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Principal – Agent Problem in The Russian Performance-Based Research Funding System

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Introduction

The relevance of research. In recent decades, the implementation of research policy¹ has caused an ambiguous reaction from the world research community. Criticism of the coercion of scientists to publication activity and related scientometric systems for evaluating the effectiveness of scientists in national research policies (Leiden Manifesto, DORA Declaration) is becoming widespread. In the specialized literature, the groundlessness of a number of aspects of modern research policy, its inconsistency with the internal logic of the development of science and the expectations of society has increasingly been noted (Semenov, 2019; 2020; Tambovtsev, 2018; 2020; Chernysh, 2020; Shuper, 2020). Since the 2000s - 2010s, research directions have been emerging devoted to the problems of using competitive mechanisms to stimulate research based on scientometric performance assessment, as well as the ambiguous changes observed as a result in the structure of research, the choice of topics of work, changes in the behavior of researchers and other so-called "side effects" of modern research policy (Osterloh, 2010; Frost, Brockmann, 2014; Welpé et al., 2015; Gläser, Laudel, 2016; Biagioli et al., 2019, etc.).

The relevance of such an agenda is caused by the widespread introduction of performance-based research funding systems in national research policies. The pioneer of this approach was the United Kingdom, where in 1986 one of the first variants of such a system was implemented (Bence, Oppenheim, 2005), in the 1990s a number of other developed countries followed its example. In 2000-2010, the introduction of national performance-based research funding systems, which to one degree or another provide for competition not just for research projects, but also for the actual basic funding of science subjects, became the basis of the research policy of the European Union and a number of other developed countries outside Europe (Hicks, 2010; 2012; Zacharewicz et al., 2019), thus forming a trend in world research policy. In such systems, the funding of science is more or less tied to the fulfilment of research performance indicators set by the manager of funds. At the same time, there is competition between performers for their achievement, which inevitably aggravates the formal aspects of the activities of the recipients of funding and puts pressure on the logic and strategy of their behavior.

The interpretation of new forms of research policy takes place from the positions of various theoretical concepts. Within the framework of the critical direction, the most popular is the criticism of the application of the concepts of neoliberalism or new public administration in research policy (Welpé et al., 2015; Vostrikova, Kusli, 2015; Dushina et al., 2019; etc.). In the course of decision-making by authorities, as a rule, arguments from various disciplines are used: scientometry, sociology of science, microeconomics, individual narrative evidence, etc. Since the 2000s, complex concepts of rationalization of the process of research policy formation have been formed: evidence-based policy (Wells, 2007), "science of science policy" (science of science policy, Marburger, 2005), "quantitative story-telling" (Saltelli, Giampietro, 2016; 2017) (for more information on the concepts of the validity of research policy, see Tambovtsev, 2018).

The present dissertation research is aimed at revealing the potential of another conceptual framework for the research interpretation of research policy – the agency theory and the related concept of the principal-agency problem, which has been actively applied in the context of

¹ In this dissertation research, research policy is understood as a system of influence of authorized authorities (policy subjects) on the objects of research activity (by default, the public sector of science is meant: universities and research organizations), for example, the Russian state research and technical policy and its analogues abroad (Science/Research Policy). Conceptually, the article shares the understanding of research policy proposed by V. Tambovtsev, as a set of intentions of a certain subject regarding the future state and/or dynamics of science (as a certain socio-economic system) and the means (policy instruments) chosen by him, the use of which, in the opinion of the policy subject, will ensure the implementation of these intentions (Tambovtsev, 2018; 2020).

research policy since the 1990s, but in relation to such a relatively new phenomenon as the performance-based research funding systems, has not yet received widespread distribution.

Initially, the principal-agent theory originated in the framework of economic research (1970-s) and was used to explain the nature of relations within and between firms (Jensen, Meckling, 1976; Pratt and Zeckhauser, 1985). The theory proceeds from a visual model of principal–agency relations that arise between actors, where one of them, the principal, entrusts resources to another actor, an agent who must use them to realize the goals of the principal, which the principal himself cannot achieve independently. By providing resources to the agent, the principal gets the right to control his activities (Coleman, 1990).

The key problem of principal–agency relations is that the principal cannot know how conscientiously the agent is acting to achieve his goals. In turn, the agent can use the lack of special knowledge or lack of information from the principal in order to satisfy his own interests when executing the principal's instructions (the problem of information asymmetry). The conceptual universality of the principal-agency model of relations quickly gained demand outside of economic research. For example, in political studies, it has been used in various variations to conceptualize the problems of broadcasting government decisions to relevant departments and agencies, relations between voters and members of parliament, relations in foreign policy, etc. (Moe, 1984; Strøm, 2000; Huber, Lupia, 2001; Vaubel, 2006, etc.).

In the context of research policy, the distributors of funds, as one party (the principal), and the organizations of the research sector, as the other (agents), form relationships related to the transfer of resources and the achievement of the goals of the principal - research effectiveness. At the same time, the parties may have different ideas about the direction and degree of intensity of science knowledge, pursue different goals and interests, which leads to prerequisites for the emergence of information asymmetry and tension of the parties. So, already in the first approximation, the application of the principal-agent theory touches on key aspects of the controversy about research policy and provides a broad basis for research interpretations.

In the research of research policy, the theory of principal-agency relations has been used since the 1990s (Braun, 1993; Rip, 1994). Research policy was presented as a situation in which "non-scientists" ("non-scientists") control scientists. The main problem of research policy was formulated as the problem of delegating public goals in the field of science and technology from the government to the research sector (Guston, 1996). When implementing such delegation, the government acts as a principal allocating resources to agents in the field of research and development, and due to differences in special knowledge and limited access to information, the government, as a classical principal, cannot control the compliance of the efforts made by agents to achieve their goals.

