ASSESSING THE IMPACT OF PUBLIC FUNDING AND TAX INCENTIVES IN RUSSIA: RECIPIENT ANALYSIS AND ADDITIONALITY EFFECTS EVALUATION[1]

YURI SIMACHEV , MIKHAIL KUZYK AND NIKOLAY ZUDIN

ABSTRACT

So far a considerable number of studies have used the concept of additionality as basic evaluation approach but none of them paid attention to additionality effects of the Russian innovation policy yet. In this study we performed a microeconomic evaluation of the industrial firms' public innovation support in Russia focusing on its two key toolbox elements: direct funding and tax incentives. Based on the data from a questionnaire survey of top executives of Russian manufacturing firms from 2015 we identified and evaluated the profiles and the performance of recipients of direct funding and tax incentives. We also assessed the "relative" additionality - the additionality of a concrete instrument for a particular firm relative to all other used instruments - with propensity score matching. The results show that generally Russian industrial innovation policy tends to target sufficiently large and long-operating companies. In terms of effects we have confirmed not only the importance of the fiscal support in providing main aspects of additionality but also its significance in crowding-out private investment. Our results suggest tax incentives do hardly contribute to additionality of any kind which is especially unusual regarding input additionality. One should also point out a relatively small impact of public support on science-business cooperation which is quite unexpected in view of the substantial effort provided by the Russian government in enhancing its development.

INTRODUCTION

In recent years the attention to innovation policy evaluation, particularly as a means of learning and also as a search for best practice, has intensified in many countries. What has been successful in one country may be counterproductive in the other, so the problem identification should be combined with certain „experiments" over solution methods combined with learning processes development (Rodrik 2008; Chaminade et al. 2009). By now an extensive experience in assessing the impact of public policies on fostering companies' innovation activities has been accumulated. There is also significant progress in the development of methodologies concerning the assessment of science-technology and innovation policies (Crespi et al. 2011). Objectives of the innovation policy evaluation have become more complex due to the need of recording a substantial amount of different factors and effects, including non-economic ones. The evolution of evaluation techniques develops in several directions (OECD 2012):

(1) establishment of frameworks and conditions, formation of the evaluation culture, and - sometimes - the development of assessment legislation;
(2) expansion of assessing institutions and their coordination, distribution and improvement of assessment practices;
(3) formation of the base and infrastructure for evaluation - determination of standards and methodologies, combining assessment with Key Performance Indicators (KPI), accumulation of policy implementation data, support for the evaluation expert community.

The following features of a modern evaluation practice of innovative instruments can be distinguished:

(1) regular assessment, cross-country comparison of results;
(2) long observation periods (over 10 years), maintenance of extensive detailed statistical databases used for performance evaluations; openness of assessment procedures to capture new effects.
(3) the complexity and ambiguity of estimates (e.g. considering substitution effect), presence of significant time lags over output effects (4-6 years), high heterogeneity of the impact of incentive mechanisms; substantial econometric problems; preparation and submission of guidelines on principles and problems of evaluation;
(4) openness, publicity of assessment results; practical use of the assessment results for decision-making at government level – the spread of best practices; drawing lessons: in particular, making decisions to stop, clarify or expand various programs, mechanisms and instruments aimed at fostering innovation activity

It must be admitted that the Russian public innovation policy evaluation system in comparison with the best foreign examples turns out to be quite imperfect and unbalanced – due to the excessive emphasis on direct results of support and lack of attention to the process of drawing lessons.

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CONCEPT OF ADDITIONALITY: MAIN POINTS

In recent years the concept of additionality has become the basic evaluation approach of the innovation policy toolbox. In the context of government intervention the notion of additionality involves a comparison of the real situation of receiving government support with a hypothetical scenario of what would have happened if no support had been provided.

The central element of the additionality concept is the change in specific indicators and company characteristics achieved thanks to government support. For this reason additionality is often classified by the type of considered indicators and thus is divided into input, output and behavioral additionality. It must be added that in economic literature a significant portion of innovative development problems lies in the features of economic agents innovative behavior: lack of responsiveness to new knowledge, low level of cooperative activities etc. (Gok, Edler 2011). Thus, behavioral additionality should be considered more closely. Also more detailed subclasses of each type of additionality exist, which are briefly represented in figure 1. To save time we will not dig into them but instead would highlight some important points concerning the basic concept of additionality.

Figure 1 – Main types of additionality
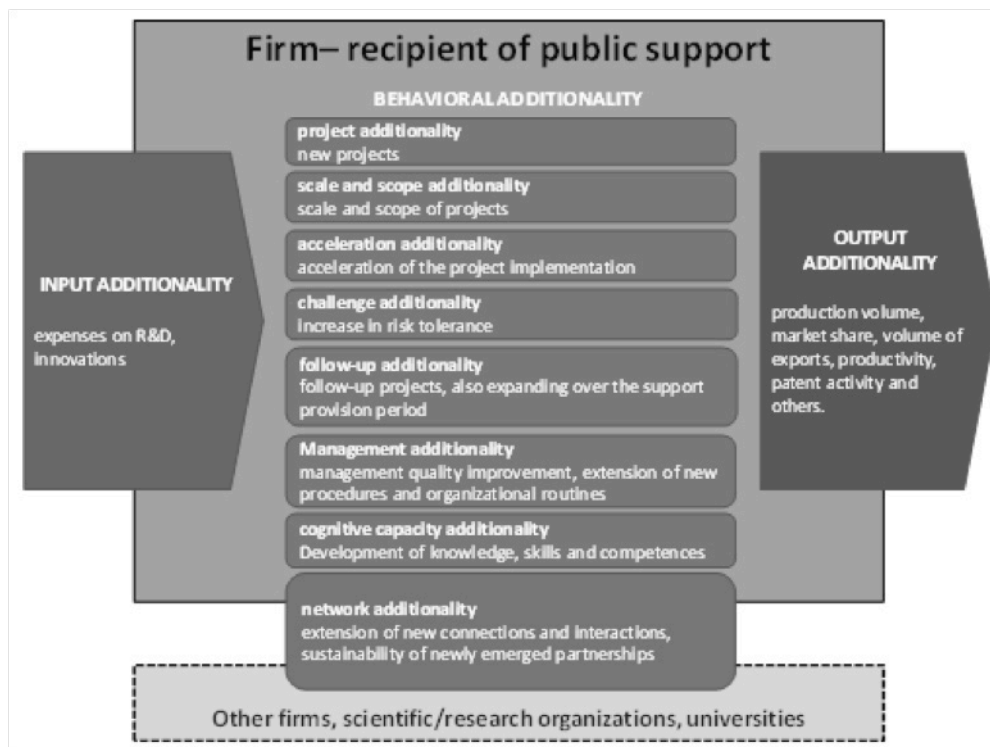
Sources: based on Buisseret et al. (1995); Georghiou (1997, 2002); Bach, Matt (2002); Georghiou et al. (2002); Rye (2002); Falk (2004); Georghiou, Clarysse (2006); Idea Consult (2006); Hsu et al. (2009); Gok (2010); Roper, Hewitt-Dundas (2012); Viljamaa et al. (2013); Wanzenbock et al. (2013); Lohmann (2014); Neicu et al. (2014)

In general, along with the main and obvious advantage of the additionality concept which lies in operating with "clean" results of public support not being achieved in the absence of the latter, one can identify a number of other important arguments in favor of this approach:
- a wide range of considered effects, including hardly formalized "quality" results of support, such as development of partnerships and competences;
- consideration of not only the direct influence of public support on a recipient, but also of the indirect impact on his/her partners in science-industrial cooperation;
- consideration of government support effects not only in the period of its provision but also after its termination is essential, firstly, to test the robustness of the results and, secondly, due to the fact that these effects often occur with a significant time lag, sometimes even a few years after provision of government support (Lopez-Acevedo, Tan 2010; Crespi et al. 2011a).

