petelski, Milesi and Verre use the example of the innovation system in Argentina to prove that there is no complete crowding-out effect [9]. Azoulay, Zivin, Li, and Sampat come to conclusion that public funding spurs the development of private-sector patents [10]. Also Jian Xu, Xiuhua Wang and Feng Liu argue that public investments have a positive effect, in particular, direct public funding stimulates private investments in R&D [11]. Public funding encourages private investment in innovation projects by making them more attractive in terms of removing uncertainty and increasing their economic efficiency. Thus, programs of public funding of innovations should perform function of attracting and stimulating private investment, which in total is reflected in the rate of economic growth, in the indicator of labor productivity and in the living conditions of the population. Failure to perform the incentive function means that the business has valid reasons to refuse in co-funding R&D. For Instance, Felipe Berrutti & Carlos Bianchi show that public participation does not have a positive impact on the country's innovation system and additional public funding causes

an increase in private funding but only as part of firms' acquisition of created innovations [12].

An innovation project has its own stages of development starting from the seed stage to the distribution stage. Each stage of an innovation project has its own funding features, from feasibility grants, business angels to venture capital funds, debt or bridge loans and public stock markets with the corresponding increase in cash flow and private participation in project funding. The most difficult stage of innovation project is the seed or start-up stage since the absolute majority of projects at this stage have a lack of funding for research activities and creating a product prototype. Therefore, the most promising ideas do not get the necessary development [26]. The main forms of funding innovation projects at the seed stage are their own funds or seed public investment. As a rule, such investments are allocated in the form of grants on a competitive basis. Many countries do not support innovation projects at early stage as investment evaluation of such projects requires appropriate competencies and initial costs. The most common type of funding of innovation projects at the early stages is business angels. Their role is played by private investors who provide equity funding for innovation projects. At the mature stage, developers can apply for funding from venture funds or traditional financial institutions since they already have a product and demand for it.

Under the condition of globalization, foreign direct investment is an important element of innovative development of countries. Bran, Bodisla and Mitriță believe that automatization processes are a new wave of globalization. Digitalization and automatization make the business environment more transparent and attractive which increases the inflow of foreign direct investment [13].

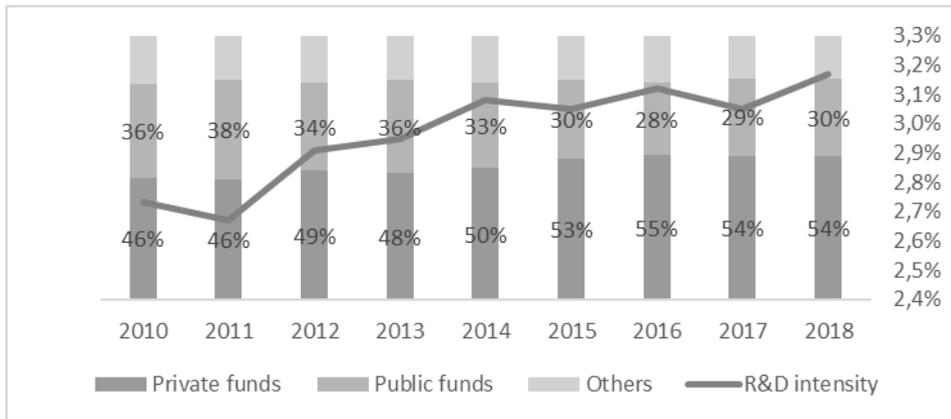
The role of the public is important in the development of business environment by setting priorities and funding [5]. According to a survey of companies in the European Union, 28% of companies do not develop innovation due to lack of financial resources. In 2018, the share of public funding for research and development averaged across the EU countries was 33%. In Russia, the same indicator reached 67% [14]. However, in absolute terms, costs vary greatly. For example: Germany's spending on research and development exceeded Russia's by 3.5 times [15].

As a testable hypothesis, the article puts forward the following statement about inefficiency of innovation systems, in which the indicator of the share of public investment is much higher than that of private investment. Public funding for innovation is not absolutely excessive but rather relative to insufficient private funding and the supply of initiative projects.

