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Evaluation of Universities' Institutional Efficiency and Performance under System-level
Reforms in Russian Higher Education

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List of Abbreviations

BoD – Benefit-of-the-Doubt

DEA – Data Envelopment Analysis

DID – Difference-in-differences

FE regression – Fixed effects regression

IV – Instrumental variable

NPM – New Public Management

PSM – Propensity score matching

STEM – Science, Technology, Engineering and Mathematics

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Conferences, where research results were presented:	<ol style="list-style-type: none">1. 6th International Workshop on “Efficiency in Education, Health and other Public Services”. Huddersfield, UK, September 2018.2. Higher Education in modern Ecosystems: Efficiency, Society and Policy. Augsburg, Germany, March 2018.3. The 31st conference of the Consortium of Higher Education Researchers (CHER). Moscow, Russia, September 2018.4. XX April Conference, Moscow, Russia, April 20195. 44th Annual Conference, Kansas City, USA, March 20196. AEFP 45th Annual Conference, USA/Online, March 2020
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1. Introduction

The emergence of the concept of New Public Management (NPM) in the 1980s questioned the previously dominating vision of the uniqueness of the organisational structure of universities (Musselin, 2007). Although NPM regulation was neither implemented in the same way nor to the same extent in different national higher education systems, its 'signs and signals' are present in many countries (Ferlie et al., 2008). The global trend of budget cuts amid the expansion of the higher education sector exacerbated questions about the efficient use of public funding, the accountability of universities, their autonomy and the degree of control by the state.

The performance-oriented approach changes the role of the public sector from service provider to market regulator and entails the introduction of performance-based funding schemes, cost-sharing mechanisms, and competition (Agasisti and Catalano, 2006) in order to enhance performance and efficiency (Agasisti et al., 2021) of higher education systems.

NPM implies improving performance (the number of outputs) and efficiency (minimization of costs and the maximisation of outputs) of universities in resource-constrained environments (De Boer et al., 2007; Gunter et al., 2016). Since efficiency discourse in research and policy on public sector organisations became more pronounced, the scholarly debate about the extent to which the state can intervene in production processes to transform universities as organisations and their production functions intensified (Hopkins, 1990; Coelli et al., 2005).

State interventions into universities' production functions have been studied from the perspective of increasing universities' performance in certain domains of their operations, usually classified along the three missions of higher education (teaching, research, and knowledge transfer). These studies included the evaluation of the effects of national assessments of institutional performance, data-driven decision making, excellence initiatives (Shattock, 2017; Froumin and Lisytukin 2015; Gawellek and Sunder, 2016); mechanisms that steer funding and attach it to state-set goals, such as normative-per capita funding and performance-based funding (Sörlin, 2007); and policies regarding university autonomy (Brunsson and Sahlin-Andersson, 2000; Aghion et al., 2010)

Another stream of research on universities' operations is grounded in the production function approach (Hanushek, 1986; Hopkins, 1990) and focuses on universities' efficiency, or their ability to maximise the outputs at the current level of resources, or minimise resources while maintaining the current level of outputs. In this field, the research has addressed the issue of comparing differing methodologies of evaluating the production function (Johnes, 2006b; Grosskopf et al., 2016), differentiating between the teaching and research production functions (Beasley, 1995; Gralka et al., 2019), as well as efficiency determinants within and across multiple national contexts

(e.g. Bolli et al., 2016; Wolszczak-Derlacz., 2017; Yang et al., 2018), providing evidence on dynamic change in efficiency and productivity of universities (Agasisti and Wolszczak-Derlacz, 2015; Bolli and Farsi, 2015; Johnes and Tsionas, 2019).

In general, efficiency and productivity analysis is widely used in policy evaluation in the public sector (Mergoni and De Witte, 2022). In higher education research, empirical evidence on the transformative ability of state regulations in changing the production function of universities in terms of efficiency and productivity exists, but as shown in the literature review, it is fragmented across national contexts and types of the state intervention, and rarely provides causal evidence on the consequences of the reforms.

The study aims at filling these gaps by providing comprehensive evidence on the effects of performance-oriented reforms in higher education in terms of universities' efficiency, productivity, and performance by addressing the case of the Russian higher education system. Russia represents an interesting case of a 'late adopter' (Steiner-Khamsi, 2006) of the global practices of NPM regulation: state-driven reforms in recent decades aimed at organisational and institutional changes in higher education and implied competition, transparency, accountability, and data-driven performance assessment (Platonova and Semyonov, 2018).

The text is further structured as follows. Section 2 is dedicated to the research problem and the research objectives of the study, presents the research gaps addressed in the thesis and introduces the context of higher education regulation in Russia. Section 3 focuses on the research design, the theoretical arguments, the methodology and the data used in the papers. Section 4 outlines the papers of the collection. The key findings of the thesis are presented in Section 5, followed by the academic and policy-oriented contributions of the research, introduced in Section 6. Section 7 discusses the limitations of the study and the future research prospects.

The results of the thesis are presented in four papers, further referred as Papers 1-4:

Paper 1: Shibanova, E. (2023). NPM policy in Higher Education: a Review of Effects on Universities' Efficiency and Productivity. *Educational Studies Moscow* (in print).

Paper 2: Agasisti, T., Shibanova, E., Platonova, D., & Lisyutkin, M. (2020). The Russian Excellence Initiative for higher education: A nonparametric evaluation of short-term results. *International Transactions in Operational Research*, 27(4), 1911-1929.

Paper 3: Agasisti, T., Abalmasova, E., Shibanova, E., & Egorov, A. (2022). The causal impact of performance-based funding on university performance: quasi-experimental evidence from a policy in Russian higher education. *Oxford Economic Papers*, 74(4), 1021-1044.

Paper 4: Agasisti, T., & Shibanova, E. (2022). Actual autonomy, efficiency and performance of universities: Insights from the Russian case. *International Journal of Public Administration*, 45(2), 121-134.

2. Research problem and research objectives

2.1. Policy effects in terms of universities' production function change

The targeted literature addresses two main evaluative techniques applied to the production function of universities. The first one, parametric is used if it is possible to specify the functional form of the production function (Aigner et al., 1977) and the non-parametric is used if the functional form is unknown (Charnes et al., 1978). In this regard, the efficiency of universities is understood as the ability of these organisations to 'increase the level of any output without increasing also the level of at least one input, or to decrease the level of any input without decreasing the current level of at least one output' (Mergoni and De Witte, 2022).

The studies of higher education efficiency started in the early 1990s. Research on efficiency in education can be concentrated not only on university-level data (e.g. Agasisti and Pérez-Esparrells, 2010), but it also considers the department and research/educational programme levels of operation (e.g. Johnes and Johnes, 1993; Cherchye and Abeele, 2005).

According to the reviews of the literature, addressing the variance in definitions of the universities' production functions (Berbegal Mirabent and Solé Parellada, 2012; De Witte and López-Torres 2017), the majority of the research conceptualises the inputs used by universities though human capital, financial, and infrastructural resources. Outputs are mostly measured across the streams of teaching (e.g. graduation rates), research (e.g. publications, citations, grants) and knowledge transfer/third missions (e.g. patents, income from intellectual property).

The literature specifically concerning the evaluation of the effects of the state intervention into the universities' production functions can be summarised across policy instruments, usually addressed in NPM and in performance-stimulating regulation, in general (Agasisti and Catalano, 2006; Ferlie et al., 2008; Lorenz, 2012): (1) financial instruments (the creation of competitive market-based and performance-based mechanisms of funding allocation, decrease in the degree of universities' financial dependency from the state, financial incentives stimulating desired behaviour and performance of universities); (2) structural consolidation (mergers, concentration of funds in major public providers); and (3) autonomy regulation (performance and qualification assessments, the regulation of universities' financial independence, academic freedom, hiring policy, strategic and operational management).

Financial mechanisms

Before the NPM era, in most countries, state funding in higher education was lowly performance-oriented and underlined the high degree of centralised regulation. Amid the expansion of higher

education systems, governments moved towards marketizing higher education and diminishing the public burden (Johnstone et al., 1998). As governments are interested in favouring organisations that service the national interest in a more productive and efficient way (Liefner, 2003; De Witte and López-Torres, 2017; Agasisti and Pérez-Esparrells, 2010; Agasisti and Johnes, 2009), they create incentivizing mechanisms that allow the alignment of state interests and institutional behaviour.

In pursuing the need to increase transparency and accountability in higher education funding, governments initiated reforms calling for the replacement of outdated negotiation procedures and the introduction of competitive schemes linking public funding with universities' performance (Jongbloed and Vossensteyn, 2001). The anticipated effects of such regulation include increase in educational quality and stimulation of competitive behaviour, which is instrumental in the awaited increase in efficiency and productivity (Aghion et al., 2010; Bolli et al., 2016).

The empirical literature demonstrates that market-inspired and competitive regulation increases research and teaching universities' performance (Agasisti, 2009), and institutional efficiency (Agasisti et al., 2021a). Universities' capacity to attract funds from competitive sources contributes to mid-term efficiency growth in more than one national context (Agasisti and Wolszczak-Derlacz, 2016; Bolli et al., 2016).

Decrease in financial dependency on the state is expected to stimulate a business-type model and performance efficiency in the new environment (De Boer et al., 2007; Aghion et al., 2010). Decentralised funding was found mostly effective in increasing universities' efficiency (Flegg et al., 2004; Tochkov et al., 2012; Thai and Noguchi, 2021; Moradi-Motlagh et al., 2016). However, some research suggests that public funding reduction contributes to significant inefficiency gains and a decrease in the availability of public higher education (Sav, 2016; 2017).

Universities reconfigure their production functions and put efforts into outputs that are rewarded by the governing authority (Agasisti and Haelermans, 2016), while quality evaluation exercises linked to funding contributes to increases in efficiency of operations (Glass et al., 1998; Glass et al., 2006). Reviews by Dougherty and Natow (2020) and Ortagus et al. (2020) show that performance-based funding schemes increase faculty's research productivity and teaching outcomes (such as graduation rates and in-time completion).

