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Perception of Scientific and Social Values in the Sustainable Development of National Innovation Systems

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Abstract: National innovation systems (NIS) are generally perceived as a set of interconnected organizations (or structures) that domestically produce and commercially implement scientific knowledge and technology. The development of any national innovation system is the key element for shaping up the scientific values in every country. Our paper identifies the trends in global innovation and technological scope associated with the formation of global economic relations, global investment, the flow of knowledge, technology, increased internationalization of R&D, and the formation of global innovation networks. In addition, it attempts to trace the relationship between instrumental values associated with the perception of science and technology and the development of NIS within the context of sustainable economic development using a case study from Russia. The paper carries out the analysis of values on the basis of the World Values Survey (WVS), as well as statistical indicators characterizing the development of the national innovation system. The obtained quantitative results stemming from our empirical model are further refined with the help of qualitative research, including the narrative economics approaches. Our results might be beneficial for the stakeholders and policymakers working with innovation policies and approaches in business, economics, and education.

Keywords: innovations; scientific values; social norms; national innovation system; sustainable economic development

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1. Introduction

National innovation systems (NIS) became the object of close study of many economists around the end of the 20th century (Proksch et al. 2019). The term itself was coined by the representatives of the school of evolutionary economics and the best-known and the most cited definition happens to be the one made by Lundvall (2010), who defined it as a system consisting of the elements and relationships interacting together in production, diffusion, and application of the novel and economically useful knowledge that is rooted or located in a given national state (Faissal Bassis and Armellini 2018).

Nevertheless, there were some representatives of the scientific school of evolutionary economics who always emphasized the importance of the legacy of Joseph Schumpeter in the study of innovation as a process of creating new knowledge because of the "creative destruction" associated primarily with the activities of entrepreneurs (Carayannis et al. 2020; Kesavan et al. 2022). However, when developing Schumpeter's ideas, evolutionists focused on the features of the institutional structure which allows building effective interactions between actors and organizations which are parts of NIS. According to them, the specificity of institutions depends on the national characteristics of the ongoing economic and educational policy, culture, and social values (Solis-Navarrete et al. 2021).

The brief digression into history can also help to understand how science became the main source of industrial innovation and what conditions allowed the technological revolution to begin (Rosenberg and Birdzell 1986, 1990; Zambon et al. 2019; Yang and Gu 2021). The historical and sociological literature emphasizes that the process of innovative development significantly depends on changes in culture and the associated institutions (Pel et al. 2020; Rodríguez-Abitia and Bribiesca-Correa 2021). Therefore, Mokyr (2016) concludes that the economic narrative about innovative development should additionally be supplemented with a historical narrative that reflects national characteristics of this development in greater detail.

In the works of North (2005) who focused on the theory of institutional change, technological and institutional innovations are viewed as the ones that play a significant role in the development of the economic orders. First of all, institutions create strong incentives for creating new knowledge and transforming it into innovations. However, history also provides interesting examples where innovations were carried out in the absence of institutional incentives due to the irrepressible attraction of people to the creation of new knowledge and inventions (Živojinović et al. 2019; Tortia et al. 2020).

In North's interpretation (North 2005), innovations are divided into technological, institutional, as well as organizational. Technological innovation largely depends on the success of institutional and organizational innovation (Perry 2020). Due to the institutional innovations, transaction costs are reduced, economic and social interactions are facilitated, and incentives are created, in particular, for the creation and implementation of technologies (Perry 2020). For example, North (1990) demonstrated that innovations related to the institution of intellectual property and the protection of this property in the form of patents served as an incentive for the growth of technological adoption in various types of business. Furthermore, the most important consequence of the development of the institutional environment and technologies was the spread of the increasing returns in ever larger types of production (Varadarajan et al. 2022). According to North's concept, the increasing returns, along with market imperfection, represent a factor that forms the direction of institutional changes (Nureev et al. 2020).

Representatives of the evolutionary and institutional economic theory schools of thought advocate that institutional factors have a significant impact on the development of the NIS. However, in order to study the innovation systems of various countries, it is crucial to obtain the relevant data (Dahesh et al. 2020). Obtaining the data on the social values and related institutions is subject to certain limitations related to the very nature of institutions as rules and norms that structure repetitive interactions between people (North 1989). According to North (2005), institutions should be viewed through the prism of actors' intentionality. Moreover, intentionality depends on the subjective perception of reality and the dynamics of both economic and social indicators of the development of the economic order. Therefore, obtaining relevant information about institutions faces the problem of objectivity and representativeness of the data used in this process.