Thus, the use of the additionality concept as the basis for the analysis of public support effectiveness enables to minimize the risks of overvaluation (due to the orientation on a net effect) and of undervaluation (what is even more important from the standpoint of identifying and disseminating best practices).

CONTEMPORARY EMPIRICAL EVIDENCE ON PUBLIC SUPPORT ADDITIONALITY: BRIEF OVERVIEW

So far a considerable number of studies assessing the effects of innovation policy on firms' activity with the use of the concept of additionality has taken place. However, none of the known studies paid attention to additionality of the Russian innovation policy. In most of them the objects of analysis were various instruments of government funding solely or (more rarely) financial support for innovation in any form as the direction of the public innovation policy. Making no claim to cover all the existent empirical evidence on additionality, we, nevertheless, can identify some common features and patterns regarding the additionality of financial support on the basis of the findings of about thirty studies.

Input and output effects of public support as well as network additionality became most often subjects of analysis (figure 2). Three other types of behavioral additionality – acceleration, follow-up and challenge - in contrast, have relatively rarely attracted the attention of researchers. Finally, despite the fact that cognitive capacity additionality is often considered in theoretical works, in practice it is usually either not included in the scope of the empirical analysis or considered as a part of the follow-up or management additionality.

In most cases the results obtained by the researchers confirmed the presence of different additionality effects. However, there are important single reverse examples.

For instance, the study of Marzucchi, Montresor (2013) dedicated to the analysis of the results of financial support provided at regional and national levels for companies' innovation activities in manufacturing sector of two European countries - Italy and Spain - revealed in both countries the absence of input additionality for regional innovation funding in contrast to its presence at the national level. With regard to Italy the authors discovered significant positive impact of government support (both at regional and national levels) on process innovations, but negative impact on product innovation financing at the regional level. Researchers believe that obtained results can be explained by the fact that regional support stimulates more the "deepening" of the innovation activity rather than the production of new products. In addition, a negative relationship between regional funding and improvement of employees' qualification could be identified in case of the Italian companies. Also the same consistent pattern was found for networking with other companies aimed at obtaining information, while in the case of information networking with the scientific organizations the effect of regional funding has been, in contrast, positive.

In the study of Montmartin, Herrera (2015) devoted to the analysis of the public financial support and tax incentives on the scale of private funding of R&D on the basis of data for 25 OECD countries over a twenty-year period (1990-2009), the authors came to the conclusion that tax incentives at the country level increase the intensity of business expenditure on R&D, while direct government funding leads rather to the opposite result. In a more „localized" study (Montmartin et al. 2015) on the basis of data from 94 regions of mainland France for 2001-2011, the authors analyzed the direct and indirect impact of financial support provided at the regional, national and supranational (EU) level on private R&D spending. The results suggest that a significant input additionality

Figure 2 –Additionality of direct financial support for innovation activities of companies - generalization of empirical evidence
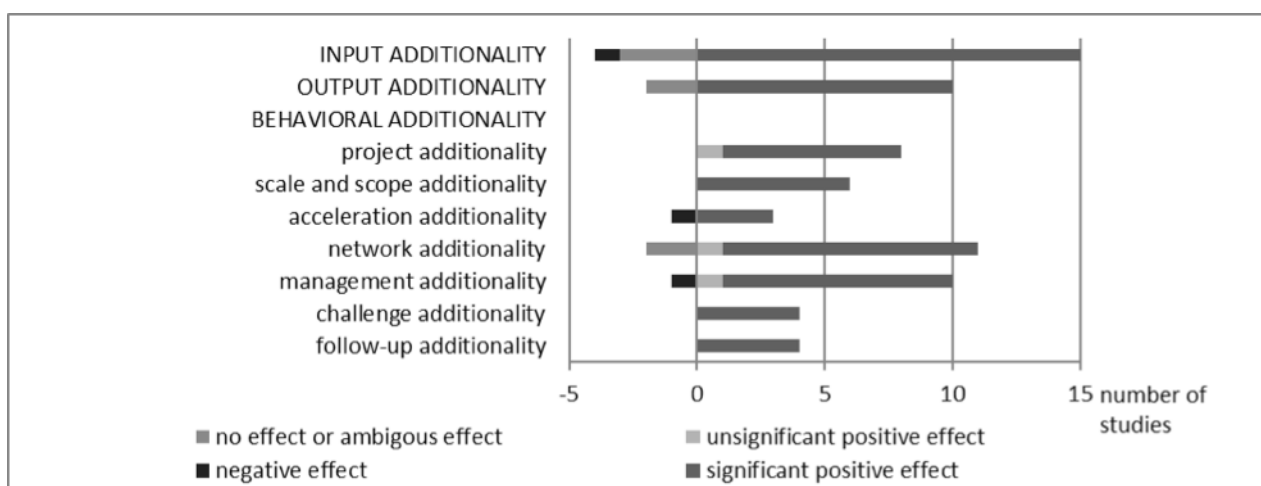
Sources: based on Đallejón, Quevedo (2005), Pegler (2005), Georghiou et al. (2005), OECD (2006), González et al. (2005), Czarnitzki, Licht (2006), Fier et al. (2006), Falk (2007), Busom. Ribas (2008), Hsu et al. (2009), Gelabert et al. (2009), Clausen (2009), Knockaert, Spithoven (2009), Idea Consult (2009), Baghana (2010), Wanzenbock et al. (2011), Catozzella, Vivarelli (2011), Marzucci, Montresor (2012), Antonioli et al. (2012), Lucena, Afcha (2013), Lohmann (2014), Hud, Hussinger (2014), Montmartin, Herrera (2015), Cantner, Kösters (2015), Montmartin et al. (2015).

was revealed only for the national government subsidies, while the corresponding additionality was statistically insignificant for EU financing and regional subsidies.

Quite interesting and unexpected results have been received by Lohmann (2014) through in-depth interviews with project managers in the airline industry: government participation in financing of projects, contrary to expectations, did not lead to the reduction in terms of their implementation time, but on the contrary - to prolongation, meaning that the acceleration additionality is negative. This is determined by the long period of provision of subsidies which significantly exceeded the typical duration of supported projects. At the same time, however, a number of respondents described the increase in duration as a result of public support for projects as a positive effect, which allowed carrying out more detailed projects and thus increasing the chances of their successful implementation.