Structural consolidation in higher education

The structuring of the higher education institutional landscape is one of the axes of state policy towards enhancing both individual universities' efficiency, and the overall system performance

and competitiveness. Under NPM, the state, on the one hand, aims at building the market-like diversification of the sector and enhancing institutional diversity. On the other hand, the state tends to increase the concentration of resources within the best-performing organisations to achieve better performance and (or) international competitiveness through consolidating the system (Neave, 1985; Ferlie et al., 2008). From the structural viewpoint, the existing state interventions can be classified as those aiming at institutional mergers and resource consolidation (excellence initiatives).

Mergers, voluntary or involuntary, are processes during which two or more universities are functionally and (or) structurally combined into one organisation with unified management control (Rocha, 2020). From the state perspective, mergers are driven by the intention of reducing the number of higher education institutions, reallocating resources and consequently to reduce the public burden in financing higher education (Välilmaa et al., 2014). The empirical research demonstrates that mergers contribute to increased research performance (Liu et al., 2018; Kang and Liu, 2021), voluntary mergers are beneficial for efficiency and productivity growth (Johnes, 2014; Papadimitrou and Johnes, 2018; Johnes and Tsionas, 2019). Evidence on top-down mergers is mixed, demonstrating that while an increase in efficiency occurs (Agasisti et al., 2021a), it does not last long (Yongmei and Wenyan, 2008).

Excellence initiatives are policies provoked by ‘status anxiety’, driven by the rise of global competition and rankings in higher education and are designed to enhance particular groups of universities and their capacity at the international arena (Froumin and Lisyutkin, 2015). Many studies report the positive effects of such policies on publication activity of universities (Möller et al., 2016; Zong and Zhang, 2017; Matveeva et al., 2021), and provide evidence on the positive effect of excellence initiatives on universities’ efficiency and productivity (Yaisawarng and Ng, 2014; Yang et al., 2018; Civera et al., 2020).

Autonomy regulation

One of the trends in NPM reforms is embodied in decentralising managing authorities and reallocating decision-making power, which was taken from the central government or any other superior specialised governing authority and transmitted directly to public service providers (Enders et al., 2013). An increase in universities’ performance and efficiency due to an increase in their autonomy might be expected because of the introduction of new resource allocation mechanisms, a better ability to compete for scarce resources, and flexible human resource management practices. Aghion et al. (2010) show that a higher degree of autonomy is an essential driver of universities’ performance because more autonomous universities have more capacity to

respond to market competition and to convert revenues into performance outcomes. McCormack et al. (2014) prove that managerialism matters in universities in the sense that a more flexible management style generates more research and better teaching performance. From the efficiency and productivity perspective, the evidence is mixed. On the one hand, less autonomous regulation allows universities to maintain their efficiency level during economic crises (Lehmann et al., 2018), and some delimitations in autonomy, for example the restricted assessment of staff qualifications can be beneficial for efficiency (Berbegal-Mirabent, 2018). On the other hand, more autonomous universities operate with higher efficiency and productivity gains (De la Torre et al., 2017; Kantabutra and Tang, 2010).

Summarising the evidence, the majority of studies on specific NPM-inspired policy interventions in higher education demonstrate that the thematic state reforms were effective in provoking positive change in universities' efficiency, productivity, and performance. However, the evidence on the unintended consequences is worth mentioning as well. Incentive-based interventions enhance the vertical and horizontal differentiation of higher education systems. Policies contributing to the concentration of resources within particular groups of universities, such as excellence initiatives, increase the concentration of high-quality research and universities' stratification in terms of research productivity and enhance the sorting effect – over time more talented human capital is accumulated within the same organisations (Bolli et al., 2016; Lovakov et al., 2021). Performance-based funding schemes were also found to contribute to increased institutional stratification and differentiation in the European (Sorlin, 2007; Abankina et al., 2018; Dougherty and Natow, 2020) and the US contexts (Favero and Rutherford, 2020; Ortagus et al., 2020), which is not beneficial for educational opportunities and access to university-level education (Malinovski, Shibanova, 2021).

Thus, the analysis of the literature on the effects of state policy on universities' production functions identifies the following limitations that I am addressing in the dissertation.

The first limitation comes from the fact that the evidence provided is fragmented across national contexts and does not allow for a comprehensive understanding on how performance-oriented regulation has impacted higher education institutions. The possible explanations lie in the low availability of data and the difficulty of operationalizing, measuring and thus establishing the policy effects (Agasisti and Dal Bianco, 2009). To tackle this limitation, the dissertation addresses NPM-inspired policies within one national context and takes advantage of using harmonised datasets, thus producing empirical evidence on a large sample of universities. The structuring of the narration of the empirical evidence on the effects of state intervention into Russian universities'

production functions mirrors the instruments of such policy, summarised in Paper 1. Thus, the dissertation assesses the effects of the introduction of a performance-based funding model (Paper 3), of structural reform (excellence initiative, Paper 2), and provides evidence on the reform of institutional autonomy (Paper 4).

The second challenge arising from the literature concerns the high variability in defining the universities' production functions. This issue was raised and illustrated in detail in reviews by several authors (Berbegal Mirabent and Solé Parellada, 2012; De Witte and López-Torres 2017). The inputs and outputs used to depict the production functions of Russian universities are harmonised among the papers in the thesis. This allows us to interpret the results in a more concise way.

The third limitation of the existing literature concerns the fact that only two studies in the thematic scope provide causal evidence in an international context (Lehmann et al., 2018; Civera et al., 2020), and one study produces causal evidence on NPM-based regulation in Russia (Agasisti et al., 2021a). The dissertation thus provides a methodological advancement in the field by addressing causal methods: propensity score matching (Rosenbaum and Rubin, 1985; Paper 2), semi-parametric difference-in-differences (Paper 3), and the instrumental variable approach (Abadie, 2005; Paper 4).

Finally, the thematic evidence demonstrates that performance-enhancing policies are capable of leading to unintended consequences, particularly, to establish higher institutional stratification and differentiation within higher education systems (Dougherty and Natow, 2020; Ortagust et al., 2020). Such a stratifying effect is studied with respect to a specific regulation, namely, the introduction of a performance-based funding scheme (Paper 3).

2.2. Research question and research objectives

Based on the lack of causal and comprehensive evidence about the effects of the state intervention into universities' production functions, discussed in the previous sections, this dissertation addresses the following major research question:

RQ: What are the effects of performance-oriented system-level reforms on universities' production functions in the context of the Russian higher education system?

It is worth noting that the thesis exclusively focuses on public higher education institutions, representing 90% of student enrollment. The private sector is excluded from the analysis because of its minor role in the institutional landscape and because it is not affected by most of the major recent policy reforms under investigation. The collection of papers, constituting the thesis,

addresses the research gaps, discussed in section 2.1 and contribute to solving the research problem. To fulfil this, the following research objectives are addressed:

Research Objective 1: *Synthesise the evidence on the effects of performance-stimulating interventions in the universities' production functions and elaborate a typology of such interventions.*

The dissertation aims at providing a thorough understanding on how performance-oriented regulation has impacted higher education institutions. To this end, it is first necessary to understand which types of performance-oriented interventions in higher education exist and have been studied in empirical research. Secondly, there is a need to systematise the components of the universities' production functions addressed in the thematic research, and the theoretical arguments about the mechanisms of state interventions into universities' production functions. Finally, a typology of the performance-enhancing interventions has to be elaborated to fulfil objectives 2 and 3 of this thesis, as the empirical contribution of the papers has to be built in the way that provides the maximum possible evidence on NPM regulation effects.

Furthermore, this research objective addresses the first and the second research limitations, summarised in section 2.1. Paper 1 is specifically dedicated to a synthesis of the existing empirical research on the state capacity to transform universities' production functions and elaborates a typology of such interventions. The typology distinguishes between 'state as financier', 'the structuring state' and the 'autonomy steering state' types of interventions, and is addressed throughout the dissertation. Thus, Paper 2 provides evidence within the scope of the 'structuring state' policy, namely, the excellence initiative, and studies the effects of this policy in terms of universities' efficiency, productivity and research performance. Paper 3 provides evidence within the 'state as financier' stream of policies and studies the effects of funding redistribution due to the introduction of performance-based funding mechanisms in terms of the teaching and research performance of universities. Finally, Paper 4 assesses the effects of reforming the autonomous status and provides evidence in terms of efficiency and research productivity differentials due to differences in autonomy levels, enjoyed by universities.

Research Objective 2: *Develop a comprehensive framework to model and measure the change of universities' production functions under state interventions.*

Paper 1-4 collectively contribute to fulfilling this research objective and challenge the research limitations 2 and 3, elaborated in section 2.1. While Paper 1 synthesises the theoretical frameworks addressed in the existing research on universities' production functions, Papers 2-4 apply

synchronised theoretical arguments (mostly grounded in the principal-agent theory and managerialism; Deem and Brehony, 2005) and production function definitions (in terms of inputs used and outputs produced by universities) to consequently resolve the research objective 3.

The unification of the production function definitions, and especially the usage of a single database providing information on the Russian universities' operations, additionally contributes to challenging the research limitation 2 and generalising the results. More information on the data used is provided in Section 3.

Research Objective 3: Evaluate the effects of state interventions into universities' production functions.

This objective addresses the limitations arising from the lack of causal evidence within the field of NPM regulation in higher education (limitation 3) and the fact that the absolute majority of the existing research in the field reveals the intended consequences of the regulation. However, some evidence is dedicated to studying the stratifying potential of the performance-enhancing reforms and the divergence of universities' production functions (Ortagus et al., 2020; Guccio et al., 2016).

In fulfilling this objective, the dissertation addresses a collection of quantitative methodologies to: (1) evaluate the universities production functions (DEA and its derivatives: the Malmquist index (Papers 2 and 4), Benefit-of-the-Doubt (Paper 4)), more on this in Section 3 and 4.

(2) provide causal evidence on the effects of the state reforms by addressing propensity score matching (Rosenbaum and Rubin, 1985; Paper 2), semi-parametric difference-in-differences (Paper 3), and instrumental variable approach (Abadie, 2005; Paper 4) methodologies.

All the papers in the collection introduce the Russian context of the governing higher education to contextualise the research. The next Section 2.3 is specifically dedicated to briefly introduce the historical evolution of the system-level governance in the national context and provides an overview of the Russian higher education policy background.