## **2 The comparison of public funding of R&D in EU and Russia**

One of the priorities of the European Union's innovation policy is to increase the indicator of R&D intensity. It reflects the degree of interest of economic entities in the development of innovations. The European Council set an overall target of 3 % of GDP [16]. At the same time, the share of public funding in the structure of R&D expenditures should not exceed 38%. Now the gap between the 2018 indicator and the target is 0.81 % which in absolute terms is equal to 110 billion EUROS. A comparative analysis of the values of the R&D intensity indicator of European Union and the Russian Federation for the period from 2007 to 2018 shows that the values of R&D from 2007 to 2018 fluctuated around 2% in the European Union and 1% in Russia [16]. It should be noted that the value of the indicator for the European Union differs across 28 countries. The leaders are Sweden with 3.32%, as well as Austria and Germany with values greater than 3%. Russia's lag in this indicator from these countries is significant and indicates major problems in funding R&D.

In most countries private funding is significantly higher than public funding. This is because most of the innovation market in these countries consists of innovations that have reached the stage of commercialization. They allow companies to improve their performance. If we take a look at the structure of sources of innovation funding for enterprises in the leading countries of European Union and Russian Federation we can conclude that a significant part of innovation funding in European Union is accounted for by private investment of more than 50 % in 6 out of 7 cases. For example, Austria managed to increase the R&D intensity indicator by almost one percentage point between 2007 and 2017 which is the second result among the countries of the European Union. Fig. 1 provides a comparison of R&D intensity and changes in the structure of innovation funding in this country.



**Fig.1.** The comparison R&D intensity and the structure of funding of R&D in Austria.

Source: [15].

The picture shows that in Austria, simultaneously with the growth of R&D intensity, there is an inverse relationship between public and private funding. During the period under review, the share of public funding has decreased by 6 percentage points while private funding has experienced a significant increase from 46% to 54% in the R&D funding structure. There is also a strong positive correlation between the values of private funding and R&D intensity, the correlation coefficient of the two variables was 0,86.

The situation is the opposite in the Russian Federation where a significant part of the costs of innovation activities is borne at the public budget. Between 2013 and 2018, the share of government R&D funding was stable at 68% [15] which indicates a low level of efficiency in performing the function of stimulating private investment since public funding did not attract them but rather replaced them.

The degree of government involvement is a debatable issue among economists. However, public support for innovation is present in the vast majority of developed and developing countries. It is expressed in various forms. For example, direct funding of innovation projects prevails in Germany, while tax benefits prevail in France [15]. According to the study by Dominique Guellec and Bruno Van Pottelsberghe, direct public funding is a substitute for private funding and reduces its effectiveness [17]. Keuschnigg and Ribi, in their research on the effectiveness of public funding methods, concluded that the direct support has a positive impact on the development of innovations, while tax incentives for income tax have negative effect on the contrary [18].

The European Union is developing medium-term innovation funding programs for a period of 5-7 years. Splitting funding programs for medium-term periods allows you to maintain the relevance of the program in terms of the budget, the main areas of funding, as

well as the conditions for its provision. The government of the European Union plans to attract a significant part of the funding deficit through private capital. Public participation makes innovation projects more attractive to private capital. The framework program for 2014-2020 is the Horizon 2020 and, in particular, InvestEU, is the basis for public funding of research activities of the European Union. The program's budget is 77 billion EUROS which are divided into six different areas such as advanced science, industrial leadership, social challenges and others. Table 1 shows the structure of distribution of Horizon 2020 funding among the main users.

**Table 1.** The share of EU contribution at the end of 2016, %.

<b>Participants of Horizon 2020</b>	<b>Share, %</b>
Public bodies	6,3
Private sector	33,2
Universities	32,9
Research organizations	22,3
Others	5,3

Source: [19]