Tax incentives are considerably less the object of additionality studies. As a rule, researchers only considered the input additionality and obtained an empirical evidence of its presence (Figure 3). In the above mentioned research (Montmartin et al. 2015), the authors came to the conclusion that the direct positive effect of tax incentives for a particular region approximately balances the indirect negative effect for the other regions.

Figure 3 – Additionality of tax incentives for innovation activities of companies - generalization of empirical evidence
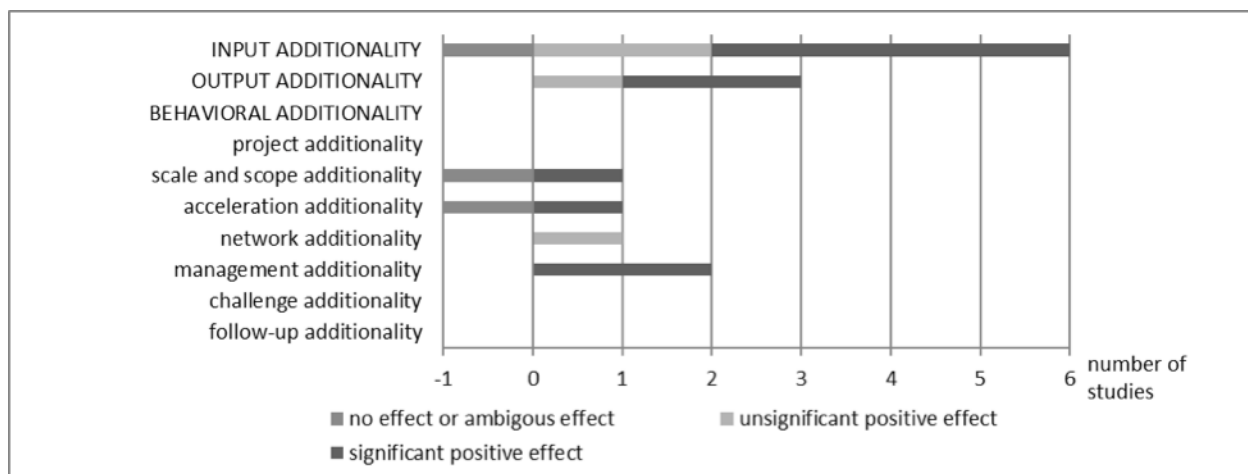
Sources: based on Poot et al. (2003), Hægeland, Møen (2007), Catozzella, Vivarelli (2011), Lokshin, Mohnen (2012), Zoran, BotriÐ (2013), Neicu et al. (2014), Montmartin, Herrera (2015), Freitas et al. (2015), Montmartin et al. (2015).

OBJECTIVES, METHOD AND DATA

The aim of our study is to perform a microeconomic evaluation of support provided to industrial firms in Russia by focusing on two main instruments: direct funding and tax incentives. The usage of these two instruments for the analysis is quite straightforward as they are traditionally viewed as key elements of the national innovation policy toolbox (e.g. David et al. (2000); OECD (2015)) and are well ahead of other instruments in terms of "coverage" and number of firms supported (Kuzyk, Simachev 2013).

The objectives of this study were as follows:
- firstly, to identify the "typical profile" of the firms-beneficiaries of the government support policy as a whole and of direct funding and tax incentives in particular;
- secondly, to consider basic input, output and behavioral additionality effects;
- thirdly, to analyze the "relative" additionality of direct financial support and tax incentives.

- Data were collected from a questionnaire-based survey, which addressed top executives of Russian manufacturing firms in September-October 2015.

The organizer of the survey was the Interdepartmental Analytical Center. The field operation was carried out by the publishing and information center „Statistics of Russia". While constructing the sample we targeted public support recipients to meet the research objectives. Thereby we tried to capture in our sample, on the one hand, mostly high technology industries which are relatively more often supported by the government in Russia than low-tech and medium-tech industries (Zudin 2015) and, on the other, large companies because as results of several studies prove they become more often beneficiaries of government support more in comparison with SMEs (Fier, Heneric 2005; Aschhoff 2010; Simachev et al. 2014a). As a result, the final sample consisted of 658 firms, ¾ of which belong to high-tech industries – first of all from the chemical and machine-building complex. The sample is characterized by an equal share of small companies and relatively large enterprises (while the general population is dominated by small firms) (Table. 1). Additionally, it should be noted that in the sample - as in the whole of Russian industry - companies with private ownership prevail, but at the

same time public companies are also widely represented, what is very important from the standpoint of public support distribution analysis and its results. Finally, a major part of the surveyed firms are in a relatively healthy financial condition, but companies experiencing financial problems are also significantly represented in the sample.

Table 1. Sample structure

Characteristic		Share in the sample
Industry	Manufacturing textiles, clothing and footwear	7,45%
	Wood processing, manufacturing of wood products, pulp, paper and paperboard	5,32%
	Chemical production (excluding pharmaceutics)	6,23%
	Manufacturing of pharmaceutical products	4,71%
	Metallurgy, manufacturing of finished metal products	9,73%
	Manufacturing of machinery and equipment (except for machine-tools)	18,84%
	Manufacturing of machine-tools	3,95%
	Manufacturing of electrical machinery and electrical equipment	8,36%
	Manufacturing of computer technology, equipment for processing information, radio, TV and telecommunication	9,42%
	Manufacturing of medical equipment	4,86%
	Manufacturing of control and measuring devices	3,65%
	Automobile production	4,56%
	Shipbuilding	4,10%
	Manufacturing of railway rolling stock	4,86%
	Manufacturing of aircraft	3,95%
Operation period	less than 5 years	8,81%
	5-10 years	16,26%
	10-20 years	26,90%
	more than 20 years	48,02%
Ownership	state and municipal (including the ownership of state-owned corporations)	9,27%
	mixed	5,78%
	private	84,95%
Number of employees	less than 100 emp.	24,77%
	101-200 emp..	22,95%
	201-500 emp..	24,32%
	more than 500 emp..	27,96%
Financial condition	poor	17,93%
	satisfactory	69,91%
	good	12,16%

Sources: prepared by the authors

To determine the composition of the companies that are "consumers" of government support we used a questionnaire in which respondents were asked to mark if they had received budget financing, used tax incentives or other public support instruments and measures in 2013-2015. Actually, the analysis of the public support results and additionality is based on the responses from CEOs for covering a wide range of corresponding effects related to "classical" types of additionality with the exception of management and follow-up additionality (Table 2). It is important to note that one of the main restrictions of the survey was that we only asked one person in a company. CEOs were chosen as they are actually better informed compared to any other single specialist regarding the firm's profile, its position on the market and most importantly the impact of public support of different kinds on its activities and organizational routines.