2.3. Policy background: the context of NPM regulation in Russian higher education

According to Rosstat (state statistical agency), Russian higher education system consists of more than 1,200 higher education institutions, with about 500 of them being branches of head universities. 90% of students study in public universities, and the private sector of institutions plays a minor role in the institutional landscape. Participation in higher education is high: one-third of the relevant age population participate in university education. In terms of tertiary education enrollment, participation exceeds 70% (World Bank, 2018).

The majority of higher education institutions are subordinate to the Ministry of Higher Education and Science, but some are controlled by other ministries, e.g. the Ministry of Agriculture or the Ministry of Health (Platonova and Semyonov, 2018).

The initial conditions of reforming Russian higher education system, incorporated into planning economy and providing skilled professionals for the industry under the Soviet era differed from the other national regulatory contexts drastically (more on the higher education regulation in the USSR – see in Platonova and Semyonov, 2018; Shibanova and Malinovskiy, 2021).

Since the seizure of the Soviet union, the Russian higher education system experienced two major periods of regulation: marketisation of educational provision in the 1990s (the *laissez-faire* period, Platonova and Semyonov, 2018), followed by further intensification of performance enhancing and quality assuring regulatory frameworks, and a general conservative turn in governance and control, especially intensified since 2010-s. In the early years of the new Russian history, many Soviet regulations in the field were abolished and reformed, e.g. mandatory job placement for graduates was cancelled, and private educational providers were legalized. The general shift to new market economy drove the sector's development and rapid expansion along with contributing to growth of commercial and usually low-quality part-time programs providers (Shibanova and Malinovskiy, 2021).

Since the 2010s, the state recommitted itself in controlling the market environment, ensuring quality standards in higher education provision and enhancing higher education efficiency and performance. During this period, the state strongly relied on the policy borrowing, actively steered the system, and built subordination mechanisms (Shibanova, Malinovskiy, 2021). An evident emphasis was made on adoption of NPM regulation (Ferlie et al., 2008; Platonova and Semyonov, 2018) that included data-driven management and decision making (e.g. introduction of the monitoring of institutional performance of higher education institutions, Guba et al., 2020), support of selected universities through a range of supply-side enhancing reforms, strict quality control through accreditation mechanisms and elimination of diploma mills (more than 1,000 low-quality higher education institutions, mostly branches and private providers, were suppressed during 2010-s; Shibanova and Malinovskiy, 2021). The idea that the state should provide mass and free higher education is a part of the post-Soviet political pact and fits popular paternalistic aspirations about other social benefits. According to surveys, households choose publicly funded higher education of a standard quality over investing even a minor part of their income in higher quality (ibid).

Before the conservative turn in higher education regulation, universities, along with other public organisations, were structured into three types according to the degree of subordination to the state authorities: “*kazennoe*” (a term that can be translated as ‘belonging to the treasury’, completely state-owned; those mostly subordinated to the Ministry of Defense and provide educational programmes in the field of state service) , *budgetary* (composing the majority of the system) and the *autonomous* (only 48 universities have the autonomous status of public universities; State Law №174, 2006). Shortly after, all three statuses were kept, but the universities’ duties and privileges were reconsidered (Budget Code, 2007). During this short period between two regulations, autonomous universities enjoyed more liberties than they do today: it was possible to spend unused public funding on their own needs without negotiating this with the governing authorities.

After the reform, two particular privileges were kept for autonomous universities: financial plans are approved by supervisory boards (and not by the governing authority as in budgetary universities); privately raised income can be spent according to universities’ needs without approval from the state authorities (Agasisti and Shibanova, 2021). Beyond that, autonomous universities can redistribute all non-state funds to the next period and reinvest it into financial assets upon supervisory board approval. In addition, the limit of public procurement that does not need the approval from supervisory ministry is extended compared to other institutions (more information on the legislative differences is presented in the [working paper](#) version of the Paper 4). A range of the leading universities have the right to develop advanced curricula on the basis of the federal educational standards.

From the perspective of funding mechanisms, the system is designed as follows. In general, public funding for higher education is just 0.5% of GDP (total funding – 0.9%; Rosstat, 2019). Although the absolute majority of students study at public universities, from students’ perspective the system is a dual-track (Smolentseva, 2020): half of the students in public institutions pay for their education. The average fee comprises ~40% of the average personal disposable income. Both state and privately-funded study places constitute the major source of income for the system (Shibanova and Malinovskiy, 2020).

Consistent with the overall regulatory logic, since 2010s, the government started reforming public funding mechanisms in higher education, and linked the amount of public expenses to universities’ performance. The main rationale behind this reform was to ensure higher quality of educational provision, performance of universities and transparency in funding allocation (prior to this reform funding allocation was majorly subject to negotiation procedures between the governing authorities and the universities; Agasisti et al., 2021).

Today the funding scheme is based on (1) the normative and activity-based component of providing at least 800 publicly funded places per each 10,000 of the population aged 17-30 years and (2) the performance-based component, a sophisticated formula accounting for the basic costs of educational provision depending on the fixed differentials in costs (due to regional disparities, educational programmes, etc) and for performative differentials – a funding surplus that depends on the performance indicators achieved (mostly in teaching and research; Agasisti et al., 2021a). Inter alia, this funding scheme has contributed to significant consolidation of resources and enrollment: 53 leading universities (formally defined in the legislation, out of ~ 900 public institutions) accumulate ~39.7% of the total public funding and ~20.9% of students in the public sector (Shibanova and Malinovskiy, 2021).

During the same period (since 2010s), several structural reforms framed the higher education system into several functional types: the excellent research-intensive, regional flagship, specialized technical and sector-oriented, and mass-absorbing institutions (Malinovskiy and Shibanova, 2019). The state gradually introduced a range of specific programmes, enhancing the supply side of higher education provision. Among these are federal and national research universities, created in the late 2000s. The former were created through merging regional educational providers under umbrella structures of organisations in federal district centres (Romanenko and Lisuytkin, 2018). Several other waves of mergers were implemented, including the creation of regional flagship universities, serving regional economic development and knowledge transfer mission, in 2016-2019 (Agasisti et al., 2021a). National research universities represent the first large-scale project stimulating a limited number of comprehensive universities, followed by the 2015 excellence initiative, Project 5-100. And thus, recent government policy aimed at consolidating and stratifying the national higher education system into several functional types: world-class, regional flagship, specialized technical, sector-oriented, and mass-absorbing institutions (Shibanova and Malinovskiy, 2021).

3. Research design

The dissertation sequentially presents the stages of implementation of the study aimed at identifying the effects of state policies on the production functions of universities. The research first develops a typology of the possible performance-enhancing regulation in higher education, summarises the conceptualization of universities' production functions and the theoretical arguments addressed in hypothesising the possible effects of the targeted policies (Paper 1). The typology is further addressed in the empirical part of the dissertation, where I employ a collection of quantitative methods, allowing the assessment of the production function of universities and providing empirical evidence on the effects of the state-led reforms in higher education.

The thesis focuses on Russian public universities (main campuses), representing up to 70% of the system in terms of the students' population, and operating in the majority of Russian regions. Samples used in the Papers 2-4 do not include military or arts higher education institutions because of their specific production functions. Due to data availability, the analysis in Paper 3 is based on a sample of public universities subordinate to the Ministry of Higher Education and Science. Papers 2-4 each introduces a specific reform and contextualises the evidence. The empirical investigation is conducted addressing universities as the level of the analysis (Papers 2-4). Samples of universities addressed in Paper 2, Paper 3 and Paper 4 represent 26%, 41%, 74% of public head higher education institutions present in the Monitoring of performance of higher education institutions (see section 3.3. for more details on this data source).

3.1. Theoretical framework

The central concept in the thesis – universities' production functions (Hanushek, 1986; Hopkins, 1990) – derives from production theory (Shephard, 1970) and represents 'the process [of operations] by means of which an institution [...] transforms inputs (typically labour and capital) into outputs' (Hopkins, 1990: 11). Thus, the study relies on the assumption that universities possess a production technology consisting of alternative means and uses of resources to produce outputs, maximise utility, and minimise costs. This requires using the perspective introduced in the organisational sociology literature of universities as 'complete' organisations (Brunsson and Sahlin-Andersson, 2000) of 'managed professionals' (Rhoades and Slaughter, 1997) with identity, hierarchy (including management), and rationality constructed as the result of modernisation policies.

As the research aims at understanding the effects of public policies, it relies on two main methods of evaluating the effect of an intervention on the universities' production functions. First, in order to understand whether 'we are doing the right thing' (Drucker, 1977), I rely on research activity

measures (mainly publication activity) as it is included in the set of the outcomes of interest of the addressed policies. Second, to understand whether ‘we are doing it right’ (ibid) I rely on efficiency and productivity measures, or the degree to which universities are able to maximise the outputs at the current level of resources, or vice versa, minimise resources while maintaining the current level of outputs.

The study is framed within two main theoretical groundings in order to explain the relationship between state intervention into the production functions of universities and their efficiency and performance: the principal-agent model and the managerialism approach.

The first approach, being one of the theoretical rootings of NPM (Barzelay, 2005; Schuber, 2009), is usually addressed in policy evaluation studies in education (e.g. Glass et al., 2006; Rutherford and Rabovsky, 2014). It allows the consideration of state-university contractual relationships, with the government specifying what outputs the university should produce and leaving the universities to decide how they will do it (Lane and Kivisto, 2008). Assuming that the universities are rational economic agents aiming at maximising their utility and minimising costs for the reward from the principal – increasing efficiency in response to performance regulation – addressing the principal-agent model is especially useful in the context of the statist and regulated Russian higher education system.

In the study, this approach is addressed in formulating hypotheses on the effects of state funding steering and autonomy regulation. For instance, to overcome the problem of information asymmetry, the government can grant a public institution autonomy in decision-making in exchange for monitoring and control mechanisms, and an increase in public managers’ self-regulation is accompanied by increased accountability (Enders et al., 2013). The stimulus to overcome rigid managerial practices creates a favourable institutional setting to implement new practices, techniques, and products (Wynen et al., 2014). Higher-level managers transmit the goals and priorities to lower level managers, and need internal performance control tools (Wynen and Verhoest, 2016). An increase in efficiency can be expected because the monolithic structure of a public organisation atomizes into structures under the rule of autonomous managers, free to deregulate the use of inputs and stimulated to maximise outputs. This approach is addressed in Paper 3 and Paper 4.