The system of views on the principal-agency problem in research policy was formed in the period 1993 – 2003. However, later, despite calls for further disclosure of the potential of the principal-agency dilemma in research policy (Braun, Guston, 2003; Fernández-Carro, 2009), no new fundamental steps were taken in the discussion on this topic. Currently, the existing versions of the principal-agency problem do not fully meet the modern agenda of research policy due to the widespread use of performance-based research funding systems, in which a significant share of funding for performers is tied to their performance, expressed as a rule in the form of publication performance indicators. This makes significant adjustments to the presented schemes of the principal-agency problem in research policy and opens up a completely new field for research interpretations.

This is particularly relevant in the context of the Russian research policy. In Russia, the full-fledged formation of the national performance-based research funding systems began with the entry into force of the Decree of the Government of the Russian Federation No. 312 dated

08.04.2009 "On the assessment and monitoring of the effectiveness of research organizations performing research, development and technological work for civil purposes" (hereinafter - PP 312). Despite the fact that the Russian system of science financing has de facto developed based on the results, a unified methodological description of this system has not yet been formed in the Russian profile literature: measures for the implementation of PP 312 are considered as a system of "monitoring and non-departmental evaluation of the performance of research organizations" (HSE, 2014; 2015a; 2015b); "federal system monitoring the performance of research organizations performing research, development and technological work (FSMNO)" (RIEPP, 2019); "evaluation of the effectiveness of research activities of organizations performing research and development" (RIEPP, 2020).

At the same time, PP 312 establishes at the national level a regular assessment of research performance in the ex post mode and links the results of the assessment with the subsequent funding of universities and research organizations – which are the main features of the performance-based research funding systems according to the methodology (Hicks, 2010; 2012; Jonkers et al., 2016; Zacharewicz et al. 2019, etc.). Thus, in order to study the principal-agency problem in the Russian research policy, it is necessary to conduct a methodological description of the Russian FSMO system as a performance-based research funding system.

Based on the above, the goals and objectives of this dissertation research are formulated as follows.

The purpose of the research is to identify the potential of agency theory for rationalizing modern scientific policy.

In accordance with this goal, the following **research objectives were formulated**:

1. Analyze existing research positions on the interpretation of the agency problem in scientific policy;
2. To develop an updated scheme of the agency problem, taking into account the structure of modern performance-based research funding systems (PBRFS);
3. Set the parameters of the Russian performance-based research funding system;
4. Identify and analyze the signs of an agency problem based on the example of data on research performance in the Russian performance-based research funding system;
5. Prepare proposals for further application of the potential of agency theory for the rationalization of Russian research policy.

The object of research: the Russian performance-based research funding system.

The subject of research: the principal-agency problem arising in the functioning of the performance-based research funding system.

The degree of research elaboration of the problem.

Methodology, general reviews and comparisons of performance-based research funding systems - Hicks (2010; 2012), Van Daalen, et al. ((2014), Junkers K. et al. (2016); Zacharewicz et al., 2019; including within the framework of university funding (higher education) - Herbst (2007), Dougherty & Natow (2015).

Comparative analysis of performance-based research funding systems in different countries - De Boer et al. ((2007), Reborá, Turi (2013), Gena A., Piolatto M. (2016), Q quest & Banner (2015).

Research on national models of performance-based research funding systems: Australia - Butler (2003; 2010); New Zealand - Buckle, Creed (2022); Great Britain - Bence, Oppenheim,

(2005), Marques et al., (2017); Denmark - Larsen (2010); Italy - Franseschet, Costantini (2011); Benedetto, Malgarini (2016); China - Xu & Li (2016); Norway – Aagaard et al., (2015); Flanders – Luwel (2021); Sweden – Qquist, Benner (2012), Karlsson, Persson (2012); Czech Republic - Vanecek (2014); Good et al. (2015) and a number of others.

The Russian federal system for monitoring the performance of research organizations is considered in the works of Grishakin et al. (2020), Ulyakin et al. (2021), Doronin (2018); Doronin, Komarov (2018); Gusev et al. (2018); Kosyakov et al. (2017), Ushakov (2017); as well as in analytical HSE (2014; 2015a; 2015b); RIEPP (2019; 2020).

The theoretical apparatus of the principal-agency problem is disclosed in the works of Jensen and Meckling (1976); Akerlof (1970); Williamson (1985); Kapelyushnikov (1994; 1998), including the application of the principal-agent dilemma in the study of various socio-economic relations Moe (1984); Strøm (2000); Huber, Lupia (2001); Vaubel (2006) and others. The problem of principal-agency relations in science policy was developed in the works of Braun (1993); Rip (1994); Guston (1996); Rip, Meulen (1996); Caswill (1998); Meulen (1998); Guston (1999; 2000); Morris (2003); Shove (2003).

Methodological and theoretical basis of the research: to solve the tasks set by the author of the work, the methods of system analysis, logical and statistical analysis, methods of induction and deduction, analysis of documents and reporting were used, in-depth interview. The theoretical basis of the research was the work of well-known foreign and Russian scientists on the problems of research policy, performance-based research funding system, agency theory, the principal-agent problem, as well as the regulatory framework of the Russian Federation as an institutional aspect characterizing the legal environment of the object of research.

The information base of the study was made up of data on the performance of research activities of Russian organizations for the reporting periods 2015-2019, which were sent by organizations to a database containing information on the performance of research organizations performing research, development and technological work (DB RD NO) and whose data have been verified.

The main provisions and conclusions.

In the context of science policy, the allocators of funds, as one party (the principal), and the organizations of the scientific sector, as the other (agents), form relationships related to the transfer of resources and the achievement of the goals of the principal - scientific performance. At the same time, the parties may have different ideas about the direction and degree of intensity of scientific knowledge, pursue different goals and interests, which leads to prerequisites for the emergence of information asymmetry and the manifestation of corresponding risks. Thus, the application of agency theory is able to capture key aspects of scientific policy and provides a broad basis for research interpretations.