Table 2. Comparison of the public support effects and different types of additionality

Effect	Additionality
volume of company's investment in new equipment based on its own or borrowed funds has increased	input
volume of company's spending on innovation based on its own or borrowed funds has increased	
volume of company's spending on R&D based on its own or borrowed funds has increased	
company's revenue has increased	output
company's market share on the domestic market has increased	
company's market share on the external market has increased	
production volume of new (improved) products has increased	
profitability of core company's activities has improved	
company's general competitiveness has increased	
import dependence of the company has been reduced	import substitution
a promising new project (projects) was launched	project
public support has allowed to implement a larger project (projects)	scale and scope
public support has allowed to implement a project (projects) with a longer payback period	
public support accelerated the implementation of the project	acceleration
public support reduced risks of project implementation	challenge
development (strengthening) of the company's linkages within scientific and industrial cooperation has occurred	network
public support has allowed to redistribute part of company's funds towards the other areas not related to the subject of support	—

Sources: prepared by the authors

We associate the reduction of risks of innovation activities as a result of public support with the 'challenge additionality' since this effect contributes to the risk "tolerance" of companies and thus to the initiation and implementation of more risky projects. Reducing import dependence of companies (an item which was included in the scope of the analysis due to the active implementation of the import substitution policy in the Russian industry) does not directly correspond to any of the "classic" types of additionality and for this reason we regard it as a separate category. Finally, the redistribution of existing funds towards other areas not related to the subject of public support is nothing more than the well-known and frequently observed "crowding out" effect in national and foreign studies, which is the opposite to input additionality (David et al. 2000; Lach 2002; Chudnovsky et al. 2006; Benavente et al. 2007; Simachev et al. 2015).

We use frequency and regression analysis to identify the specifics of the beneficiaries of public support and reveal its main additionality effects. For a more precise definition of "relative" additionality effects of direct funding and tax incentives we used a propensity score matching (PSM) which is one of the main techniques of analyzing additionality at firm level (e.g. Fier et al. (2006); Baghana (2010); Marzucchi, Montresor (2013); Cantner, Kösters (2015)). An important distinguishing feature of our approach is that we analyzed the additionality of a concrete instrument for a particular firm relative to all other instruments used and therefore could consider the "relative" additionality. This enables us to highlight inherent additionality effects precisely to tax and financial instruments distinguishing them from the "background" of all other elements of the innovation policy toolbox.

It is necessary to pay attention to two important limitations of our study. Firstly, we analyzed the "generalized" streams of public support (direct financial support and tax incentives). More specifically, in our research we did not focus on particular instruments but considered financial support and tax incentives in any form. It seems to us justifiable because these two policies are fundamentally different and companies tend to choose a set of instruments of one kind - financial or tax (Ivanov et al. 2012). Note also that such a "generalized" approach is widely used in modern empirical studies (e.g. Gelabert et al. (2009); Lokshin, Mohnen (2012); Marzucci, Montresor (2012); Hud, Hussinger (2014); Bodas Freitas et al. (2015)).

Secondly, we do not distinguish between federal and regional support. Meanwhile, as noted above, the effects of such support can vary considerably (Marzucchi, Montresor 2013). However, such differences most clearly manifest themselves in the case of financial support. In Russia the financing of innovation activities from the federal budget significantly exceeds the volume of the relevant funding at the regional and local levels (Gorodnikova et al. 2016).

RESULTS

## BENEFICIARIES OF PUBLIC SUPPORT - THE TYPICAL PROFILE

Before analyzing additionality results caused by tax and financial instruments we briefly turn to the formation of the typical profile of the beneficiaries of public support. On the whole one third of the sampled companies used some public support instruments in 2013-15; while 20 per cent of companies have received government funding, about the

same – 21 per cent have made use of different tax incentives and 10 per cent of companies received both streams of support.

Large and long operating (over 20 years) companies have more frequently become the recipients of public support than relatively newly established and small (100-200 employees) companies. Note that such a

"failure" of the public support in relation to small firms was observed by us earlier (Simachev et al. 2014a).

Figure 4 - Receiving state support in 2013-2015 by companies of different categories - percentage of the total company sample by category
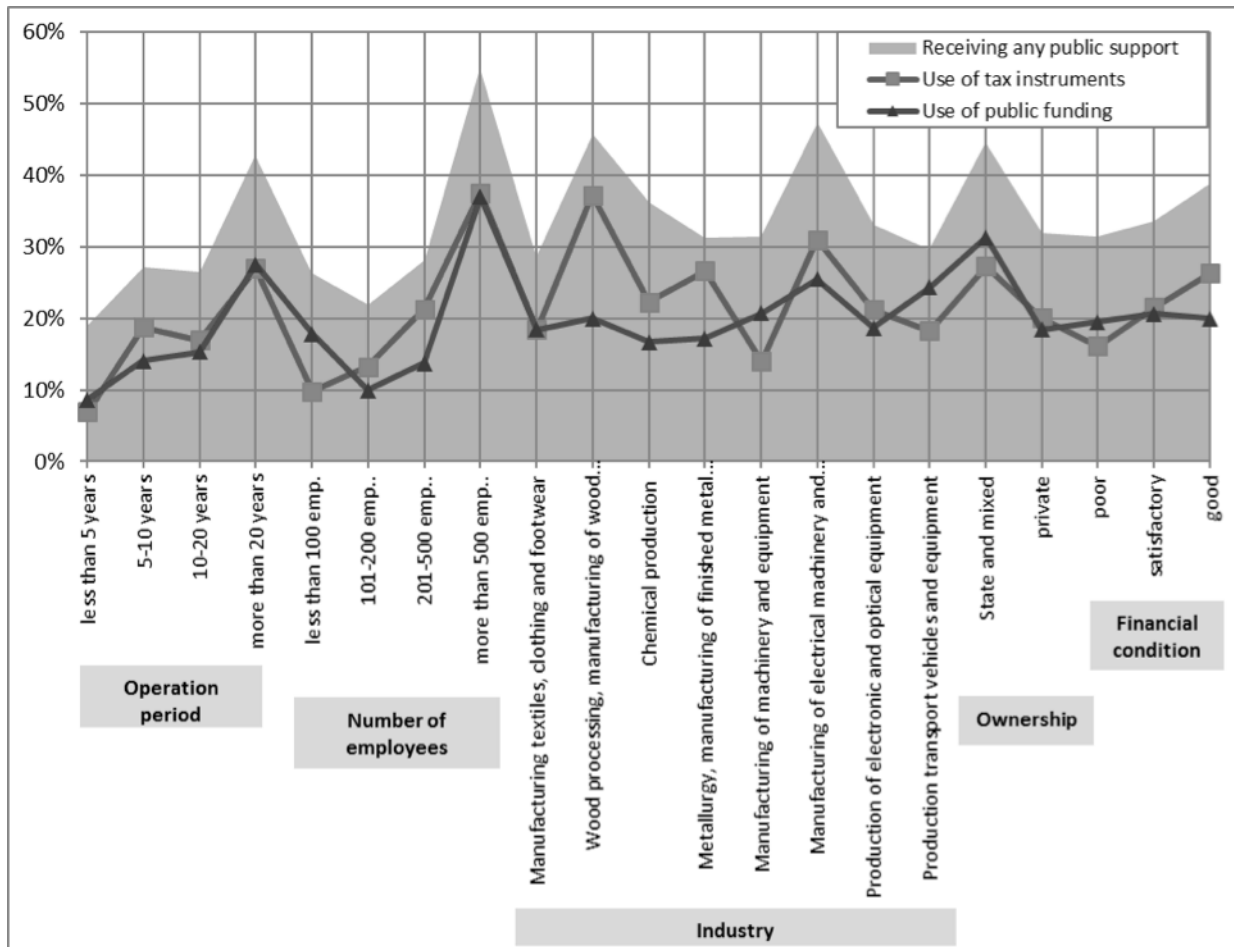
Sources: prepared by the authors