Here it is worth noting that the thesis does not specifically address the problem of opportunistic behaviour, discussed in detail in other research on state regulation within the framework of state-university contractual relationship (e.g. Rebora and Turri, 2011; Matveeva et al., 2021). According to Kivistö (2007), the informational asymmetries can result in opportunistic behaviour patterns at both

individual (e.g. researcher) and institutional levels: shirking, opportunistic cross-subsidisation, distortion of monitoring information. The research presented in the thesis, concerns only the issue of universities' production function transformation and does not study manifestations of possible opportunism within organisation. This limitation is further discussed in section 7.

While the principal-agent framework is addressed to explain the universities' response to regulation at the organisational level, the managerialism argument, another pillar of NPM (Shepherd, 2014) is used to formulate micro-level explanations of why and how universities' production functions are expected to transform under performance-enhancing state regulation.

The managerialism approach (Deem & Brehony, 2005) embodies the principle of 'letting managers manage' and regards them as the major agents of change within organisations: if bureaucratic regulation (typical of the public domain) is removed, public managers will behave like ones from the private sector and adopt advanced tools and techniques in order to stimulate an organisation's performance. Internal performance regulation procedures will be established because managers have a rational incentive to benefit from the increased performance of the organisation (Osborne & Gaebler, 1992). Under managerialism, I hypothesise that innovative managerial tools will be used in universities in order to fulfil the increased public demand introduced in the policy regulation. Thus, an increase in efficiency and productivity will be achieved through the introduction of the mechanisms required under NPM regulation in the public sector: target setting, performance evaluation adoption, and resource reallocation (Schubert, 2009; Kuipers et al., 2014; Shepherd, 2014). This approach is addressed in Papers 2-4.

The impact of NPM and other regulatory frameworks on universities could rely on other theoretical approaches, mostly emerging from the organisation theory and sociology perspective.

According to the isomorphism argument, universities tend to homogenise in structure in order to compete for political power, legitimacy, and economic fitness within state-imposed institutional regulation. In doing so, higher education organisations can follow coercive (compliance with rules and norms), mimetic (copy the leaders), or normative (achieved through professionalisation) isomorphism (DiMaggio and Powell, 1983; Stensaker and Norgård, 2001). Although this framework provides a grounded explanation of organisational change mechanisms, it concentrates on clarifying why organisational fields become similar in structures, e.g. why quality assurance (Csizmadia et al, 2008; Seyfried et al., 2019) and performance contracts (Joo and Halx, 2012) are universally adapted, and does not concern itself with efficiency and productivity change. For this reason, the isomorphism argument is not central to the study.

Resource dependence considers organisational change as a reaction to the external environment, on which the university depends in acquiring resources (Pfeffer and Salancik, 2003). Thus, in their operations, universities prioritise activities in accordance with the demand of the stakeholder that makes decisions on their funding and survival (Fowles, 2014). Although this perspective concerns the production function of organisations, it explains universities' responses to public policies only where funding regulation is concerned, while policy cases of interventions regarded in the thesis go beyond this single mechanism of intervention. However, its explanatory arguments are partially used in framing of the empirical part of Paper 3, in accounting for the degree of universities' dependency on public funding to explain the effects of the introduction of performance-based funding.

3.2. Methodological approach

The production function is first measured through universities' research activity outputs, mainly the number of publications (Paper 2, Paper 3, Paper 4), as first, in the previous research, there is higher agreement on evaluation of research performance as opposed to teaching performance, which is still hard to conceptualize, and second, because research productivity produces spillover effect on teaching activities as well (Berbegal Mirabent and Solé Parellada, 2012; De Witte et al., 2013).

The second measurement of universities' production function is concentrated on their efficiency and productivity by means of a nonparametric approach based on linear programming (Färe et al., 1994; Johnes, 2006a) – Data Envelopment Analysis, DEA. In the thesis, DEA and its derivative, the Malmquist productivity index (Färe et al., 1997) are the main methodologies used in evaluating universities' efficiency and productivity (Paper 2 and Paper 4).

The non-parametric approach has gained popularity in the field of production function evaluation in higher education for two reasons: it allows taking into account the multiplicity of resources and products that the institutions produce, while information about its functional form or about the unit production price is not needed to evaluate the production function (Boussofiene, Dyson and Thanassoulis, 1991). This approach is central in evaluating the efficiency of higher education organizations (De Witte and Lopez-Torres, 2017; Wolszczak-Derlacz, 2017; Johnes and Tone, 2017; Gralka, Wohlrabe, Bornmann, 2019; Agasisti, 2011; Lee and Worthington, 2016; Sagarra, Mar-Molinero, and Agasisti, 2017) and, specifically, in assessing the effects of public policies on universities (Gawellek and Sunder, 2016; Yaisawarng and Ng, 2014; Papadimitriou and Johnes, 2019).

Finally, to provide the evidence about the state intervention effects, three causal methodologies are used in the study: propensity score matching (Rosenbaum and Rubin, 1985; Paper 2), semi-parametric difference-in-differences (Abadie, 2005; Paper 3), and instrumental variable approach (Paper 4).

To address the research objective 1, Paper 1 provides a systematic (Pare et al., 2014) literature review. This method allows systematizing and critically examining the existing academic debate and evidence on the possible state interventions into universities' production functions and their consequent effects. The empirical literature found and proved to comply with the aim of the review was further classified along two dimensions: (1) the elements of the production function (or the variables/indicators/measures of universities inputs and outputs used in the assessments) and (2) types of state policy interventions. Finally, a typology of the state interventions into universities' production function was developed: 'state as financier', 'structuring state' and the 'autonomy steering state' policies.

Next, to address objectives 2 and 3, policy interventions present in Russian higher education were matched with a particular type of the state interventions revealed and the effects of each were evaluated. Three particular policies were chosen for the empirical assessment: (1) 'structuring state' – the Russian excellence initiative Project 5-100 (2013-2020), (2) state as financier policies – introduction of performance-based funding in Russia (in 2015), (3) 'autonomy steering policies' – autonomy regulation in Russian higher education system.

In Paper 2, the effects of the excellence initiative are evaluated with a multi-step methodological strategy. First, propensity score matching procedure is used to form a control group of universities that did not participate in the programme (Rosenbaum and Rubin, 1985) The average treatment effect on the treated is evaluated in terms of the increase in the number of publications indexed in the international citation databases. Following this, bootstrap DEA (Simar and Wilson, 1999) and Malmquist index (Fare et al. 1994) are applied to evaluate the levels of efficiency and productivity across the experimental and the control groups. Finally, the average measures of the production functions of the two groups are compared with general statistical tests for two samples. The timespan of the data used includes 2012/3-2017/8 academic years.

Paper 3 addresses the effects of the funding redistribution due to introduction of performance-based funding mechanism. The methodological strategy firstly includes selection of the treatment and control groups by distinguishing universities on the basis of whether they consequently received more or less funding because of the reform by means of time series cluster analysis (Montero and Vilar, 2014). At the second step, the causal effect of the redistribution of public

funds between universities, the semiparametric difference-in-differences estimator (Abadie, 2005) is used, as it provides unbiased estimation of the treatment effect. This method challenges the endogeneity problem by weighting the changes in the outcome variable between the T_0 and the subsequent periods for the untreated observations based on their propensity scores, which are in their turn subject to semiparametric approximation by a logit estimator (Hirano et al., 2003). Further, the weighted changes across the treatment and control groups are compared as in the traditional difference-in-differences estimator. The timespan of the data used includes 2014/5-2018/9 academic years.

Paper 4 studies the effects of the autonomy regulation. The methodological strategy is the follows: first robust DEA scores are calculated to evaluate universities' efficiency. Second, I distinguish between the formal status of autonomy and the actually used, informal autonomy, and construct the 'autonomy-in-use' index by means of DEA-derived Benefit-of-the-Doubt methodology (Cherchye et al., 2007). Lastly, I use a panel FE regression and an instrumental variable approach to provide robust evidence for the relationship between institutional autonomy (formal and informal), research performance (the number of publications) and efficiency. The timespan of the data used includes 2014/5-2017/8 academic years.

3.3.Data sources

The empirical analysis presented in the dissertation is based on two large administratively collected datasets:

1. Monitoring of performance of higher education institutions, (2012-2020) – used in Papers 2-4;

This database provides information on the institutional performance of all higher education institutions operating in Russia (except for institutions providing training in the interests of national defence, security, and law enforcement). In 2020, the Monitoring included data on 1,222 institutions (of which 906 are public institutions, 530 are branches of main campuses). More than 110 indicators included in the database provide information on the educational and research activities of universities, their capital, infrastructural, and human resources. Since the first year of the Monitoring, the set of core indicators included has remained almost unchanged. This database serves as the main source of the data as it provides the most complete publicly available information on Russian higher education on an organisational level.

The Monitoring was first launched as part of the implementation of the government roadmap "Changes in the social sectors aimed at improving the efficiency of education and research" (2013-

2018). Piloted prior to its official release in 2013, the Monitoring was designed to become the main source of decision-making on closures, reorganisations (mergers) and quality assurance in higher education. Administered by the Ministry of Science and Higher Education (prior to 2018 – Ministry of Education and Science), the Monitoring is obligatory for all higher education institutions in Russia, including main campuses and branches. Data collection forms are sent to rectors of higher education institutions for completion.

Although the Monitoring is the only non-aggregate publicly available source of data on Russian higher education, some limitations arising from the data collection are worth mentioning. First, although the methodology of all indicators is harmonised in the period of the study from the Ministry side, the methodology of collecting and aggregating the data at the university level can produce undesirable variations in the data. Second, as the universities are aware that the Monitoring serves as a tool of quality assurance, in some cases, information transmitted can be distorted. Finally, the Monitoring data on research activity does not account for the disciplinary identity of universities, and thus delimits the analysis, making it impossible to account for the specifics of publication activity in STEM and humanities, for example.

2. Data on the financial activities of universities, Ministry of Higher Education and Science (2012-2018) – used in Paper 3.