In research on scientific policy, the theory of principal-agency relations has been used since the 1990s (Braun, 1993; Rip, 1994). Science policy was presented as a situation in which "non-scientists" control scientists. The main problem of science policy was formulated as the problem of delegating public goals in the field of science and technology from the government to the research sector (Guston, 1996). When implementing such delegation, the government acts as a principal that distributes resources to agents in the field of research and development, and due to differences in special knowledge and limited access to information, the government, like a classical principal, cannot control the compliance of the efforts made by agents to achieve their goals.

An analytical review of the literature showed, that for the first time the discourse of the agency problem in the field of scientific policy was established in the work of D. Braun, *Who Governments Intermediate Agencies? Principal-Agent Relations in Research Policy-Making*,

Journal of Public Policy 1993. This work is the basis for the subsequent body of literature as the earliest and laid the foundation for the discussion of the agency problem in relation to a particular specific economic sector-scientific policy. Research of the publication landscape based on the work of Braun (1993) using the specialized Litmaps software Litmaps(<https://app.litmaps.com/>) (hereinafter-Litmaps) showed that the work of Braun (1993) has 212 citations (на as of 14.11.2023). Of these, 13 works directly correlate with the topic of this dissertation. At the same time, 9 of them offer fundamentally new interpretations or applications of agency theory for the purpose of rationalizing scientific policy.

Based on the results of the analysis of the discussion on the problem выделено, three main areas were identified, in which the фокусировались positions of researchers were focused:

1) triadic relations and the special role of intermediary organizations, which have a significant impact on the nature of the principal-agent relationship in scientific policy (Braun, 1993; Rip, 1994; Rip, Meulen, 1996; etc.). This concept has become the basis for the discussion of the principal-agency problem in scientific policy.

2) modern competitive scientific policy helps to mitigate the tension between the principal and the agent (Meulen, 1998; Morris, 2003);

3) criticism of the application of the principal agent theory in relation to scientific policy. The relationship between money managers and support recipients is too complex for the apparatus of agency theory to describe (Shove, 2003).

Having considered the evolution of views on the principal-agent problem, в итоге было it was found that the discussion eventually stops at two opposing positions, both of which somehow retouch the potential of agent theory in scientific policy: the principal-agent problem is either significantly mitigated by the current competitive institutions of scientific policy (Maurice, Mulen), or simply it does not reflect the complexity of the relationship between the actors involved (Seam). (Vershinin, 2022)

However, comparing the authors' arguments with modern mechanisms for stimulating scientific performance, it was concluded that the proposed versions of the principal-agency problem do not fully correlate with the current agenda of scientific policy. Since the beginning of the 2000s, performance-based research funding systems (systems for funding science by results) have become widely used in scientific policy, in which a significant share of funding for performers is tied to their performance, usually expressed in the form of publication and patent performance indicators. The main problem that has not been taken into account in the existing interpretations is this criticism of the scientific policy, which is organized on the basis of active promotion of scientific performance, and which is implemented within the framework of national performance-based research funding system (PBRFS). As a rule, such criticism focuses on side effects, such as the influence of scientific policies on the content and choice of scientific topics, information distortion, gamification of research strategies, etc. (Osterloh, 2010; Frost, and Brockmann, 2014; Welpe et al., 2015; Gläser, and Laudel, 2016; Ushakova et al., 2016; Biagioli et al., 2019, etc.) – in other words, the effects that the classical principal-agent problem describes with the help of the concepts of principal and agent maximizing their benefits, information asymmetry and the resulting opportunistic behavior ("evasion", moral hazard, and/or unfavorable selection).

Summarizing the gaps of current literature and the principal-agency problem in scientific policy, the dissertation concluded:

1. The main specifics of the PBRFS-linking funding to the scientific performance of agents-are purposefully not considered in current works on the agency problem in scientific policy;

2. In contrast to the classical models of principal-agency relations in scientific policy, indicators of scientific performance begin to play a special role in the PBRFS – their implementation and their ability to record agency performance depends on the final assessment of the principal of the agent's conscientious efforts;

3. Indicators of scientific performance acquire a new nature: they are used for the intermediary function, which in the classical interpretations of the 1990s was assigned to intermediary organizations.

In order to develop a new interpretation of the agency problem in science policy, we investigated the sources of information asymmetry in the PBRFS according to the main indicators of scientific performance used—publication and patent performance indicators—as well as the asymmetry of information in the course of expert evaluation, which is often used in the PBRFS as an adjunct to scientometric evaluation.

The scientific performance indicators used in the PBRFS are in the crosshairs of the parties' interests and their specifics can significantly affect the parties' compliance with their obligations. The scientific performance indicator, in order to meet the goals of the principal, must perform the following functions:

- reduce information asymmetry.
- reduce the possibility of opportunistic behavior of agents;
- prevent the effects of adverse selection / avoidance / moral hazard from occurring.

Analysis of publication and patent indicators of scientific performance using the agency theory showed that these indicators:

1. Preserve the asymmetry of information between the principal and the agent, because there is still uncertainty about the real value of the results obtained, their real demand;

2. They preserve the field of maneuver for opportunistic behavior of agents, since potentially agents can multiply passing and/or deliberately unclaimed patents, which leads to the risk of evasion effects;

3. Contribute to the manifestation of the effect of unfavorable selection, since general comparisons of performance by indicators may devalue the efforts of researchers aimed at obtaining a complex, breakthrough result.

Control of scientometric assessment through the involvement of expert assessment, from the point of view of the agency problem, also has its drawbacks associated with two main problems:

- unavoidable affiliation of an expert who performs an expert examination on a narrow professional topic (solidarity or unwillingness to spoil relations with a narrow circle of colleagues) - influence on reducing the expert's motivation.
- linguistic problem (the inability to verbally accurately record the value of results and at the same time the possibility of broad interpretations in the right interests; the ability to retouch/ emphasize facts at your own discretion).