When considering different industries one can note a certain "concentration" of both public support dimensions in the field of electrical equipment production and also a relatively frequent use of tax incentives by wood processing companies in a line with pulp and paper industry companies. Finally, companies with government participation in capital more frequently become the beneficiaries of financial support and tax incentives.

Regression analysis by including the explanatory variables presented in Figure 4 allows us to define more clearly the profile of beneficiaries

using different tax and financial support instruments (Table 3.) The use of tax incentives in the review period was most typical for large companies and unusual for SMEs (not more than 200 employees). Large and long-operating companies had the greatest chance to receive government financial support; at the same time, however, small firms also often became the recipients of budget funds.

Table 3. State support for companies in 2013-15 - results of the binary logistic regression model

Independent variables (dummy)		Dependent variables (dummy)		
		Receiving any public support	Use of tax instruments	Use of public funding
Industry	Manufacturing textiles, clothing and footwear	control		
	Wood processing, manufacturing of wood products, pulp, paper and paperboard	+*	+**	
	Chemical production			
	Metallurgy, manufacturing of finished metal products			
	Manufacturing of machinery and equipment			
	Manufacturing of electrical machinery and electrical equipment	+*		
	Production of electronic and optical equipment			
	Production transport vehicles and equipment			
Operation period	less than 5 years			
	5-10 years			
	10-20 years	control		
	more than 20 years	+**		+**
Ownership	State and mixed			
	private	control		
Number of employees	less than 100 emp.		-**	+*
	101-200 emp..		-*	
	201-500 emp..	control		
	more than 500 emp..	+***	+**	+***
Financial condition	poor			
	satisfactory	control		
	good			
Chi-square		78,39***	66,98***	65,44***
N		658		

Notes:
Maximum VIF value – 3,20.
*   – significant a 10% level;
**   – significant a 5% level;
*** – significant a 1% level.
Sources: prepared by the authors

Interestingly, the regression analysis revealed no statistically significant relationship between private industrial companies and fully public companies or companies with mixed ownership, which is consistent with previous empirical results (Simachev et al. 2014a).

MAIN EFFECTS OF PUBLIC SUPPORT

Talking about input additionality the most widely observed effect is the increase in investment in new equipment based on own or borrowed funds. Interestingly, almost as often respondents mentioned the crowding out effect (see Table 4.).

The most common output effects of public support are the increase of new and improved products produced and increases in revenue, as well as growth of profitability and general company competitiveness. In contrast, least likely public support led to increasing market shares of companies on the external markets. Although not significantly, public policies of any kind also contributed to a decreasing import dependence

of the scrutinized companies. Among the key behavioral effects of public support one can find accelerated project implementation and encouragement of launching new projects. Government support relatively rarely led to the development of scientific-industrial cooperation, which seems very surprising in view of the impressive scale of the public policy in recent years aimed at encouraging network between science and industry (Simachev, Kuzyk 2015).

Input, output, as well as behavioral additionality was effected to a significantly greater extent by financial instruments than by tax incentives (Table 4). Financial support significantly stood out from the other instruments in terms of effects such as growth of investment in new equipment, increase in production volumes of new and improved products, acceleration of project implementation and risk tolerance At the same time, the crowding-out of own private funds through government funds was higher in case of direct financial support.

Table 4. Major results of public support – frequency statistics

	All the recipients of government support	Companies using tax incentives	Companies enjoying public funding
INPUT ADDITIONALITY	35,6%	36,7%	42,5%*
- volume of company's investment in new equipment based on own or borrowed funds has increased	28,4%	25,9%	34,3%**
- volume of company's spending on innovation based on own or borrowed funds has increased	15,3%	17,3%	17,2%
- volume of company's spending on R&D based on own or borrowed funds has increased	15,8%	17,3%	18,7%
OUTPUT ADDITIONALITY	47,3%	48,2%	56,0%***
- company's revenue has increased	18,9%	16,5%	20,9%
- company's market share on the domestic market has increased	13,5%	10,1%*	16,4%
- company's market share on the external market has increased	2,7%	2,9%	2,2%
- production volume of new (improved) products has increased	21,2%	19,4%	27,6%***
- profitability of core company's activities has improved	18,0%	18,0%	17,9%
- company's general competitiveness has increased	18,9%	16,5%	22,4%
IMPORT SUBSTITUTION ADDITIONALITY **- import dependence of the company has been reduced**	4,1%	4,3%	4,5%
BEHAVIORAL ADDITIONALITY	44,6%	46,0%	55,2%***
- a promising new project (projects) was launched	19,8%	21,6%	24,6%**
- public support has allowed to implement a larger project (projects)	11,7%	12,9%	14,2%
- public support has allowed to implement (projects) with a longer payback period	12,6%	15,1%	14,2%
- public support accelerated implementation of the project	21,6%	20,9%	26,9%**
- public support enabled to reduce risks of project implementation	13,5%	15,1%	17,2%*
- development (strengthening) of the company's linkages within the scientific and industrial cooperation has occurred	8,1%	8,6%	9,7%
CROWDING-OUT EFFECT **- public support has allowed to redistribute part of company's funds towards other areas not related to the subject of support**	29,3%	27,3%	37,3%***
N	222	139	134

Notes:

The significance of differences, the Chi-square test
*   – significant a 10% level;
**   – significant a 5% level;
***   – significant a 1% level.
Sources: prepared by the authors

RELATIVE ADDITIONALITY OF TAX INCENTIVES AND PUBLIC FUNDING

In this section we would address the "relative" additionality, i.e. the additionality of a concrete instrument for a particular firm relative to all other used instruments, to capture "net" additionality effects.

For a more precise identification and comparison of the effects generated by tax respectively financial support, we use the following typical algorithm[2]:

1. The first step involved the assessment of the two sets of expected probabilities (propensity scores) of using tax incentives or of obtaining financial support by building bivariate logistic regressions with a "standard" set of control variables for the sampled companies (see Table 3). Since the questionnaire about public support effects was addressed only to recipients evaluation was carried out under the sub-sample of companies which obtained government support of any form in 2012-15.