The database provides detailed information on planned and actual expenditures and revenues of public higher education institutions. The database covers the period 2013-2018 and contains more than 70 financial indicators on 279 and 264 (in 2013 and 2018, respectively) universities subordinate to the Ministry of Science and Higher Education. The indicators include the amounts of state funding (subsidies and grants) for educational, scientific, sports, and cultural activities; social, administrative, and capital expenditures; and scholarships funds for higher education institutions. Data are collected and administered by the Financial Department of the Ministry of Education and Science, and additionally verified by the Federal Treasury and the Ministry of Finance.

In the study, data on 214 universities present in the database throughout the period and covering 68.5% of full-time-equivalent students are used. Although the data are trustworthy, verified by three state agencies, and provide the most complete information on the sources and amounts of funding of higher education institutions, they produce some limitations to the analysis. First, private providers and universities subordinate to sectoral ministries (e.g. the Ministry of Transport or the Ministry of Health) are excluded from the analysis, produced in Papers 3. Second,

information on financial activities prior to 2014 are unavailable in the database, while the introduction of the performance-based funding was finalised in 2015. The exclusion of potential pre-reform differences could have produced bias in the analysis.

4. Outline of the papers

The collection of four papers of which this dissertation consists (Annex 1-4) provide conceptual results and empirical evidence that targets the main research question of the study: *What are the effects of performance-oriented system-level reforms on universities' production functions in the context of the Russian higher education system?*

Paper 1 frames the study by specifically addressing research objective 1 and (1) synthesising the existing research evidence in the field and thus help highlighting the research gaps, (2) resulting in a typology of the state performance-oriented interventions into universities' production functions. This typology of the 'state as financier', 'structuring state' and 'autonomy steering state' is addressed along the thesis and structures the way of how I address research objectives 2 and 3. Thus, Papers 2-4 each contributes to evaluation of specific types of the state regulation. Paper 3 also produces the evidence on the potential stratifying effect of the NPM policies and concludes with demonstrating the unintended stratifying potential of such policies.

Table 1 provides a brief outline of the papers, their relation to the research objectives and resulting outcomes.

Table 1. Overview of the papers composing the dissertation.

	Paper 1	Paper 2	Paper 3	Paper 4
Sample	33 research papers	30 public universities	214 public universities	384 public universities
Theory/ Approach	Systematic-critical literature review	Production function Managerialism	Production function Principal-agent theory	Production function Managerialism Principal-agent theory
Methods		PSM, DEA, Malmquist index	Time series cluster analysis, semi-parametric DID	BoD, DEA, FE regression, IV
Result	Typology of state interventions	Estimation of effects of a structuring policy (excellence initiative)	Estimation of effects of a financial policy (performance-based funding)	Estimation of effects of an autonomy-regulation policy (autonomous vs non-autonomous status)
RO	RO 1 - RO 3		RO 2 and RO 3	

Source: Author

4.1. Outline of Paper 1

Table 2. Summary of Paper 1

Title	NPM Policy in Higher Education: a Review of Effects on Universities' Efficiency and Productivity
Research Aim(s)	<ul style="list-style-type: none"> • systematically review the empirical evidence of state policies in terms of efficiency and productivity change of higher education institutions • develop a typology if NPM-led state interventions
Data	<ul style="list-style-type: none"> • Scopus, Web of Science, and EBSCOhost publication databases • 33 papers in the final sample • Timespan: 1980-2022
Methodology	Systematic literature review
Results	<ul style="list-style-type: none"> • The majority of the existing research is coherent in demonstrating that enhancement of competitive environment and decrease in unconditional universities' dependency from the public funding increase organizational efficiency and productivity; • Supply-side concentration of resources through excellence initiative is also effective in transforming universities' production function; so are voluntary mergers, while top-down mergers are questionable; • Autonomous universities operate more efficiently, but more centralised control is effective during economic turbulences.
Contributions	<ul style="list-style-type: none"> • Identification of research gaps in the filed of policy evaluation and efficiency measurement in higher education: prevalence of empiricism, lack of causal evidence, fragmentation of evidence. • Typology of state interventions within the NPM logic: 'state as financier'; 'structuring state'; 'autonomy steering state'
Status	Accepted for publication in the Educational Studies, Moscow
Author's contribution	Single-authored paper

Source: Author

Motivation of the study

Amid enhanced attention to performance, efficiency and productivity of public sector policy, the scholarly debate about the extent to which the state can intervene in production processes has intensified (Brunsson and Sahlin-Andersson, 2000). Scholarly research in the field of production function estimation has addressed the issue of comparing teaching and research production processes (Beasley, 1995), efficiency and productivity determinants within and across multiple national contexts (Bolli et al., 2016), assessed dynamic efficiency change universities' operations (Johnes and Tsionas, 2019).

Efficiency and productivity analysis is widely used in policy evaluation in the public sector (Mergoni and De Witte, 2022). In higher education research, studies on the transformative ability of the state also exist, but they have not been systematised in terms of the presence of the intended effects and consequences of the reforms.

In order to address the existing research gap and synthesise the evidence on the ability of the state to transform universities' production functions, this research aims to systematically review the empirical evidence of state policies in terms of efficiency and productivity change of higher education institutions.

Methodology

The aim of the paper is fulfilled by providing a systematic literature review (Pare et al., 2014). This method allows systematising and critically examining the existing academic debate and evidence on the possible state interventions into universities' production functions and their consequent effects. In this study, only empirical research on the subject is taken into account.

The paper search was conducted in three main academic literature libraries: Scopus, Web of Science, and EBSCOhost. To guarantee the relevance of the selection, the search was restricted to papers in peer-reviewed academic journals in all fields, written in English between 1980 and 2022. The starting point of this timeline arises from the year of publication of the pioneering papers assessing efficiency in education (De Witte and López-Torres, 2017). The following combinations were used for search in keywords, headings and abstracts: (universit* AND efficiency), (higher education AND efficiency), (universit* AND policy AND efficiency), (higher education AND policy AND efficiency), (universit* AND policy AND productivity), (higher education AND policy AND productivity). The initial search was refined through abstract analysis, which resulted in 130 documents.

After full-text analysis, 96 irrelevant papers were excluded if they failed to meet the following criteria (1) not addressing empirical methodology of production function evaluation; (2) not studying the effects of policy regulations (causally or descriptively); (3) is not a case study of a single university or a small sample. Finally, 5 papers were added via a snowball method. In total, 32 academic papers, published between 2004 and 2022, were selected for the review.

Results

The evidence can be summarised as follows, though with caution due to its extremely fragmented nature. First, the study allows categorising the performance-enhancing policies, addressed in efficiency evaluation research, in three groups: 'state as financier', 'the structuring state' and 'the autonomy steering state'.

The majority of the existing research is coherent in demonstrating that enhancement of the competitive environment and decrease in unconditional universities' dependency from the public funding increase organisational efficiency and productivity. However, some research (e.g. Sav,

2016; Sav, 2017) raises concerns about the negative effects of decreasing public spending on higher education provision, as it contributes to decrease in operational efficiency of universities and can reduce educational opportunities.

Supply-side concentration of resources through excellence initiatives are also effective in transforming universities' production functions. The evidence on the top-town mergers is extremely limited, and in general, their implementation, in contrast to voluntary mergers, is questionable. Bologna reform was beneficial in increasing both teaching and research efficiency, but it likely produced opposite effects on large universities that experienced more difficulties while restructuring. Finally, on average, universities enjoying higher levels of autonomy operate more efficiently, but fragmented evidence shows that more centralised control is effective during economic turbulence.

4.2. Outline of Paper 2

Table 3. Summary of Paper 2

Title	The Russian Excellence Initiative for higher education: a Nonparametric Evaluation of Short-term Results
Co-author(s)	Agasisti T., Platonova D., Lisyutkin M.
Research Question(s)	<ul style="list-style-type: none"> • Have there been any changes in the efficiency of participating universities since the implementation of the excellence initiative?
Data	<ul style="list-style-type: none"> • Monitoring of performance of higher education organizations • Initial sample: 152 universities, eligible to participate in the excellence initiative • Matched sample: 30 universities (15 x 15) • Timespan: 2012/3-2017/8
Methodology	Propensity score matching, DEA, Malmquist index
Results	<ul style="list-style-type: none"> • Excellence initiative participants were more successful in publication activity at the end of the observed period, average treatment effect is 186-351 publications (depending on the matching specification). • Although participants increased their efficiency at the initial stage of the reform, there is no major effect of the excellence initiative in terms of efficiency of the participants compared to the control group over the whole period. • The policy effect in terms of productivity is present. • The increase in the productivity of the participating universities is mainly explained by the change in the production possibilities frontier. In contrast to the control group universities, the participating universities transformed the production technology.
Contributions	<ul style="list-style-type: none"> • Reduction of causality ambiguity in producing evidence of a complexly designed policy intervention • Contribution to the discussion of excellence initiatives as transformative tools of changing organizations. • Findings support the idea of a 'beauty contest' developed by Menter et al. (2018) and discussed on the case of German excellence initiative by Civera et

Status	al. (2020) – presence of short-term mobilization effect in rapid efficiency gains followed by efficiency loss.
Author's contribution	Published in the International Journal of Operational Research Analysis of quantitative data, preparation of sections: Introduction, Context, Methodology and data, Results, Discussion. Publication support and interaction with the journal (corresponding author)

Source: Author

Motivation of the study

Increased attention to rankings and the international competitiveness of higher education has become a global trend along with the desire to improve the efficiency of universities since the 1980s. Rankings have become an expression of the global 'struggle for excellence' and are perceived and used as a tool to determine the status of individual higher education institutions, reflecting the quality, performance and competitiveness of higher education systems (Hazelkorn, 2011).

Since 2000, more than 40 excellence initiatives have been launched in more than 20 countries (Salmi, 2016; Froumin and Lisyutkin, 2015). Although excellence initiatives presume significant investments, they are not limited to additional funding provision with the aim to boost universities' research productivity. These policies aim to bring organisational change and create new sustainable institutional environments within higher education institutions (Chirikov, 2018), and usually universities are provided with advisory and consultancy help.

Since the start of the excellence initiative, Project 5-100, in Russia in 2013, the participating universities have received significant investment from the federal budget (more than US\$850 million as of 2018), or 2% of the federal-level expenses on higher education. While Turko et al. (2016) and later Poldin et al. (2017) identified the positive impact of the initiative on publication productivity, no evidence on the capability of the policy to increase the universities' efficiency was present in the Russian context.