In the course of the dissertation, it is concluded that from the point of view of modeling agency relations, the well – known statement that expert and scientometric assessment complement each other is controversial. In both cases, the principal deals with the asymmetry of information expressed in one form or another. The main problem with combining these approaches is that when used together, they do not balance each other, but rather are interdependent and follow each other.

Summarizing the results of the analysis from the point of view of the agency theory of the application of scientific performance indicators and expert evaluation in PBRFS, the dissertation proposes a new scheme of the principal-agency problem in modern scientific policy (the first thesis submitted for defense, more details below).

The logic of the agency theory is tested on the example of the experience of Russian scientific policy in the Russian PBRFS. To do this, it was necessary to separate the Russian PBRFS from the context of the state scientific (scientific and technical) policy of Russia. To this end, a methodological review of foreign science funding systems was conducted based on the results, and the main typical parameters of such systems were recorded. The obtained results of foreign experience are compared with the Russian practice of evaluating scientific performance. As a result, it was established that the full-fledged formation of the Russian national PBRFS begins with the entry into force of the Decree of the Government of the Russian Federation No. 312 of 08.04.2009 "On the assessment and monitoring of the performance of scientific organizations performing research, development and technological work for civil purposes" (hereinafter-PP 312). PP 312 establishes a regular ex post assessment of scientific performance at the national level ex post and links the results of the assessment to the subsequent funding of universities and research organizations – which are the main features of the results-based science funding system according to the developed PBRFS methodology (Hicks, 2010; 2012; Jonkers et al., 2016; Zacharewicz et al. 2019 and etc.).

Based on the results of an analytical comparison of foreign PBRFS and Russian practice of evaluating scientific performance, the thesis is put forward for defense: Russia has formed a national system for funding science by results (hereinafter – PBRFS), which meets the methodological requirements for PBRFS (the second thesis submitted for defense, more details below).

Testing of the logic of the agent theory in terms of direct testing of signs of opportunistic behavior of agents was carried out on the basis of data on the scientific performance of organizations involved in the Russian PBRFS. For this purpose, we used data on the performance of scientific activities for the reporting periods of 2015-2022, which were sent by Russian organizations to the Database containing information on the performance of scientific organizations performing research, development and technological work (hereinafter referred to as the RD NO database) and whose data were verified. As the main tool of the Russian PBRFS, the RDS NO database accumulates all information about the scientific performance of the organizations being evaluated and is used to calculate values based on scientific performance indicators.

During preparation for the analytical processing of primary data, the following features of the Russian PBRFS were taken into account. Monitoring and evaluation frequency in the Russian PBRFS are organized as follows:

- information collection (monitoring) - annually.
- making a decision on the fate of the organization – once every 5 years (three possible consequences: liquidation; maintaining the statusquo; the right to receive additional funding);
- extraordinary performance evaluation – no more than once every 3 years.

The Russian PBRFS reached its design capacity by 2019, when the Unified Methodology for calculating the minimum (threshold) values of performance indicators for reference groups and evaluating organizations performing research, development and technological work for civil purposes was approved (hereinafter referred to as the Unified Assessment Methodology, given in Appendix 2 of the dissertation). Prior to that, seminars and discussions were held in 2017-2018, and the Ministry of Education and Science of the Russian Federation worked out, among other things, the final outlines for evaluating scientific performance within the framework of an Interdepartmental Working Group. Thus, the agents were aware of the plans and progress in preparing for the integrated performance assessment, which was scheduled for 2019 (assessment based on performance data for the period 2015-2018). In this regard, as one of the working

hypotheses, it was expected that the consequences of maximizing efforts would appear by this period. goal-achieving agents and possible concomitant opportunistic behavior.

Data from the RD NO database showed that as at the end of 2022, 2333 organizations conducting research and development were registered in it. Of these, 1,159 organizations sent information on the performance of scientific activities by the end of 2022. Of these, the data of 1,116 organizations passed data verification and received confirmation from the relevant federal executive authorities (hereinafter referred to as FOIV) or state corporations. These are mainly institutions of the public sector of science that are subordinate to the Ministry of Education and Science of the Russian Federation, the Ministry of Health of the Russian Federation, the Ministry of Agriculture of the Russian Federation, the Ministry of Culture of the Russian Federation and other federal educational institutions that have subordinate organizations that conduct scientific activities. For the purposes of the dissertation, primary data on the scientific performance of 1116 organizations was uploaded from the database of RD NO, and their data was verified for further processing and identification of statistical dependencies.

An analysis of the primary data upload from the RD NO database for the period 2015-2022 showed that the evaluated organizations actively responded to the indicators of publication activity in the PBRFS and made significant efforts to maximize its value by the time of the first final assessment in 2019. This is demonstrated by significantly increased publications in WoS and Scopus – the values of which are used in the formula for evaluating using a Single Evaluation Method. Dynamics of the average number of publications per employee performing research and development showed an increase of more than 2.5,5 times by 2019 per employee of Web of Science and Scopus publications both in general and for organizations of the Ministry of Education and Science of the Russian Federation (Figure **Ошибка! Закладка не определена.** – dynamic of replication activity on the example of publications in Scopus).