Elvekrok, Veflen, Nilsen and Gausdal proved the effectiveness of the triple helix approach where each element performs its function: business forms the requirement, scientific organizations develop solutions and universities provide the creation and flow of knowledge [20]. Also Wenhui Pan, Pengwei Zhao and Xianfeng Ding show that collaboration's effect on research innovation in high innovation networks is larger than that in low innovation networks [21]. The distribution of funding in the Horizon 2020 program follows the concept of a triple helix. Table 1 shows that more than 50% of funding goes to universities and research organizations where knowledge is created. More than 30% of funding comes from private sector which is engaged in the implementation and commercialization of created innovations. The main focus of funding is projects related to advanced science – 7.5 billion euro, with one funded project accounting for 1.24 million euro. The development of advanced science involves creating incentives for research, creating infrastructure and, importantly, attracting scientists from other countries. The way to encourage private investment is to fund innovation companies that should ensure the technological leadership of the European Union in the near future. 4.5 billion euro were allocated for this purpose which is one-fifth of the total cost of the program. According to European researches one Euro of public funding can attract private investment in the amount of five euro [7]. The Analysis of the program's cost structure reveals the mechanism for creating and developing innovations in the European Union. First of all, the public performs a social function by investing financial resources in the development of science, education and innovation which aimed at improving the quality of life of society. Then there are projects aimed at developing the business sector while the amount of funding for these projects is less than for social projects since private funding induced at public funding is taken into account.

In Russian innovation practice, it is difficult to find an analogue of European program, the Horizon 2020. Innovation initiatives in the Russian Federation are funded through several development programs and institutions.

As a part of the strategy for innovation development of the Russian Federation, a program for financing science and education was created - "Development of science and technology". This program is aimed at financing budgetary institutions that carry out fundamental and exploratory research and improving conditions for Russian researches. Table 2 shows the structure of funding for science and technology under the program "Development of science and technology". The table shows that the share of private

funding is insignificant and that 1 euro invested by public brings 10 eurocents of private funding which indicates a low efficiency of the incentive function.

**Table 2.** The structure of funding under «Development of science and technologies» program.

Year	2013	2014	2015	2016	2017	2018
Efficiency of public funds, Eurocent	0,00	0,12	0,11	0,13	0,12	0,10
Public funds	100%	89%	90%	88%	89%	91%
Private funds	0	11%	10%	12%	11%	9%

Source: [22]

An important difference between the European and Russian programs lies in the mechanism of distribution of funds, as well as in their users of this program. While the European program allocates funds in the form of requests from researches from all over the world, the Russian program distributes funds not directly to researchers but through budget institutions acting as intermediaries. This complicates money flow routes and reduces their efficiency by creating additional bureaucratic difficulties for researchers and intermediaries to interact.

«VEB Ventures» is a venture Fund of the Russian Development Institute “Bank for Development and Foreign Economic Affairs” which was restructured in 2019. The purpose of the Fund is to finance high-tech projects through direct investment, creation of investment funds or provision of debt financing. This Fund is designed to close the funding gap for mature innovation projects. The distribution of funds takes place in the form of selection with pre-established criteria which are an acceptable filter for innovation projects but there are opportunities to circumvent the established restrictions which can significantly affect the effectiveness of the Fund.

Industrial development Fund which has the task of financing the integration of digital solutions to industrial enterprises. It was created in order to modernize and create new industrial facilities, as well as fulfill the goals of the import substitution strategy. The Fund has strict conditions for providing funding for projects including a narrow list of the use of funds, for example, it is forbidden to use funds for research.

Separately, the program “Development of Industry and increasing its competitiveness” should be highlighted, the total budget of this program for the period from 2013 to 2020 amounted to 7 billion Euros from Federal budget. This program is aimed at providing Russian industry with modern equipment and increasing the share of high-tech products in country’s GDP. In view of the high volume of capital investments, the government of the Russian Federation expects to create a mixed budget of the program with the involvement of private capital in order to solve the problems set for this task. Table 3 shows planned data for financing industrial development projects in the form of loans with private capital.

**Table 3.** The structure of funding projects of development manufacturing sector.

Year	Private funds (plan), bln EUR	Public funds (plan), bln EUR	Efficiency of public funds, eurocent
2013	-	0,49	-
2014	-	1,73	-
2015	-	1,51	-
2016	0,24	1,89	0,13
2017	0,18	1,83	0,10
2018	0,13	2,73	0,05
2019	0,15	3,92	0,04

2020	0,15	6,06	0,02
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Source: [23]

The planned indicators in table 3 reflect the problem of prevailing public funding. For example, in 2017, it was planned to attract 0.18 billion euro of private capital to industrial development projects. However, according to the official portal of development programs of the Russian Federation, the indicator of actual attraction of private funds was equal to zero [23]. The economic crisis in Russia caused by the COVID-19 pandemic became a reason of a reduction in incoming cash flows to the public budget. Therefore, the Ministry of Finance during the budget planning period for 2021 announced a reduction in expenditures under the program “Development of industry and improving its competitiveness”. According to Russian Ministry of finance the program budget is short of funds in the amount of 1.5 billion euro. This lack of funding should be compensated by private investments, however, the analysis of historical data shows a low interest of private investors in the development of projects under the public program.