Methodology

The strategy of the analysis included selection of experimental (participants of the Project 5-100) and control groups of universities (those similar to the participants in terms of the observable characteristics), and then comparison of performance (publication activity), efficiency and productivity scores in the two groups.

At the first step, a propensity score matching procedure was implemented (Rosenbaum and Rubin, 1985) in order to form a control group of universities, as similar to the participants in the year before the launch of the programme, as possible. The covariates, used in matching, were derived

from the government's announcement about the Project. According to the announcement, the participating universities had to demonstrate excellence in human resource development (high qualifications of the academic staff), internationalisation, research productivity and teaching. The robustness of the matching was additionally insured by adding environmental (the region of operation) and structural characteristics (e.g. study programmes differentiation) and by checking the balance in the matched sample through variant specifications of the matching model.

The average treatment effect on the treated in terms of publication activity was estimated as follows:

$$\tau_{ATT} = E(\tau|D = 1) = E[Y(1)|D = 1] - E[Y(0)|D = 1] \quad (1)$$

where τ is a treatment indicator, and $[Y(1)|D = 1]$ and $[Y(0)|D = 1]$ are potential outcomes of the treated group if they receive treatment and do not receive treatment respectively.

At the second step, bootstrap DEA, a method based on a programmed envelopment of observed multiple input–output vectors (Boussofiene et al., 1991) was used to calculate efficiency of the universities in the matched sample.

The combination of inputs and outputs is feasible only for the efficiency frontier of the production possibility set. For the output-oriented model, the technical efficiency is

$$Max \varphi_k + \varepsilon \sum_{r=1}^s s_r + \varepsilon \sum_{i=1}^m s_i \quad (2)$$

$$\text{under the condition } \varphi_k y_{rk} - \sum_{j=1}^n \lambda_j y_{rj} + s_r = 0, r = 1, \dots, s, \quad (3)$$

$$x_{ik} - \sum_{j=1}^n \lambda_j x_{ij} - s_i = 0, i = 1, \dots, m, \quad (4)$$

$$\sum_{j=1}^n \lambda_j = 1, \quad (5)$$

$$\lambda_j, s_r, s_i \geq 0 \quad \forall j = 1, \dots, n; r = 1, \dots, s; i = 1, \dots, m \quad (6)$$

Where s are outputs, m are inputs, y_{rk} is the volume of output of type r , belonging to university k , x_{ik} is the volume of input of type i , belonging to university k , s_i and s_r are the slack in outputs and inputs respectively. The efficiency rate of university k is defined as $\tau_y = \frac{1}{\varphi_k}$; university k is efficient, if the efficiency rate $\varphi^* = 1$ and there is no slack in the volumes of inputs and outputs. If $\varphi^* = 1$, then the university under evaluation is a frontier point. i.e., there is no other universities that are operating more efficiently than this particular one.

The study relied on a simplistic specification of the universities' production function. Inputs reflect total available capital (total income) and human resources (the number of faculty and the student ability proxy – the average entrance examination score) – similarly the inputs were defined in e.g.,

Sarrico and Dyson (2000); Ray and Jeon (2008), Agasisti and Pohl (2012), Johnes (2013). The outputs are presented by the total number of students to measure teaching activities (Thanassoulis et al. 2011; Agasisti and Johnes, 2015) and the maximum number of publications indexed Web of Science/Scopus, the target indicator for the excellence initiative. The robustness of the estimates was checked through an alternative specification, more details on this are presented in Paper 2 of the Annex.

Finally, Malmquist productivity index was evaluated according to the same input-output specification:

$$MPI_i = \left(\frac{E_i^{t+1}(x^{t+1}, y^{t+1})}{E_i^t(x^t, y^t)} \right) \times \left(\frac{E_i^t(x^{t+1}, y^{t+1})}{E_i^{t+1}(x^{t+1}, y^{t+1})} \times \frac{E_i^t(x^t, y^t)}{E_i^{t+1}(x^t, y^t)} \right)^{1/2} \quad (7),$$

or productivity change = efficiency change × change in technology (Fare et al., 1994)

Results

After successfully matching the participating universities with the control group, the average treatment effect was attained: 262.53 ± 57.27 publications, reported by the nearest neighbor matching in favour of the participant group.

The participants managed to improve their efficiency and productivity by 12.3% and 20%, respectively. However, non-participants outperformed the participants in efficiency gains shortly after the Project 5-100 launch. This allows to speculate about the possible spillover effects of the excellence initiative later studied by Lovakov et al. (2001; although in terms of publication activity). In terms of productivity, the excellence initiative did contribute to significant gains, mainly caused by the shift in the production frontier, meaning that the ‘excellent’ universities were able to change the production technology within the sector.

4.3. Outline of Paper 3

Table 4. Summary of Paper 3

Title	The Causal Impact of Performance-Based Funding on University Performance: Quasi-experimental Evidence from a Policy in Russian Higher Education
Co-author(s)	Agasisti T., Abalmasova E., Egorov A.
Research Question(s)	<ul style="list-style-type: none"> • Did the extra funding received by universities due to the PBF reform causally influence their performance in subsequent years?
Data	<ul style="list-style-type: none"> • Monitoring of performance of higher education organizations • Data on the financial activities of universities, Ministry of Higher Education and Science • Sample: 214 public universities • Timespan: 2014/5-2018/9
Methodology	Time series clustering, semiparametric difference-in-differences

Results	<ul style="list-style-type: none"> • Time-series clustering allowed to filter the sample into 72 universities that consequently lost in public funding over the years studied ('losers'), 67 'winners', and 75 universities not exhibiting any particular trend in the amount of the public funding received. • Introduction of performance-based funding had a positive impact on the performance indicators included in the formula, namely, entrance examination scores, share of foreign students, publication activity. • The policy effect of increasing performance is robust only for the sub-sample of leading universities and for universities located in the Moscow and St Petersburg regions.
Contributions	<ul style="list-style-type: none"> • Though the analysis is limited to short-term effects, it allowed identify how universities change their behaviour and react to newly introduced incentives • A stratifying potential of the policy is revealed: only the leading and already 'wealthy' universities benefited from the reform, while the regional providers will most like be trapped in the resource dependency.
Status	Published in the Oxford Economic Papers
Author's contribution	Preparation of sections: Introduction, Literature Review, Theoretical Framework, Discussion.

Source: Author

Motivation

In recent decades, many countries have promoted reforms aimed at increasing the accountability, transparency in funding redistribution and performance of universities (Parker, 2011). Performance-based funding has become one of the key instruments for aligning state interests, the amount of public funding allocated to universities, and enhancing their efficiency (Jongbloed and Vossensteyn, 2016; Jongbloed et al., 2018).

Russia was no exception, and since 2012, the governing authorities have promoted performance evaluation, gradually introducing the new performance formula scheme of public funding redistribution. In the context of such a policy, the scarcity of available resources has made some universities sustainably receive more public funding in the years after the introduction of the new mechanism, while the others lost (Abankina et al., 2018).

This paper aims at establishing a quasi-experimental assessment of the effects of the redistribution of public funding due to the new funding scheme, more specifically, focusing on the effects on university performance.

Methodology

The main difficulty in evaluating the causal effect of Russian performance-based funding policy on university performance lies in the absence of a natural control group, as all public universities were subject to the reform alike. Hence, a two-step methodology was developed.

First, the research team identified three groups of universities, experiencing different redistribution effects due to the new funding scheme: ‘losers’ that consequently lost in public funding over the years studied, ‘winners’, constantly receiving more and more funding, and universities not exhibiting any particular trend in the amount of the public funding received. This grouping was achieved by means of time-series clustering that underlined (1) calculating the Pearson Correlation-based distance the average values of the funding received and (2) using the k-means clustering algorithm.

At the second step, a semi-parametric difference-in-differences (DID) estimator is used. While the traditional parametric DID estimator strongly depends on the assumption of a parallel trend, our quasi-experimental design relaxes the parallel trend assumption. The selection for the treatment is not random but pre-determined by a performance-based multi-factor formula. Hence, it is possible that performance in the pre-treatment period could be a source of an additional variation and cause endogeneity bias in the estimates. To obtain an unbiased estimate of the treatment effect, the semiparametric DID estimator developed by Abadie (2005) is used. This method challenges the endogeneity problem by weighting the changes in the outcome variable between the T_0 and the subsequent periods for the untreated observations based on their propensity scores, which are in their turn subject to semiparametric approximation by a logit estimator (Hirano et al., 2003). Further, the weighted changes across the treatment and control groups are compared as in the traditional difference-in-differences estimator.

The outputs used in the modelling are: the average entrance examination scores of the freshmen, publications indexed in Web of Science and Scopus, the share of international students, extra-budgetary research income, and the salary ratio (the ratio of the average research staff salary to the average regional salary).

Results

The main finding of the paper is that the introduction of the performance-based funding had a positive effect in stimulating the competitive environment in the system, and produced a significant impact on universities’ production functions, namely, in increasing the admission quality, degree of internationalisation and research productivity. At the same time, controlling for the leading status of the universities and their location, the effect seems to be heterogeneous and beneficial only to the leading universities and universities located in the privileged regions of Moscow and St Petersburg.

Finally, the reform disproportionately benefited well-performing institutions that are already receiving greater resources and thus increased stratification in the system, which is a risky consequence in terms of ensuring higher education access and provision.