Figure **Ошибка! Закладка не определена.** - Agents' maximization of the value of the estimated indicator for the integrated assessment of 2019, using the example of publications in journals indexed in Scopus

Source: compiled by the author on uploading data from the RD NO database (upload date 18.10.2023)

At the same time, the number of publications indexed in the RSCI database - those that do not participate in the calculation of the publication performance indicator - showed a sharp decline. Despite some fluctuations, the average number of RSCI publications per R & D employee is steadily falling, both in general for all organizations and for organizations of the Ministry of Education and Science of the Russian Federation. The dynamics of data uploading showed that until 2016, the increase in the intensification of publication activity in the RSCI continued, but later this growth was replaced by a sharp drop almost дватwice in 2017 (informing agents about the planned comprehensive assessment in 2019). As a result, despite a slight recovery in subsequent years, the average number of publications RSCI per employee still remains reduced by almost 1.22 times compared to 2015 or 1.5 times compared to the last peak in 2016. In organizations of the Russian Ministry of Education and Science, the trend is similar: a noticeable drop is observed in all years up to 2018aa. Despite the subsequent recovery from the 2019 comprehensive assessment, the конечном final, reduction in RSCI publications per researcher by 2022 was more than в 1.6,6 times as compared to 2015 , or almost 1.9 times as compared to the last peak in 2016. (Figure **Ошибка! Залкадка не определена.**)



Figure **Ошибка! Залкадка не определена.**-Loss of interest of agents to the results of scientific activity excluded from the assessment of scientific performance, on the example of publications in journals indexed in the RSCI

Source: compiled by the author on uploading data from the RD NO database (upload date 18.10.2023)

Simultaneously with the maximization of the values of the evaluated indicators by the agents, a side effect with signs of opportunistic behavior of the agents was also revealed. According to the Unified Assessment Methodology used in the Russian PBRFS, the indicator of publication activity is normalized for research personnel, engaged in research and development. Consequently, decrease in the number of researchers in the reporting documentation of agents will also lead to an increase in the value of the indicator.

Thus, data on the dynamics of the number of researchers show a significant decrease in the number of employees employed in R & D over the entire period. Despite a small increase in 2016, there has been a collapse in the number of researchers since 2017. The lowest value was achieved by 2018, when by the time of the integrated assessment in 2019, the research staff

employed in R & D had decreased by more than a third from the level of 2015. Despite some recovery in subsequent years, the number of researchers based on the agents' reporting materials is currently only 71% of the 2015 level.



Figure **Ошибка! Закладка не определена.**-Basic growth rates of the number of researchers relative to 2015, in organizations estimated by the Russian PBRFS

Source: compiled by the author on uploading data from the RD NO database (upload date 18.10.2023)

It was checked a possible explanation for the above-mentioned decline was tested as a result of a decrease in the number of researchers due to the retirement of older researchers or the elimination of those who did not receive a scientific degree. However, it was found that since 2016, the number of researchers with a degree and the number of young scientists has also significantly decreased, in 2018, the decrease was by 30% and 32%, respectively, from the number of 2015. Thus, the decline in the number of researchers with an academic degree and young scientists under 39 years of age correlates with the overall decline in the number of researchers. As a result, by 2019, by the time of the first comprehensive performance assessment, the number of researchers with an academic degree was 70% of the 2015 level, and the number of researchers aged 39 years was 68% of the 2015 level. (Figure **Ошибка! Закладка не определена.**).

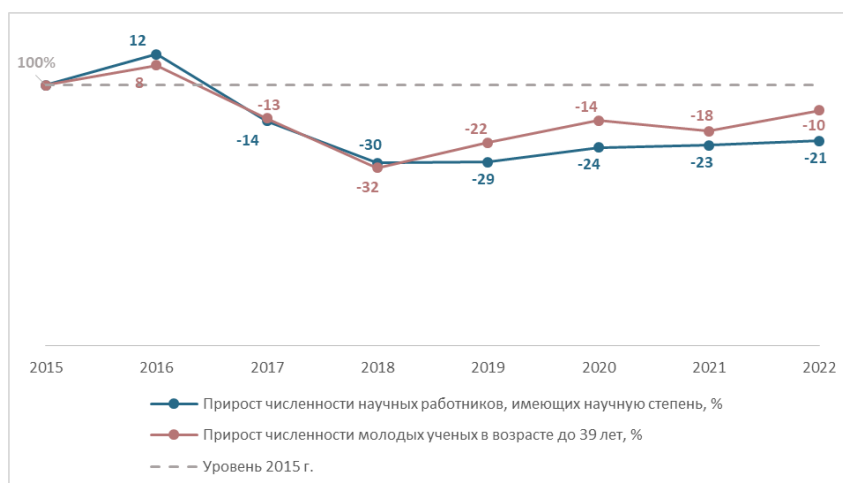


Figure **Ошибка! Закладка не определена.**-Basic growth rates of the number of researchers with an academic degree and young scientists relative to 2015 in organizations evaluated by the Russian PBRFS

Source: compiled by the author on uploading data from the RD NO database (upload date 18.10.2023)

Reductions in R & D personnel also correlate with a decline in the training of highly qualified personnel in organizations. Data on the dynamics of the number of doctoral students and postgraduates relative to 2015 also indicated a downward trend: in 2018, the number of doctoral students decreased by 45%, postgraduates-by 25% compared to 2015. Only starting from 2020, the number of postgraduates is almost restored to the level of 2015. Thus, the peak reduction in the number of postgraduates and doctoral students occurs by the first comprehensive assessment of 2019 in the Russian PBRFS.

The R & D database data was also analyzed for the distribution of the number of R & D personnel by functional categories. In the R & D database, the personnel engaged in research and development is taken into account as the average number of employees (part-time employees, as well as part-time employees and persons working under civil law contracts) of organizations (corresponding divisions of higher education organizations) performing research and development. Research and development personnel are divided into five categories: researchers, faculty members, technicians, support staff, and other personnel. Abbreviations in the first two categories – researchers and teaching staff-directly affect the macro-optimization of indicators A and B according to the formulas of the Unified Assessment Methodology (Figure **Ошибка! Закладка не определена.**).