Within the framework of various currents of institutionalism, either quantitative or qualitative data on institutions are predominantly used. Thence, in recent years, there has been a tendency within the framework of the new institutional economics to increasingly use the quantitative data that can directly or indirectly judge the quality of institutions and their impact on economic development (Greif 2006; Balatsky and Ekimova 2015). Within the framework of original institutionalism, the emphasis is traditionally placed on the use of qualitative data which are obtained as the result of discursive analysis, participant observation, and the analysis of historical sources (Nilsen and Sandaunet 2021).

Social institutions and values influence economic development which is a subject of research of institutional and evolutionary economics. This paper investigates the influence of institutional factors on the development of the Russian innovation system. We have selected Russia as a case study and as a subject of the narrative analysis presented in this paper for several reasons: Russia has undergone significant political and economic changes since the collapse of the Soviet Union in 1991, with the country transitioning from a

centrally planned economy to a market-oriented system. While progress has been made in terms of economic growth and modernization, the country still faces numerous challenges in building a robust innovation system (Roud and Vlasova 2020).

There are several reasons why studying the Russian innovation system is relevant. First of all, Russia has a long and storied history of innovation, with many notable scientific and technological achievements throughout its history (Fedotova et al. 2022). However, the country has struggled to modernize and innovate in recent years, with many of its industries falling behind their international counterparts (Zysk 2021). Understanding the factors that have contributed to this decline is of great interest to scholars and policymakers. Russia is home to a large and highly skilled workforce, with a strong tradition of higher education and scientific research. The country has the potential to emerge as a significant player in the global innovation landscape, and understanding the factors that will contribute to this emergence is of great interest to scholars and policymakers (Barinova et al. 2022). In addition, Russia's unique political and cultural context makes it an interesting case study for understanding the challenges and opportunities faced by emerging economies in the 21st century (Klarin and Ray 2019). Moreover, Russia has a complex and evolving relationship with the global economy, and understanding the factors that shape this relationship is of great interest to scholars and policymakers (Tsygankov 2019). As such, studying the Russian innovation system is of great interest to scholars and policymakers alike.

In recent years, Russia has made significant efforts to develop its national innovation system, but there are still several issues that need to be addressed to improve its effectiveness. These issues include a lack of coordination and cooperation between institutions, a lack of entrepreneurial culture, and a need to improve the quality of R&D. Addressing these issues will require a coordinated effort from government, industry, and academia, and will require a long-term commitment to building a strong and effective innovation ecosystem in Russia (Shmeleva et al. 2021). We employ the empirical data from the World Values Survey (WVS) to assess the institutional quality. The Russian data are reported in the WVS time series (1981–2022) sample with 1961 respondents in the time period of 1989–1993, 2040 respondents in 1994–1998, 2033 respondents in 2005–2008, 2500 in 2010–2014, and 1810 respondents in 2017–2022 making it a total of 10344 analyzed interviews (World Values Survey 2022). However, quantitative assessments of social values and related institutions do not allow us to understand which specific norms and rules are used by the actors of the national innovation system. Additional qualitative data are needed to comprehend how certain rules and institutions influence the interactions of actors in the national innovation system. Such data can be obtained and analyzed by applying the latest scientific trend represented by the narrative economics. The WVS dataset provides a rich source of quantitative data that can be analyzed using statistical methods. However, the data can also be used to inform qualitative research, providing insights into the cultural and social context in which these attitudes and beliefs are formed.

There are several reasons why narrative economics is the best approach for analyzing national innovation systems. Narrative economics is uniquely capable of capturing the diversity and complexity of innovation processes. Innovation is a multifaceted and dynamic process that involves many different actors and factors. Narrative economics recognizes this complexity and provides a way to examine the ways in which social, cultural, and economic factors interact to shape innovation outcomes (Alblooshi et al. 2021). Additionally, narrative economics is particularly well-suited to understanding the role of stories and narratives in shaping economic behavior and decision-making. National innovation systems are shaped by a wide range of stories and narratives, from the heroic entrepreneur to the innovative scientist (Tuckett and Nikolic 2017). These stories shape the way we think about innovation, and influence our economic choices and behavior. Last but not least, narrative economics provides a way to examine the cultural and social factors that shape innovation processes. Innovation is not just a matter of technology and economics, it is also shaped by social and cultural factors such as values, norms, and beliefs. Thence, narrative economics provides a

way to examine these factors and to understand how they shape innovation processes and outcomes (Ninan et al. 2022).

All in all, narrative economics offers a unique and powerful lens through which to examine national innovation systems. By focusing on the role of stories and narratives in shaping economic behavior and decision-making, narrative economics provides a way to capture the complexity and diversity of innovation processes and to understand the cultural and social factors that shape these processes. As such, it is the best approach for analyzing national innovation systems and understanding the factors that drive innovation and economic growth.