2. Secondly, for the analyzed two dimensions of public policy (tax incentives and direct financial support), pairs of most similar recipients and non-recipients were identified. Pairs were formed by nearest neighbor matching on the basis of propensity score variables created at the first step.

3. Thirdly, the average effects on the treated companies (or ATTs) for tax and financial support were estimated (for more details see Newey (2009)). It is important to note that initially this effect is described by the following functional dependence

$$ATT_{ij} = E(Y_{ij}^1 - Y_{ij}^0 \| S_i = 1) = E(Y_{ij}^1 \| S_i = 1) - E(Y_{ij}^0 \| S_i = 1) \quad (1)$$

где i – considered dimension of support (tax or financial); j – specific effect of the support; Y_{ij}^1 - indicator of presence or absence of the effect in case of receiving support of j type i; Y_{ij}^0 - the corresponding indicator in the hypothetical situation, if this type of support has not been received; Si – indicator of obtaining support of a specific type i (1 – presence, 0 – absence).

The main problem here is that the indicator is unobservable, so it is necessary for the calculation to find an approximation. Steps 1 and 2 enabled us to do this by using the observed values of this indicator obtained for the "most similar" companies, which were not recipients of a specific support type. As a result, the functional dependence takes the following form:

$$ATT_{ij} = E(Y_{ij}^1 \| S_i = 1) \square E(Y_{ij}^0 \| S_i = 0) \quad (2)$$

Note that since the variables and are binary, the mean of ATTs are located in the range from - 1 to 1. The ATT's zero value corresponds to the case where the average values of indicators $Y_{ij}^1 \| S_i = 1$ and $Y_{ij}^0 \| S_i = 0$ (or the value of effect for recipient and non-recipient consequently) is identical. This means that the use of the specific instrument does not increase or reduce the likelihood of a certain effect compared with the total set of public incentive mechanisms. Thus, the ATT indicator in this case reflects the "relative" additionality, provided by a certain dimension (tax or financial) on the background of general public support policy.

Evaluation results indicate that across almost all considered effects the impact of financial measures exceeds the impact of tax incentives. Exceptions are only two output indicators (the market share on the external market and profitability) and the scale and scope additionality (Figure 5).

Figure 5 – Relative additionality of tax and financial support – average treatment effects on the treated sub-sample of companies which received government support in 2013-15
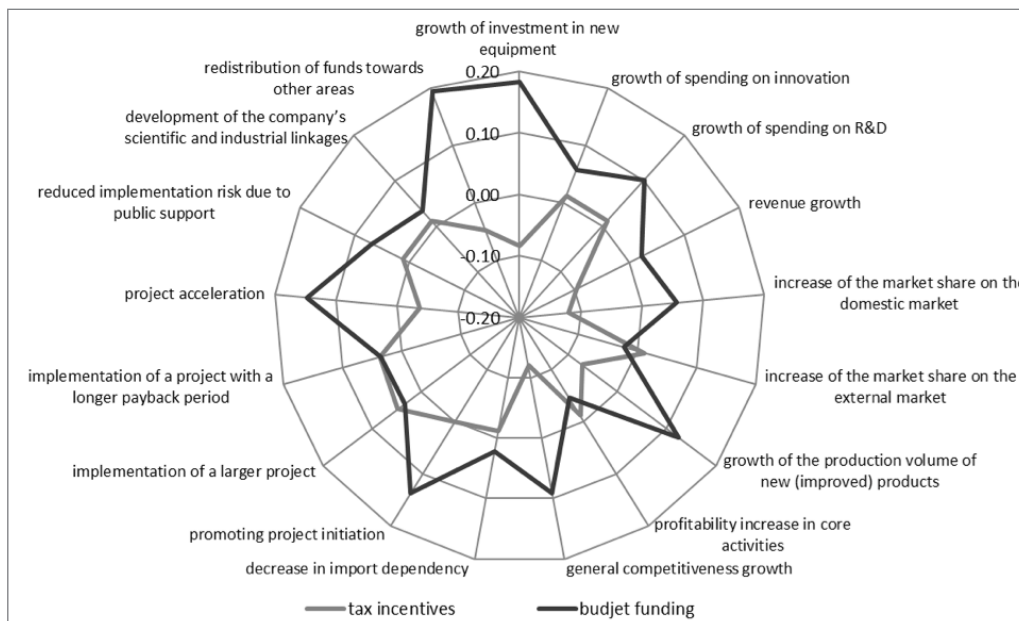
Sources: prepared by the authors

2   A similar approach is used, for instance, in studies Fier et al. (2006); Baghana (2010); Marzucchi, Montresor (2013); Cantner, Kosters (2015).

The most significant "failure" of the tax instruments' impact is observed in respect of the investments in new equipment, the market share on the domestic market and the general competitiveness of the company. At the same time, it is important to note that the crowding out effect is inherent to a much greater extent to financial instruments than to tax measures.

Aggregation of ATT values for input, output and behavioral additionality revealed that financial support most strongly affects the input company characteristics with a noticeable positive impact also on its output and behavioral parameters (Figure 6). In comparison tax measures have lower additionality effects, especially in terms of output additionality.

We take now a brief look at the question how company characteristics relate to specific effects. We calculated the parameters of ordinal regression models in which the dependent variables were the individual treatment effects on the treated companies[3] - the differences between the effects (with values 1 or 0) in the "recipient non-recipient" pairs: - .

Explanatory variables reflect all of the above "standard" characteristics of companies (Table 3), except for the industry sector which was not sufficiently representative in the sub-sample formed by pairs of recipients and non-recipients of tax and financial support. For this reason, the industries have been aggregated according to their technology level[4]. In these models values of control variables correspond to those of the recipients (treated). Below only results for the meaningful models are presented (Table 5).

The results though should be interpreted with great caution due to the relatively small number of observations (pairs of "recipient / non-recipient"). Nevertheless, we believe it is important to note two consistent patterns (at least as a hypothesis for further empirical testing on larger samples): first, the effects of tax support occur more often in companies with state or mixed ownership and, second, the positive impact of tax incentives is less typical for small businesses than for larger firms.