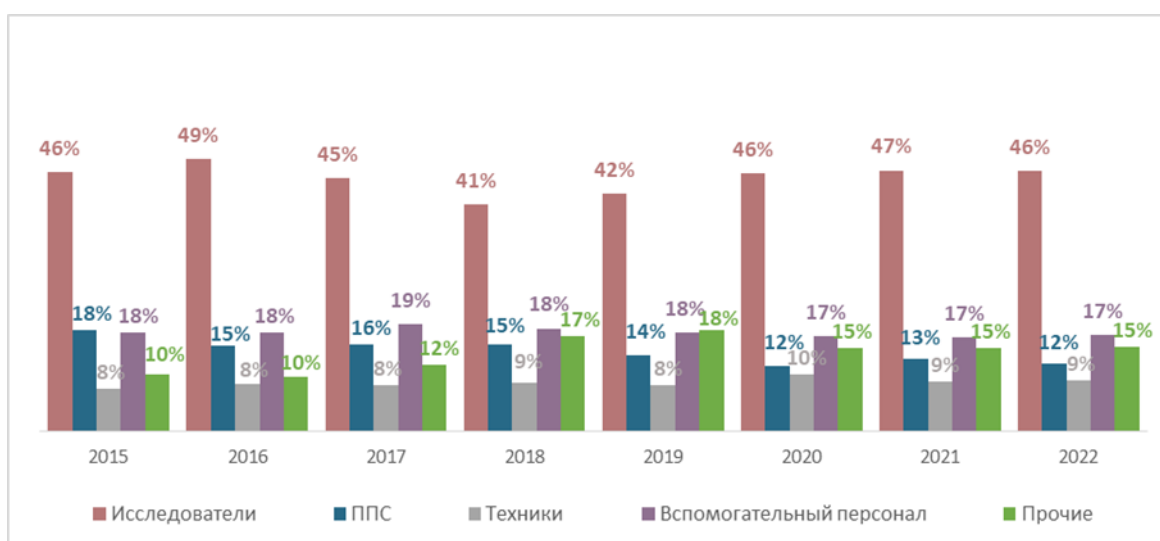


Figure **Ошибка! Закладка не определена.**-Distribution of research and development personnel by category

Source: compiled by the author on uploading data from the RD NO database (upload date 18.10.2023)

However, by the time of the first comprehensive assessment in 2019, the category of researchers had undergone major changes. Their share in the total population decreased from 46% in 2015 to 41% in 2018. The share of faculty members who, along with teaching activities, performed research and development in research departments or departments of higher education organizations, gradually decreased from 18% in 2015 to 15% in 2018.

The share of service personnel, on the contrary, shows growth or relative stability in all its categories. The share of the other category increased most noticeably – from 10% to 17% by the first comprehensive assessment of 2019. Thus, the data indicate that since 2017, the structure of scientific personnel has experienced an annual redistribution towards an increase in the share of service personnel due to the share of employees engaged directly in scientific activities (a decrease in the number of researchers and teaching staff). positions of agents in indicators A, B). After a comprehensive assessment of 2019, personnel reallocation began to level out again, but the share of teaching staff remains reduced in 2022 by a third from the level of 2015, while the other category is increased by a third.

Based on the results, the main conclusion can be formulated as follows: in the Russian PBRFS, there is a sign of opportunistic behavior "shirking"(shirking, expressed in agents underestimating the number of R & D employees in order to increase the values of the indicator measuring publication activity.

Based on the results of the analysis of data on the scientific performance of organizations involved in the Russian PBRFS (unloading from the R & D database) for 2015-2022, the following conclusion was made: in the Russian PBRFS, there is a sign of opportunistic behavior "shirking", expressed in agents underestimating the number of R & D employees in order to increase the values of the indicator measuring publication activity. activity (the third thesis submitted for defense).

Additionally, the thesis provisions were tested during two in-depth interviews with representatives of the principal (decision-makers in senior positions in leading Russian scientific foundations: the National Technology Initiative Project Support Fund; the Russian Foundation for Technological Development). In the course of the interview, the thesis research points about the asymmetry of information between the manager of funds and the recipient of support were confirmed. Additionally, the interviewees pointed out the problem of costs of relations between the principals among themselves (relations in the hierarchy of principals), which affects the activities of agents, or may represent an additional lever of pressure on the principal for their own interests.

Based on the results of the dissertation research, the following recommendations and prospects for applying the agency theory are formulated:

1. bdue to the lack of opportunities to reduce information asymmetry in currently used scientific performance indicators, it is recommended to reduce the amount of funding linked to scientific performance indicators and / or use scientometric assessment as a secondary (auxiliary) in the assessment of scientific performance within the framework of the PBRFS;
2. It is recommended to abandon the mass expert assessment of performance for all organizations, and focus only on evaluating the performance of organizations that are at risk of falling into category 3 (scientific organizations that have lost their scientific activity as the main type of activity and development prospects according to PP 312). Expert assessment should not be used as a supplement to scientometric assessment, but as a tool for making precise decisions on controversial cases.
3. nwhen making decisions in scientific policy, it is necessary to take into account the entire chain of principals and agents involved, their hidden interests and motives. The same recommendation applies to future research on the principal-agency problem – the theory is a working tool for checking possible biases in scientific policy decisions.