In order to solve the problem of the relevance of data from the institutions that influence the development of NIS, this paper uses a synthetic methodology and two types of data: (i) quantitative—based on the review of social values research within the WVS; and (ii) qualitative—based on the analysis of narratives from social media.

This paper is structured as follows: Section 2 provides the concise literature review on the topic which compliments the discussion already outlined in the Introduction. Section 3 lists materials and methods presenting the data and the empirical model. Section 4 offers the overview of the results stemming from the model's estimations. Section 5 features the discussion of these results. Finally, Section 6 concludes the paper with the closing remarks, policy implications, and the pathways for further research.

2. Literature Review

It is apparent that socio-economic development and technological innovation have been under the close scrutiny of the scientific academic literature for a very long time (Verbeek et al. 2002; Fortes et al. 2015; Zuo et al. 2021). Since the time of Karl Marx, the impact of technological innovations has been considered quite predictable and viewed in a positive context (Inglehart and Welzel 2005). The impact of technological innovations has been a central theme in the Marxist theory of history. Marx argued that technology was a key driver of historical change and that the development of productive forces played a crucial role in the evolution of social relations (Zhu and Mitcham 2020). However, since Marx's time, the impact of technological innovations has been viewed as largely positive and predictable, a perspective that is increasingly being questioned in contemporary debates (Achmad 2021). For Marx, the development of technology was a central factor in the evolution of social relations and the production of wealth. In Marx's view, technological innovations allowed for the creation of surplus value, which was appropriated by capitalists and used to expand production and increase profits. The development of technology also led to the displacement of labour and the creation of a reserve army of unemployed workers, which Marx saw as a fundamental contradiction of capitalism (Thompson and Laaser 2021). However, despite these critical perspectives, the impact of technological innovations has been largely viewed in a positive light in contemporary discussions. Technological innovations are seen as drivers of economic growth, productivity, and efficiency. They are seen as enabling new forms of communication, creating new markets and opportunities, and enhancing the quality of life for people around the world. Back in the 19th century, Marx could not predict the development of the knowledge society and the significant growth of the service sector (Clark and Gevorkyan 2020). On the one hand, the changes in social values and institutions are of an incremental nature, and, on the other hand, are poorly predictable, especially in the face of radical social and technological challenges (Miceli et al. 2021).

The interplay of social values, institutions, and innovation requires somewhat more detailed research that would employ qualitative data in order to gain an understanding of the nature of these relationships (Castro 2019). Of course, in the modern world, culture, values, and institutions become significant in terms of the prospects and pace of economic development, but there are also significant differences associated with national and regional characteristics. Understanding such features is impossible without deep immersion in the social environment where narratives circulate, as well as the help of actors who communi-

cate and express their attitude and interpretation of ongoing events (Kryshtanovych et al. 2022).

In general terms, institutional formation is driven by shared values and beliefs that provide a common framework for action and interaction. Values shape the norms, practices, and behaviours of individuals, which in turn influence the formation and evolution of institutions (Risi et al. 2023). For example, the rise of modern democracy can be attributed to the values of liberty, equality, and justice that were central to the French Revolution.

Values play a key role in shaping institutional formation in two primary ways. First, values provide a shared language and set of beliefs that facilitate collective action and coordination. By establishing common values, individuals can work together towards common goals, creating institutions that are more effective and sustainable. Second, values help to define the goals and objectives of institutions, guiding their development and evolution over time. Furthermore, values and institutions are shaped by the historical and cultural context in which they arise (Ashwin et al. 2020). Different cultures and societies have distinct values and beliefs that shape the formation of their institutions. For example, Confucianism, with its emphasis on social order, hierarchy, and respect for authority, has influenced the development of institutions in East Asia.

Moreover, the historical context in which institutions arise can also shape their values and goals (Webb et al. 2020). For example, the development of democratic institutions in Europe and North America was influenced by the experiences of colonialism, slavery, and religious conflict, which led to a focus on individual rights and freedoms.

The growth of technological innovations is associated with the formation of institutions of science and education (Dahesh et al. 2020). Over the course of human history, only the last two hundred years have seen processes where the institutionalization of scientific activity and the increase in public spending on this activity have become powerful sources for the exponential growth of knowledge and its translation into technological improvements (Cavusgil 2021). Education, science, and innovation activities require significant resources and, above all, free time of actors which they could devote to these activities, perceiving them as useful and beneficial (Welzel 2013). Therefore, the profound changes associated with the formation of a knowledge society are associated with radical changes in the social organization of society and its key institutions, families, enterprises, as well as its self-organization (Maldonado-Villalpando et al. 2022).