Figure 6 – Relative input, output and behavioral additionality of tax and financial support measures – average effects on the treated (ATT) sub-sample of companies which received government support in 2013-15
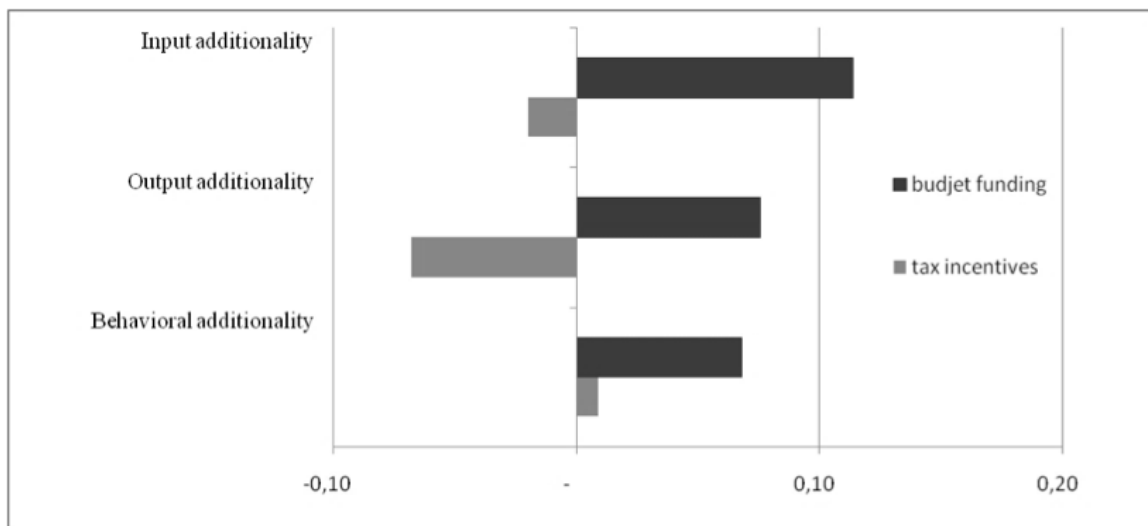
Sources: prepared by the authors

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3   This approach is used, in particular, in Hottenrott, Lopes-Bento (2013).
4   In our sample the low-tech industries include textiles, clothing and footwear, wood processing and pulp and paper industry, medium-tech includes metals and fabricated metal products, high-tech includes chemical industry and mechanical engineering (for more details see Zudin (2015)).

Table 5. Individual treatment effects on the treated for tax and funding instruments - calculation results of the binary logistic regression model

		Effects of tax incentives							Effects of public funding			
		increase in investment in new equipment	increase in volume of spending on innovation	growth of revenue	increase in general competitiveness	launch of a new project	implementation acceleration of the project	project implementation risks decline	increase in investment in new equipment	increase in volume of spending on innovation	network development	project implementation risks decline
Technology level of sector	low			+ *				+ *		- **		
	medium	control										
	high		+ **		- *	- **						
Operation period	less than 5 years				- ***				+ **			
	5-10 years				- *			- *		- **		
	10-20 years	control										
	more than 20 years	+ *			- *					- **		
Ownership	State and mixed		+ ***		+ **		+ **	- ***	+ ***	+ ***		+ *
	private	control										
Number of employees	less than 100 emp.				- ***	- ***			- *			
	101-200 emp..						+ *					
	201-500 emp..	control										
	more than 500 emp..	+ ***	+ *									
Financial condition	poor							+ **				
	satisfactory	control										
	good		+ **								- *	- *
Chi-square		18,05*	19,36*	17,60*	24,46**	19,92**	18,63*	20,74**	32,05***	28,43***	18, 84*	21,11**
N		83							88			
Maximum VIF value		2,55							5,13			

Notes:
*   – significant a 10% level;
**   – significant a 5% level;
***   – significant a 1% level.
Sources: prepared by the authors

DISCUSSION AND POLICY IMPLICATIONS

1. The ongoing Russian public policy to stimulate firms' development through a substantial variety of instruments for different target groups (e.g. Kuzyk, Simachev (2013))[5] is characterized by a strong emphasis on sufficiently large and long-operating companies. Such a result is not surprising, especially not for the Russian economy. Positive relationship between the size of the firms and the likelihood of receiving government support has been identified in a number of empirical studies (e.g. Fier, Heneric (2005); Aschhoff (2010); Simachev et al. (2014a)).

The focus shift of public support towards large and long operating companies occurs due to a number of factors. Firstly, these companies are more "visible" for the state and objectively are better able to lobby their interests in the government. Secondly, a large established business has a strong and highly diversified system of connections with the public authorities and a lot of experience in attracting and using government support. The latter is particularly important because, as has been shown in several studies, the company which has previously received support is more likely to receive it in the future too[6] (e.g. Falk (2006); Aschhoff (2009)). Thirdly, as it is noted in the study of Garcia and Monhen (2010), a greater proportion of large companies in the set of public support recipients may indicate a risk aversion of the government: indeed, support of a relatively small number of large companies in comparison with a lot of smaller firms is associated with lower transactional costs of support allocation and administration. Moreover, because large companies often demonstrate a "formally" higher innovation activity authorities tend to support them to generate a pseudo-positive result important for reporting (Simachev et al. 2014a). Finally, especially in periods of crisis, the government is more inclined to support large companies across particular industries, regions or/and the national economy as a whole[7] (Simachev et al. 2010).

The question on the relative efficiency of government support for small and large firms is rather controversial. Today one can find empirical evidence of significant influence of government support both on SMEs, including behavioral changes (Loof, Heshmati 2005; Wanzenbock et al. 2013), as well as substantial corresponding changes in large firms (Falk 2006). The obtained results of our study rather confirm the second point of view. However, due to the relatively small number of relevant observations, we can only hypothesize that in Russia instruments of government support (especially tax incentives) provide positive changes mainly for medium and large sized firms.

Our view is that "quality" of the recipients and not formal characteristics of beneficiaries (such as size, age etc.) should matter and qualify for government support. The recipients of government support should have a big potential for further successful development and, what is more important, demonstrate abilities to implement it. However, in Russian reali-

ties that principle is not always followed. In periods of relative economic stability the government mostly supports successfully developing firms (e.g. Simachev et al. (2014a)), whereas crises force the government to shift the support focus towards troubled companies, especially if these are of a great importance in the context of providing socio-economic stability in the region or/and in the whole country (Higher School of Economics, Interdepartmental Analytical Center 2009; Mau 2010).

2. Tax and financial instruments of government support have de facto different target audiences: the use of tax incentives is not likely for small firms, whereas medium-sized companies relatively rarely appear to be recipients of financial support. The former can be the reflection of both the imperfect parameters of the tax instruments (their rate, base, etc.) for small businesses and the existence of significant implementation and administration problems, which are acceptable for large companies but too excessive for small firms. The fact of relatively rare financial support of medium-sized firms can be considered as another empirical evidence of a lack of instruments aimed at funding medium-sized projects and companies. (see also Simachev et al. (2012)).

3. The relatively small impact of government support on science-business cooperation seems to us quite unexpected (abroad, this effect is among the most frequently observed ones, especially in the case of financial support – e.g. Pegler (2005); Busom, Fernandez Ribas (2008); Idea Consult (2009); Marzucchi, Montresor (2013)). This fact is rather discouraging, as the Russian government makes considerable effort to enhance linkages and interactions between the R&D sector and industry. In the last few years, the government initiated a number of policies fully or to a large extent focused on the development of cooperation: financial support for projects to develop high-tech industries, executed by companies in cooperation with universities and research institutions; creation of a technological platform network; approval and implementation by the largest public sector companies of the medium-term innovative development programs which include cooperation activities with universities and research institutions; promotion of support programs for the development of innovative territorial clusters etc. The absence of an explicit result of these efforts, to our mind, can be explained by the fact that government support often does not lead to the creation of new linkages and partnerships but only contributes to the "capitalization" of long-established ones (Simachev et al. 2014c). It is worthwhile to note that a significant contribution of government support to the improvement of existing science-business linkages and partnerships has been widely observed abroad (e.g. Georghiou et al. (2005); Lohmann (2014)).