In general, the dissertation research puts forward a new interpretation of the principal-agency problem in scientific policy, which most fully reflects the relations of the parties in modern scientific policy. The methodological approach used in the dissertation research on the

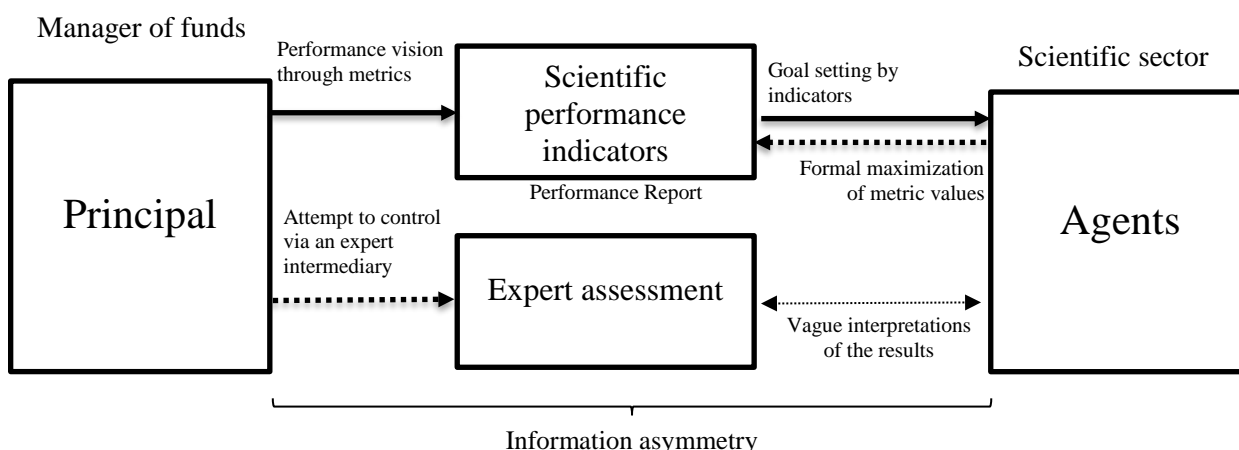
application of the principal-agent problem for determining and predicting the possibilities of opportunistic behavior of agents can be used as a tool for verifying and rationalizing decisions of a state authority that is an industry regulator of state scientific and technical policy. The theoretical and methodological results of the work can serve as a basis for further research on the problems of scientific policy and improving the efficiency of public authorities.

Research novelty of the study:

1. There is a discrepancy between the existing interpretations of the principal-agency problem in the context of research funding systems based on results.
2. The general scheme of the principal-agency problem in the system of financing science by results is presented.
3. The role of scientific performance indicators and expert evaluation in the systems of research financing based on results in the context of the principal-agency problem is considered.
4. A description of the Russian system of science funding based on results is formed in accordance with international standards of such systems and an analysis of information on its effectiveness for 2015-2022 is carried out.
5. Proposals have been prepared to mitigate the principal-agency problem in the Russian system of science funding based on the results.

The main provisions submitted for protection:

1. A new scheme of the principal-agency problem of modern scientific policy is proposed, taking into account the performance-based research funding systems (PBRFS).



General scheme of the principal-agency problem of modern scientific policy, taking into account PBRFS and based on a combined assessment of scientific performance

Source: compiled by the author

The main specific feature of modern scientific policy – the use of the performance-based research funding systems through linking funding to the scientific performance of agents, was purposefully not worked out in the interpretations presented in the literature. In contrast to the classical models of principal-agency relations in scientific policy, indicators of scientific performance begin to play a special role in systems of funding science based on results – their implementation and their ability to record agency performance depends on the final assessment by the principal of the integrity of the agent's efforts. Thus, the indicators of scientific effectiveness acquire a new nature: the intermediary function passes to them.

The use of indicators of scientific performance and expert evaluation in systems of research funding based on results does not reduce the asymmetry of information between the

principal and the agent, does not prevent opportunistic behavior of agents, and potentially leads to the manifestation of the effect of unfavorable selection.

2. Russia has established a national system for funding science by results (hereinafter referred to as the PBRFS), which meets the methodological requirements for the PBRFS.

Main parameters of the Russian PBRFS

#	Methodological parameter of PBRFS	The PBRFS Values of of the Russian PBRFS
<i>Mandatory parameters</i>		
1	The national system	of Evaluation and monitoring of scientific performance covers all budgetary organizations performing R & D (monitoring also covers non-governmental organizations -- Resolution 312
2	Institutional financing	The results of the evaluation affect institutional financing (development programs of organizations). The achieved values in terms of scientific performance indicators are linked to making a decision on the fate of the organization: 1) termination of basic funding and reorganization / liquidation of the organization; 2) maintenance of the status quo of funding; 3) right to additional funding for the organization's development program
3	Evaluation of scientific performance Ex-post	scientific performance evaluation Scientific performance is evaluated according to past periods
4	Evaluation through scientific performance indicators	According to the classification of indicators of PBRFS Hansen (2010), all three are involved categories of scientific performance indicators: 1) first order (indicators of Order 162) 2) second-order (integral indicators according to the assessment methodology); 3) third-order (ranking by reference groups)
3	Frequency of evaluation	At least once every 5 years (extraordinary evaluation - can be carried out no more than once every 3 years)
4	Evaluation period	The evaluation is carried out on the basis of information reflecting the activities of the scientific organization for at least 3 years preceding the evaluation of the effectiveness of the scientific organization
5	The approach to evaluation	iCombined (indicators of scientific performance evaluation and peer review)

Source: compiled by the author.

3. In the Russian system of science funding, the results revealed a sign of opportunistic behavior - "shirking"- expressed in agents underestimating the number of R & D employees in order to increase the values of the indicator measuring publication activity.

Based on the results of the analysis of data on the performance of scientific activities for the reporting periods 2015-2022 in the database of RD NO, it was found that the evaluated

organizations responded quite clearly to the indicators of publication activity in the PBRFS and made significant efforts to implement it. This can be seen in the significantly increased WOS and Scopus publications, whose values are used in the evaluation formula, and the significant drop in RSCI publications that were excluded from the evaluation. However, at the same time, a side effect of the indicator associated with the normalization of indicators for personnel engaged in research and development was also identified - a decrease in the number of research personnel involved in the formula according to a Single Assessment methodology – fell into the direct interest of the evaluated organizations. As a result, the number of R & D personnel employed by the time of the first comprehensive assessment in 2019 was reduced by more than a third from the level of 2015. The number of researchers with a degree and young scientists has been reduced by comparable amounts, and the volume of training of highly qualified personnel has been reduced. In the structure of R & D personnel, the share of researchers and teaching staff has significantly decreased, while the category of other employees has significantly increased.