4.4. Outline of Paper 4

Table 5. Summary of Paper 4

Title	Actual Autonomy, Efficiency and Performance of Universities: Insights from the Russian Case
Co-author(s)	Agasisti T.
Research Question(s)	<ul style="list-style-type: none"> • To what extent do Russian universities differ in their autonomy, formally and practically? • Is there a robust statistical association between university autonomy (both formal and actual), and their efficiency and performance?
Data	<ul style="list-style-type: none"> • Monitoring of performance of higher education organizations • Sample: 384 public universities • Timespan: 2014/5-2017/8
Methodology	Benefit-of-the-Doubt, bootstrap DEA, FE regression, instrumental variable
Results	<ul style="list-style-type: none"> • Formal autonomous status does not predict neither higher publication performance, nor efficiency. • Among three conceptualized dimensions of the informal autonomy, namely (i) academic freedom, (ii) financial independence and (iii) staff management, financial freedom is the main component of the index. • Informal autonomy, in its turn, and especially universities' autonomy in staff management, is a more robust positive predictor of efficiency gains.
Contributions	<ul style="list-style-type: none"> • As the heterogeneity of formally autonomous universities in terms of efficiency and performance is high, it can indicate the archaic nature of criteria according to which universities were selected to be granted autonomy privileges. Thus, legislative updates of this status are needed. • The paper contributes to increasing the causality of the evidence by means of FE panel regression and instrumental variable estimation.
Status	Published in the International Journal of Public Administration
Author's contribution	<p>Analysis of quantitative data, preparation of sections: Introduction, Context, Literature Review, Methodology and data, Results, Discussion.</p> <p>Publication support and interaction with the journal (corresponding author)</p>

Source: Author

Motivation

In the research literature, scholars have always paid attention to the relationship between universities and the government-as-regulator (Berdahl, 1990). In the NPM era, the debate on the balance between universities' autonomy and accountability has intensified. Under performance-based regulation, there exists the trade-off between decentralization and increasing autonomy on the one hand, and the steering control together with dependence from the state, on the other. Thus,

this regulation has changed university system ‘from having low formal autonomy and high real autonomy, to ... high formal autonomy and low actual autonomy’ (Christensen, 2011, p. 515).

Research is coherent in demonstrating that higher autonomy is essential for universities’ research and teaching performance because of higher capacity to respond to market competition (Aghion et al., 2010), more flexible resource and goal-setting management (Knott and Payne, 2004; De Boer et al., 2010; Quiroga-Martinez et al., 2018).

In Russia, autonomy is strictly regulated. All public universities are grouped into three categories according to the level of autonomy they enjoy: “kazennoe” (completely state-owned, non-autonomous), budgetary (the medium group) and the autonomous universities. The latter enjoy two particular privileges which according to the thematic evidence, are capable to contribute to higher levels of performance: (1) financial plans are approved by supervisory boards (and not by the governing authority as in budgetary universities); (2) privately raised income can be spent according to universities’ needs without approval from state authorities.

The study thus aims at establishing the effect of autonomy regulation in terms of research performance and institutional efficiency within the Russian context.

Methodology

To evaluate the effects of a regulatory intervention into universities’ production function, first, a distinction is made between formal autonomy (determined in the legislation) and the level of autonomy actually used by university management (Christensen, 2001; Boer and Enders, 2018).

To evaluate the informal autonomy, the Benefit-of-the-Doubt methodology (Cherchye et al., 2007) is applied: it allows building a composite indicator, or Autonomy-in-Use index. This index is based on three sub-dimensions that are (1) conceptualised in the literature (more on this in Paper 4 in the Annex) and (2) are the most relevant for the Russian context: financial independence, staff management and academic freedom. Academic freedom is measured through the share of Master and PhD students, the number of dissertation (thesis) committees, and a binary variable depicting the right of a university to determine educational standards. The staff management dimension is evaluated by accounting for the average research and teaching staff salary, the share of international staff and the share of staff with advanced degrees. Finally, the share of private income in income from educational and research activities is used in the financial independence sub-index.

At the second step, organizational efficiency is estimated. For this purpose, bootstrap DEA is addressed (discussed above), while the production function is again defined in a simplistic way:

total funds available are used as the input and total number of students along with the total number of academic publications – as the output.

Finally, panel fixed effect regressions and the fixed-effect instrumental variable estimator (FE2SLS) as proposed in Wooldridge (2002) are used to trace the relationship between university autonomy (both formal and informal), university efficiency and performance (in terms of the number of publications per staff member). Although the use of instrumental variable is challenging for several reasons (e.g. sensitivity to sample size, risk of a *weak instrument*, challenges in theoretical groundings), in the analysis, we used the legally guaranteed status of autonomy as an instrument for the composite measurement of autonomy (AiU index) based on two arguments. First, empirically, an instrumental variable should correlate with the predictor and should not correlate with the explained construct. At the previous steps of the analysis we found that the formal autonomous status did not show any significant correlation with the efficiency measurement, in the same time, formally autonomous universities demonstrated higher values of AiU index. The second, theoretical argument – we hypothesised that universities with higher informal autonomy would be able to use it more effectively if granted appropriate managerial capacity (legally guaranteed for formally autonomous institutions). More details on the use of the FE2SLS estimator are provided in the [working-paper version](#) of the Paper 4.

Results

The results of the paper are the following. Formal autonomy status does not predict neither higher publication activity, nor efficiency. However, informal autonomy is positively associated with efficiency rates, and advanced practices in staff management can contribute to increase in both publication activity and overall institutional efficiency. Moreover, the instrumental variable approach failed to provide causal evidence on the autonomy effect on universities' production function.

The high heterogeneity of formally autonomous universities might indicate the inadequacy of criteria according to which universities were selected to be granted autonomy privileges. A lack of legislative updates makes this status archaic and might inhibit institutional development in higher education.

5. Thesis statements and discussion

5.1. *Thesis statements*

The dissertation studies the transformative capability of NPM-inspired policies using empirical material from Russian universities. Concentration on data from one country, covering the same time period, allows comprehensive evidence on the issue to be provided. First, the study helps to understand which types of performance-oriented interventions in higher education regulation exist in general and have been already studied in the empirical research. After the evidence was systematised, a typology of the performance-enhancing interventions addressed in the empirical part of the dissertation was established.

The results of the thesis can be summarised in the following statements:

1. Performance-enhancing policies in higher education, designed in accordance with NPM ideas, are capable of transforming universities' production functions – increasing their performance and efficiency or their ability to maximise outputs and minimise resources. Drawing on a systematic review of the literature, three types of such policies are defined, coherent with the dimensions covered in research dedicated to institutional design of higher education systems in general (e.g. Willemse and de Beer, 2008; Malinovskiy and Shibanova, 2023): 'state as financier', 'structuring state', and 'autonomy steering state'.
2. Structural intervention by means of concentrating resources in a limited number of higher education providers to enhance the international competitiveness of universities – excellence initiative – contributed to an increase in the publication performance and organisational productivity of the participating universities. The excellence initiative also produced spillover effects on universities with similar production possibilities not included in the reform.
3. Financial intervention, or the introduction of a performance-based funding scheme, produced beneficial redistributive effects in stimulating the competitive environment, and produced a significant impact on universities' production functions, namely, in increasing the admission quality, the degree of internationalisation, and research productivity.
4. Current regulation over the status of autonomous universities does not contribute to an increase in autonomous universities' performances or organisational efficiency, and thus the regulation does not produce any differentials in universities' production functions.
5. Performance-enhancing policies in higher education bear stratifying potential for universities by conserving and enhancing the existing differences in performance. The reforms

disproportionately benefited well-performing institutions that are already receiving greater resources and thus increased stratification in terms of performance in the system.

5.2. Discussion of the results

Although this thesis did not specifically aim to explain the roots and origins of NPM regulation adoption in Russia, it is worth reflecting about them while discussing the empirical evidence derived from the analysis.

From the 1990s, neoliberal ideas and governance, based on performance, have dominated public policy worldwide (Roberts and Peters 2019). Amid higher education expansion, intensifying budget constraints, and the abolishment of Keynesian ideas in social provision, universities came to be increasingly considered as economic organisations that produce various outputs (graduates, research, knowledge transfer, etc.) from a set of available resources (financial, human, infrastructural, etc.; Hopkins, 1990; Agasisti and Catalano, 2006; Stevens and Shibanova, 2021). Thus, the first possible rationale of adopting such policies worldwide and in Russia in particular, is the rational intention to maximise the potential contribution of universities to society and economy while maintaining control over their available limited resources (Agasisti et al., 2019). Another argument is derived from the world society theory: the diffusion of NPM regulation in higher education is in place because of the spread of global ideas, and thus such regulation is normatively obligatory for participation in modern society (Schofer and Meyer, 2005).

Both arguments can be supported by the results of the thesis. First, the analysis shows that the adoption of at least several NPM-inspired mechanisms in Russia contributed to increases in higher education institutions' efficiency, productivity, and performance. Policy borrowing from the set of globalised ideas of a competitive marketized environment, strategic planning, goal-setting, and performance management contributed to the internationalisation of Russian higher education (both from the perspectives of education and research), visibility, and promotion in the international rankings. Although in Russia the regulative mechanisms did not completely transform higher education in accordance with the principles of market competition, and the system remains comparatively highly statist and quasi-market (Malinovskiy and Shibanova, 2023), especially in relation to the ineffective regulation of universities' autonomy, positive transformations are present and now evidence-based.

Nevertheless, the evidence produced allows only limited conclusions to be drawn on the effects of NPM regulation in terms of the direct and immediate outputs of universities' activities. The policy effects in terms of higher education's contribution to societal and individual development, or the

collective and individual value (Shibanova and Malinovskiy, 2021), among many – the creation of private returns in the labour market, the contribution to economic growth, the reduction of social inequalities and tensions (Arnhold and Bassett, 2021), remain unrevealed and can only be hypothesised based on other research (Agasisti and Bertoletti, 2020; Agasisti et al., 2021b).

Finally, the results of the research allow us to open a discussion about the balance of benefits and costs of NPM state regulation in higher education. While empirical evaluations produced in the dissertation suggest that public investment in reforms has been justified in terms of increasing the efficiency and performance of universities, which in turn should lead to positive externalities, the work has also revealed unexpected negative consequences of NPM. The study revealed the stratifying potential of a performance-based funding formula in terms of producing financial benefits for universities, already exhibiting high levels of performance. Higher education institutions, demonstrating lower performance, become victims of the Matthew effect, trapped in resource dependency. Similar findings were revealed for cases of decreasing public funding in the US (Sav 2016; Sav 2017) or also introducing performance-based funding mechanisms (Ortagus et al., 2020). It is possible to speculate that the negative consequences of the NPM reforms in terms of preserving the low achievement of less successful organisations and the continuous concentration of resources in a limited number of providers together with all-embracing performance control can contribute to irreversible organisational and managerial transformations within universities, once nominated as ‘low-achievers’.

Although other risks associated with NPM regulation in higher education were not assessed in the study, they need to be mentioned. Adopting production function approach to universities potentially bears risks for decision-making in the field by oversimplifying complex processes within such multi-dimensional organisations. Quantification of the results of work of universities and academics and hierarchical structures of governance, implied within NPM, can produce tensions between administrative management, scientific work and teaching (Musselin, 2007; Lorenz, 2012).