4. Our empirical analysis as well as a significant number of earlier studies confirmed the importance of the financial support in providing all major aspects of additionality. Based on our results, we can say that in Russia the effects of the financial instruments cover all three main types of additionality. The main input effect is the increase of investment in new equipment; the main output effect is the increase of production of new and improved products, and the main behavioral effect is the initiation of new perspective projects and an acceleration of project

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5   Despite the fact that Russian industrial innovation policy toolbox is rather diversified
6   In literature this effect is commonly called the Matthew effect: this term is used in the broader context with respect to scientific recognition (Merton 1968) and in a narrow sense in relation to public support for innovation (e.g. Crespi, Antonelli (2011)).
7   It is appropriate to mention the renewal in 2015 of the practice of public guarantee support provided for strategic organizations - the largest entities that have a significant influence on the formation of GDP, employment and social stability. Previously the government has resorted to such measures in the most acute phase of the previous crisis - in 2009 (Simachev, Kuzyk 2010).

implementation. It should be noted that project additionality (government contribution to firms' launching new projects) is one of the most frequently observed behavioral changes (e.g. Falk (2007); OECD (2006); Idea Consult (2009)). This cannot be said about acceleration additionality (when government support speeds up the course of the project) which, according to other research, occurs on a considerably smaller scale (see Figure 2).

Unlike financial instruments, tax incentives almost do not provide significant results in terms of additionality. The most considerable "failure" is observed in relation to such expected – but not realized - effects as the supposed increase in the firms' competitiveness, the supposed growing domestic market share and the supposed increase of investment in new equipment. The negative results concerning the last indicator seem quite surprising to us as a large set of tax incentives in Russia is basically intended to stimulate firms' investment activities. At the same time and in contrast to a number of foreign studies, which examined a significant impact of tax incentives on input characteristics related to innovation activity, first of all R&D expenses (e.g. Lokshin, Mohnen (2012); Bodas Freitas et al. (2015)), we cannot see tangible input additionality of such measures in Russia. Slightly noticeable additionality effect of tax instruments relate to scale and scope additionality (the growth of investment in ongoing projects and the increase of the acceptable payback period). It is worthwhile to note that the positive impact of tax support on scale and scope of ongoing projects, in contrast to initiation of the new ones, was rather often identified in economic literature (Guellec, Van Pottelsberghe 2003; Jaumotte, Pain 2005; Simachev et al. 2014b).

The identified clear dominance of financial instruments over tax incentives with regard to most additionality effects should, in our opinion, not be considered as an exhaustive evidence of the inefficiency of tax measures and even more not as a robust argument in favor of abandonment of this element within the innovation policy portfolio. Indeed, the set of tax instruments obtains a number of important advantages. Actually, they are potentially available for a wider range of recipients than direct funding instruments. Moreover, they are associated with lower implementation and administration costs (Simachev et al. 2014b), they do not involve government intervention in market mechanisms and, what is important, they are not directly linked to budget allocation processes (Gokhberg et al. 2014). It is also important that tax measures and public funding instruments have substantially different beneficiaries. Finally, tax incentives produce to a noticeably less degree crowding out effects (replacement of private funds by public ones - e.g. David et al. (2000); Jaumotte, Pain (2005)) which is confirmed by the results of our study.

This situation, in our opinion, is explained by the fact that the expected benefits from the tax breaks are taken into account by firms ex-ante - when making a decision on the initiation of projects and defining their parameters. Financial support, on the contrary, is often only a possible, but not a guaranteed option, so in the case of obtaining such support companies prefer not to increase the project funding due to already fixed project parameters and redistribute funds for other needs.

In addition, budget funds are often invested in obviously successful projects that would have been carried out without public support on the grounds of the above-noted tendency of risk aversion of public authorities motivated by the need to demonstrate high efficiency in their programs (David et al. 2000; Klette et al. 2000; Wallsten 2000; Lach 2002).

The arguments given above, however, do not mean that tax incentives do not need improvement. On the contrary, the revealed significant "gap" in the effectiveness between financial and tax support shows in our opinion that the latter is just more in need of improvement - in terms of input and output effects, which are often observed abroad (Hægeland, Møen 2007; Lokshin, Mohnen 2012; Bodas Freitas et al 2015; Montmartin, Herrera 2015), but almost cannot be traced in Russia.

However, tax incentives productivity should not be improved through its "enrichment" with features and attributes of financial mechanisms as this would eliminate the key beneficial characteristics of tax incentives, which are the availability for a wide range of companies and low costs of use and administration. Thus, the relatively recent "improvement" of a certain tax benefit (the ability to write off a given amount of R&D expenditure) resulted in the requirement for the companies to submit to tax authorities the full research reports, which increased the application costs of this tax break and, as a consequence, led to a sharp reduction in its popularity among firms (Simachev, Kuzyk 2015).

Finally, we would like to note that our evaluation results on the influence of tax and financial policies on companies need to be interpreted with caution. Strictly speaking, no study of this kind can claim to be a universal truth. Indeed, as evidenced by the results of numerous foreign empirical studies, even very similar mechanisms of public support can lead to significantly different results in different countries and over different periods of time, and this is due not only to the differences in the "design" of support tools, but also because of their high impact heterogeneity over sectors, companies' parameters and market functioning characteristics. The observed effects vary considerably over time, and some appear only with considerable lags.

Against the background of an objectively limited value of any single empirical research it is particularly important to reflect the huge number of studies devoted to the evaluation of impact of public support on companies, a great portion of which for the last fifteen years has been based on the concept of additionality. Such studies, especially if regularly carried out on the basis of statistical data for long observation periods, often include cross-country comparisons of the results. Finally, and most important - they are in demand by the government and are implemented in the decision-making system. For Russia, surprisingly, our attempt to estimate the additionality of the tax and financial support was perhaps the first one.

At the very end, we would like to emphasize the urgent need in Russia of introducing the practice of regular and independent assessments of the effectiveness of public policies. At the same time, in our opinion, one should focus on additionality effects caused by public support, which would not have occurred in its absence. Along with an estimation of input and output effects, it is essential to take also behavioral changes that determine to a large extent the stability of the public support impact on the companies into account. This would help to create the required information basis for decision making on public incentive policies (both existing and to be initiated in the future), and would contribute to learning and scaling of the best practices.

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AUTHORS

YURI SIMACHEV
National Research University Higher School of Economics
20 Myasnitskaya str., 101000 Moscow, Russian Federation

MIKHAIL KUZYK
Interdepartmental Analytical Center
P.O. Box 35, 31/29 Povarskaya str., 121069 Moscow, Russian Federation

corresponding author:
NIKOLAY ZUDIN
Center for Strategic Research
10 Vozdvizhenka str., 125009 Moscow, Russian Federation
T: +79165715843
E: N_zud@mail.ru