Theoretical significance of the results of the dissertation work: the dissertation work develops and presents a general scheme of the principal-agency problem in the performance-based research funding systems, which is a further development of interpretations of the principal-agency problem in research policy. For the first time, an approach to mapping principal-agency relations in national systems of science financing based on results, taking into account the administrative configuration, is proposed on the example of the Russian system. The interpretation of research performance indicators is given, taking into account their influence on the possibilities of opportunistic behavior of agents in such systems. The theoretical and methodological results of the work can serve as a basis for further research on the rationalization of research policy and improving the efficiency of public authorities.

Practical significance of the research results. In the dissertation research, proposals were formed to stop the effects of the principal-agency problem in the Russian performance-based research funding system that could potentially have a significant impact on the possibility of opportunistic behavior of the evaluated research organizations and universities: in a single methodology for calculating the minimum (threshold) values of performance indicators for reference groups and evaluating organizations performing research, experimental design and technological work for civil purposes, it is proposed to abandon the rationing of indicators for the number of researchers in favor of rationing for funding. The proposed solution is aimed at reducing the side effects of evaluating the research performance of organizations.

The methodological approach used in the dissertation research on the application of the principal-agent problem for determining and predicting the possibilities of opportunistic behavior of agents can be used as a tool for verifying and rationalizing the decisions of the state authority, which is the industry regulator of the state research and technical policy.

Approbation of the study.

The list of research events at which the results of the dissertation research were presented:

1) International Research Conference "National Economic Security: Development Potential and Challenges of the Digital Economy". Department of Political Economy, Faculty of Economics, Moscow State University named after M.V. Lomonosov, October 13, 2018 Report topic: National research and technological security: key problems of public administration and ways to solve them.

2) IOP Material Science and Engineering. International Research Conference "Digital Transformation on Manufacturing, Infrastructure and Service" (DTMIS-2018), Peter the Great St. Petersburg Polytechnic University, Russia. 2018 (Scopus).

3) Svetlana Ushakova, Olga Sergeeva, Ivan Vershinin, Aleksey Kornilov. Approach to assessing efficiency of public expenditures on applied research in the condition of digital economy. IOP Conf. Series: Materials Science and Engineering 497 (2019) 012097. doi:10.1088/1757-899X/497/1/012097 (04/03/2019).

4) International Business Information Management Conference (34th IBIMA) Madrid, Spain 13-14 November 2019 (Scopus), absentee participation (publication of materials) I. Vershinin “The Side Effects of Patent Indicators in Performance Based Research Funding Systems: Theoretical Grounds” (ISBN: 978-0-9998551-3-3) (full paper) (11/14/2019).

Main publications on the research topic:

According to the results of the dissertation research, 8 research articles were published, 1 monograph with a total volume of 7.2 pp. 1. Of these, 2 articles were published in a journal indexed in Scopus, 1 article – Wos, 2 articles – in publications included in the list of high-level journals prepared by the HSE, 4 articles - in other publications including 1 monograph.

Publications in journals indexed in Scopus and Web of Science:

1) Vershinin, I. (2022). About the principal-agency problem in research policy. *Sociology of Science and Technology*, 13 (1), 60-80. doi: 10.24412/2079-0910-2022-1-60-80 (WoS).

2) Vershinin, I. (2021). Disadvantages of patent performance indicators in performance-based research funding systems. *Research Papers of the University of Pardubice, Series D: Faculty of Economics and Administration*, 29(2). <https://doi.org/10.46585/sp29021341> (Scopus, Q3).

3) Ushakova, S. E., Gusev, A. B., Vershinin, I. V., & Kornilov, A. M. (2016). A new model of public management in science financing in Russia. *Polish Journal of Management Studies*, 13(1), 206–216. <https://doi.org/10.17512/pjms.2016.13.1.19> (Scopus, Q3).

Publications in publications from the list of high-level journals prepared by the National Research University Higher School of Economics:

4) Vershinin, I., Kornilov, A., Baikov, S. (2018). Results of monitoring the costs of research and development of Russian companies participating in the RBC 500 rating, *Society and Economics*, (6), 50–74. <https://doi.org/10.7868/S0207367618060043>

5) Vershinin I.V. (2016). On the state task in the field of science in the light of international experience. *Society and Economics*, 11, p. 5–22.

Publications in other issues:

6) Grishakina E.G., Ilieva S.Yu., Komarov N.M., Vershinin I.V. (2020). Monitoring the effectiveness of research activities of organizations that carry out research and development, based on the data of the FSMNO - DB RD NO. *Management of Science and Scientometrics*, 15(2), 223–250. <https://doi.org/10.33873/2686-6706.2020.15-2.223-250>

7) Vershinin I.V., Kornilov A.M. (2018). External perception of the research and technological complex of Russia on the example of OECD reports. *The science. Innovation. Education*, 2018. No. 2

8) Gusev A. B., Doronina E. G., Vershinin I. V., Malakhov V. A. (2018). Monitoring and evaluation of the results of research and technical activities: foreign experience and Russian practice // *Nauka. Innovation. Education*. 2018. No. 1 (27). pp. 65–91.

9) The effectiveness of research activity of organizations performing research and development: monitoring and evaluation: monograph / N.A. Ulyakina, I.V. Vershinin, Yu.Yu. Ntrebin S.Yu. Ilieva, N.M. Komarov, A.E. Burdakov. - Moscow : RUSCAYNS, 2021. - 112 p.