6. Contributions and policy implications

6.1. Summary of the thesis contribution

The dissertation brings contribution to the academic and policy-oriented debate on the NPM regulation and the state capacity to transform universities' production functions.

Thus, this study contributes to the discussion about universities as complex economic organisations with a production function that can be subject to change through building an incentive-constraint environment. A comprehensive framework consisting of (1) the typology of performance-enhancing state interventions and (2) theoretical arguments on the channels and mechanisms of change of the production function is present along the papers, comprising the thesis. Although the study does not address the political-economic reasoning of adoption of NPM policies worldwide and in Russia (discussed in more details in Stevens and Shibanova, 2021; Malinovskiy and Shibanova, 2023), it makes a contribution to the extant literature by taking advantage a unique opportunity to address the research gap of fragmented evidence in the field and study the effects of several types of performance regulation on the single empirical material, both on terms of the regulatory context and in terms of the data used.

From the methodological perspective, the study provides examples of novel combinations of empirical methods that allow reducing the endogeneity bias and increasing causality of evidence produced. In doing this, the dissertation fosters research in the field of policy evaluation in the public sector, in which organisational operations are challenging to measure both in terms of the outputs produced and in terms of establishing the complex links between the inputs and the outputs (Mergoni and De Witte, 2022). The thesis brings together several modifications of non-parametric methodology of efficiency evaluation, DEA and its derivatives, and builds its evidence by means of utilising quasi-experimental methodology to assess the effects of the public intervention. Furthermore, the study considers the universities' production functions in a three-dimensional way: (1) the performance itself, concentrating on the research mission of universities; (2) efficiency and (3) productivity of universities as measures of the internal capacity to transform resources into results of public interest.

The empirical contribution of the dissertation concentrates on providing evidence on the policy effects across three mechanisms of public intervention into universities' production functions: 'state as financier' (introduction of performance-based funding scheme), 'structuring state' (launch of the excellence initiative) and 'autonomy steering policy'. The papers in the collection of the thesis reveal positive effects of the first two regulations in terms of increasing universities' productivity and performance. Autonomy status regulation though is not contributing to any

change in universities' performance or efficiency. In this way, by mostly justifying the presence of the observable effects of setting priorities in universities' operations through incentives, the study contributes to theoretical arguments from the principal-agent and managerialism frameworks, as well as it justifies the assumptions of the institutional isomorphism (Powell and DiMaggio, 1983), though not in the sense of demonstrating the internal transformations within organisations.

6.2. Policy implications

The study allows us to formulate applications for policy makers and practitioners in the field. For countries in the process of transforming institutions and regulatory mechanisms, and facing financial shortages, NPM is an effective way of developing higher education systems. Firstly, the research has shown that the promotion of competition and the introduction of performance-based funding mechanisms have the potential to change the productive functions of universities. In the long term, the transformation of the production functions and internal management mechanisms in universities has positive effects in terms of the impact of educational institutions in the development of the economy and society. Second, the mechanism of resource concentration in a limited number of leading national universities shows effectiveness not only in enhancing the universities of excellence, but also because it produces positive effects on second-tier organisations. Thirdly, although NPM has a number of negative stratification effects, in the medium term it appears to be a justified measure for the development of national education systems.

The next implication is that competitive funding mechanisms can be modified to take into account the efficiency and productivity of universities (the ability to transform resources into results), rather than just gross performance indicators. Such a mechanism takes into account the organisational resilience of universities - the presence of efficient management in the context of limited resources and an unfavourable external environment. Targeted programmes for the development of efficient universities trapped in underfunding are also possible. Such universities can act as anchor organisations that play a critical role for the social integration of the local community and the development of the regional economy.

Further development of NPM could take into account the stratification consequences discussed above (the Matthew effect). Potential mechanisms could include designing mentoring programmes for universities of excellence with less successful organisations; creating flexible funding criteria that take into account varying university profiles and specialisations in different missions and activities (education, science, social impact, and the third mission); designing supportive development programmes that are essentially aimed at second tier universities.

Finally, an implication for public policy that is particularly relevant for Russia concerns the regulation of university autonomy. The current legislation does not allow autonomous universities to show comparatively higher efficiency, and the limited financial freedom (although it is inextricably linked with other components of autonomy -- managerial, academic, etc.) plays a crucial role in this. Short funding cycles limit universities in their ability to build long-term strategies and leave no room for manoeuvring in case of failure to achieve the promised results. Potentially, a first step to respond to this challenge could be to reform the funding mechanism and extension of the budget cycle, at least as far as research funds are concerned.

7. Limitations and future research

7.1. Limitations of the study

Despite the efforts in providing theoretically driven and empirically accurate evidence on the effects of system-level NPM policies in higher education, some limitations are present in the dissertation and must be highlighted.

The first and foremost issue in the analysis concerns the natural limitations in the data: all NPM-driven reforms were implemented in Russia not earlier than a decade prior to the start of the analysis, and thus the dissertation is concentrated on a short-term timespan. Organisational changes stimulated by public interventions require time (Manning, 2017), and longer-term effects remain to be explored. An additional limitation occurred because of constraints in data availability is that there is no quantitative information about universities' operations and performance prior to the implementation of the majority of the reforms. The main data source, the Monitoring of higher education institutions' performance, was launched almost simultaneously with the excellence initiative and the performance-based formula funding, as it was designed as an information support tool for the reforms. The aforementioned limitations in the data do not allow to address the quality of the outputs produced by universities, mainly limiting judgements about the quality of publications produced by universities. Thus, evidence on the possible opportunistic behaviour and other risks of NPM regulation, e.g. on shift to production of publications in less selective journals in response to state regulation, or misalignment of management goals and practices is absent in the study.

Second, although the design of the empirical part of the dissertation seeks to diminish the causality ambiguity, it should be noted that several simultaneously operating regulations were present during the studied periods, which could produce biases in the estimations. Some policies, such as the excellence initiative or the mergers (which is outside of the scope of this study) were targeted at very limited groups of universities, while the others, e.g. performance-based funding reform or the monitoring assessment exercise were applied universally.

Third, although I mostly respected the heterogeneity of universities, comprising Russian higher education system, some groups were excluded from the analysis, which reduces the generalizability of the results – e.g. I did not consider private universities and institutions of artistic and military training. The production functions are intentionally defined in a simplistic way in order to increase generalizability of the results across different reforms, but some can find this conceptualisation insufficient, because it e.g. ignores the cost of production and its differentiation across types of institutions.

Fourth, the analysis is limited due to the lack of in-depth information on management and administrations practices within the universities. This limitation is to some extent addressed through expert interviews, conducted along the study to understand exactly how certain policies have affected managers' behaviour within the organisations, but the results of such interviews are not reported in the papers, comprising the thesis. Further advancement in the field of policy evaluation and universities' production functions measurement could be made through incorporation of mixed methods research.

Finally, the results certainly lack external validity and can hardly be extrapolated to the national contexts in which NPM regulation was adopted a long time ago. Nevertheless, the results of the study can be useful for countries continuing their transition, e.g. post-Soviet and post-socialist regions, especially for the countries of Central Asia, among which some are now considering adopting excellence initiatives (Schneijderberg et al., 2021) and reforming universities' autonomy.

7.2. Possible future research

Given the above limitations of the current study, it is possible to develop the following lines of enquiry into the production function and the efficiency of universities.

The first possible research focus could be the continuation of quantitative assessments of the effects of public interventions. Since the papers composing the thesis were written, new data have become available that can be taken into account in order to extend the time horizon of the estimates. The lack of information about the universities before and after the treatment can be addressed by referring to the cases of the second wave of the Project 5-100 (six additional universities that joined the excellence initiative in 2015-2020). It is also possible to evaluate another development programme aimed at regional flagship universities that is already completed: 22 universities received additional funds and consultancy support for strategic development in 2017-2019. Furthermore, to meet the challenge of data limitations, the use of higher quality bibliometric information, at least allowing the disaggregation of universities' publication activity by journal impact and disciplinary focus, would be beneficial.

Starting from 2021, Russia launched a new large-scale project for the development of its higher education system, targeting 100 universities (Priority 2030). This comprehensive project includes two possible tracks of transformation, one of which is a logical continuation of the excellence initiative, the other being a programme for the development of flagship universities, contributing to the enhancement of the industry. In this vein, it seems appropriate to conduct a mixed-methods

study to examine how the transition to new strategic planning priorities has affected the production function of the system as a whole and of the universities included in the completed programmes.

The next step could be to move away from a simplistic understanding of the production functions of universities and consider universities' operations beyond the immediate outputs of their operations, such as the number of students and research indicators. It is reasonable to investigate the broader contribution of the reforms, namely whether universities have improved their efficiency in terms of technology transfer, engagement with industrial stakeholders, and what effect this possible increase in third-mission efficiency has produced for regional economies. Moreover, qualitative studies focusing on the effects of state interventions on the managerial culture and governance practices would contribute to the understanding of the production function mechanisms and change.

Given the observed effects of recent regulation in terms of its stratifying potential, it is also interesting to examine whether there are resilient universities in Russia, or universities that can exceed expectations and overcome the barriers caused by socio-economic characteristics of the region where they operate. Such a streamlining of research would focus on higher education institutions that operate efficiently, despite their circumstances and comparatively lower resources, and assess the potential of underprivileged universities to increase their efficiency and performance across the main streams of activities – teaching, research, and innovation.

Finally, increasing the external validity of the results is possible through a comparative study. It would be natural to compare Russia and Kazakhstan, sharing a common Soviet legacy. Kazakhstan has also implemented a development project for research universities, introduced performance-based funding, and plans to launch a programme for universities of excellence. However, there are significant differences between the systems: Kazakhstan's higher education system is much more marketised (64% of students study for a fee), a voucher system has been introduced, most of the universities are private (91 out of 122) and enjoy considerable autonomy from the state (Mhamed et al., 2021). An examination of the effects of similar regulatory mechanisms implemented in countries with a single higher education system in the past, now following different paths of transformations and characterised by different regulatory frameworks, is promising and relevant for a discussion on the ability of the state to transform the production functions of universities.

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