### 3 Results and discussion

From the above, it should be concluded that public investment in reviewed programs “Development of science and technology”, “VEB Ventures” and “Development of industry and increasing its competitiveness” do not perform the function of attracting business funds to research and development. A large share of public funding is a forced measure to compensate for insufficient incentives for private investors. The analysis of the EU Horizon 2020 program confirms this conclusion by the fact that public participation makes innovation projects more attractive to private capital, as a result of which the share of private investments increases while share of public investment is smaller. On the example of the EU member countries, a positive correlation was found between the volume of private funding and the R&D intensity indicator, i.e. the ratio of research and development costs to GDP. This means that a number of EU countries managed to exceed the Horizon 2020 target of 3% R&D intensity at a relatively low cost to the public by effectively performing the function of attracting private capital.

Table 4 shows the dynamics of changes in the share of public funding in innovation and GDP per head in the European Union and the Russian Federation. The table shows that the structure of research and development funding varies significantly among the countries studied. In the Russian Federation, the share of public funding is twice as high as in the EU countries taken for comparison but public funding in the Russian Federation has a much smaller impact on welfare growth. The results of our correlation analysis are shown in the last column of table 4 and confirm the existence of an inverse relationship between the indicators in the table. As the share of public funds in R&D decreases, the GDP per head indicator increases. At the same time, the smaller the share of public funding the stronger the correlation with the well-being of the population. The reason, therefore, is a greater share of private funding.

**Table 4.** Correlation between the share of public funds in R&D and GDP per head.

Country	Metrics	2012	2013	2014	2015	2016	2017	Correlation rate
Austria	Share of public funds	38%	34%	36%	33%	30%	28%	-0,96
	GDP per capita, PPP \$	46 457	47 922	48 800	49 879	52 633	54 637	
Italy	Share of public funds	43%	41%	40%	38%	35%	32%	-0,93
	GDP per capita, PPP \$	36 486	36 315	36 195	36 909	39 923	41 785	

France	Share of public funds	35%	35%	34%	35%	32%	32%	-0,88
	GDP per capita, PPP \$	37 679	39 524	40 144	40 861	42 920	44 827	
Greece	Share of public funds	50%	52%	53%	53%	43%	38%	-0,80
	GDP per capita, PPP \$	25 284	26 098	26 838	26 903	27 823	29 089	
Germany	Share of public funds	29%	29%	29%	28%	29%	28%	-0,56
	GDP per capita, PPP \$	43 360	44 994	47 012	47 684	50 564	53 012	
Russia	Share of public funds	68%	68%	69%	70%	68%	66%	-0,48
	GDP per capita, PPP	24 303	26 074	25 762	24 085	24 125	26 006	

Source: [15, 24]

A detailed analysis of the reasons for the low activity of Russian business in RR&D funding goes beyond the goals set in this article. Thus, let's just list these reasons. First, it is a preference to buy ready-made solutions available on the global market which is confirmed by the indicator of growth in the volume of high-tech good in imports for the period from 2013 to 2017 from 62 to 68 % [25, 27]. The second reason is the relatively low cost of labor which makes the integration of technology unprofitable and at the same time reduces the aggregate demand of households and, consequently, business profitability. The third reason is unfavorable business conditions including constant unexpected changes in taxation, the dynamics of the exchange rate and the cost of credit.

## 4 Conclusion

Thus, the results of our research show that a large share of public funding is not the cause of low private innovation activity and a lack of private investment. The crowding-out effect does not work here. A large share of public funding is the result of a lack of private investment in research and development. Consequently, a high share of public financing of innovations in a country can serve as the indicator of low innovation activity of business. The growing share of public funding is a mechanism to compensate for the lack of private investment.

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