In a society that is based on knowledge, the worldview of people is constantly changing. In today's world, there is a shift from the "materialistic, mechanistic world of the factory to a world where ideas take center stage" (Inglehart 2018). In the knowledge society, connections of a new type are being formed, which are stimulated both by the new technologies and the emerging informal norms and institutions that stimulate the creative behaviour of actors (Kivimaa and Rogge 2022).

Creation of the suitable conditions for the development of innovations is connected with the three most important factors: (i) stability, (ii) competitiveness, and (iii) the possibility of launching mechanisms of increasing returns (Sołoducho-Pelc and Sulich 2020). All three factors are associated with the institutions that allow the regulation of the contradictions that arise in the process of system development. It is the institutions and the values associated with them that constitute the environment that determines the degree of adaptability of society during changes associated with non-equilibrium processes, for example, those associated with the action of positive feedbacks in the high-tech industries (Zhao et al. 2018).

The institutional structure of the national innovation system compensates for the contradictions in the state innovation policy (Gifford et al. 2021). This is especially true in the case of the informal institutions which are based on the social values and social capital that dominate in the society. With the help of various models, we can identify the meaningful links between the social values and the development of innovations. However, interpreting the nature of this connection as well as the content of the rules and norms

that actors consider relevant inevitably requires using qualitative research (Kar et al. 2019; Chuang et al. 2022).

When applied to NIS, the qualitative research is based on the approach of a recently emerging field known as "narrative economics". Narrative economics originates from the pioneering work of two Nobel laureates—George Akerlof and Robert Schiller. For example, in 2016, an innovative article by Akerlof and Snower (2016) was published demonstrating the possibilities that the appeal to narratives can provide for studying events that took place in the past (for example, the features of the development of a planned economy in the USSR) (Akerlof and Snower 2016). The authors showed that through narratives one can gain important knowledge about the significant social contexts in which certain economic events took place, which can in turn significantly complement our understanding of the fundamental relationships that affect the behaviour of the economic actors.

At the same time, the term "narrative economics" was coined in 2017 by Robert Shiller in his policy paper that used the same title (Shiller 2019). This article has served as a driver for the emergence of a scientific direction which is reflected in the emergence of many original studies focused on the concept of narrative economics. Schiller gives a simple and very broad understanding of narrative as a simple story or easily expressed explanation of events that many people want to bring up in conversation or on news or social media because it can be used to stimulate the concerns or emotions of others, and/ or because it appears to advance self-interest (Shiller 2019). According to this approach, through narratives researchers can obtain information about how actors use narratives for justifying their behaviour which also implies an increased attention to the social context.

In addition, in other works of Schiller, there is a slightly different interpretation of narratives as being the simplified proto-models that actors can use in order to explain the patterns that are significant to them in their social interactions (Shiller 2019). Similar interpretations of narratives as proto-models are also common among the representatives of the original institutional economics (Whalen 2021). The approaches of narrative economics and institutional economics are surprisingly similar, if only in terms of their attention to the qualitative data and the importance of the social context for the analysis of the socio-economic interactions (Volchik 2017). Perhaps in the future there will be a convergence of the research methodology of narrative economics as well as the original and the new institutional economic theory in terms of the development of pluralistic institutionalism (Hermann 2018).

In this paper, we consider narratives as being a source of qualitative data on the significant social practices, routines, rules, and institutions that actors consider relevant for the development of the Russian innovation system. This approach develops the approach of Robert Shiller who suggested using various databases as the sources of narratives—from archives of focus group materials to databases of religious sermons (Shiller 2019). Through these media, it is possible to track much more than only the frequency of viral narratives using various forms of content analysis. There are full-text databases of mass media and Internet sources in different languages. For example, "Integrum" represents such a database in Russia. Based on the selected keywords, it is possible to select the articles that could potentially contain narratives. Then, with the help of qualitative analysis, it is possible to select specific texts that can be attributed to the narratives related to the subject of research. From such texts, a basis is formed for conducting a more in-depth qualitative analysis which makes it possible to identify significant ideas ("proto-models"), social practices, and rules that are significant for the scientific problem that is being investigated.

Furthermore, it is also possible to select (in a targeted way) the media and the sources that contain interview materials on the studied problem. This approach is in accord with the original institutional economics (OIE) and is also close to the concept coined by Schiller. Modern mass media contain a plethora of materials in which the actors of the national innovation systems reflect upon its development. These interviews can also contain a lot of biographical data of the actors which makes it possible to interpret the trends in the

development of innovations through the prism of their personal experience and attitudes towards the existing institutions and ongoing processes of the institutional changes.

Russia has been making significant efforts to develop its national innovation system in recent years, but there are still several issues that need to be addressed. Similar to many other countries, Russia has recognized the importance of innovation and has been investing heavily in the development of its national innovation system over the past decade. Despite these efforts, the state of the Russian NIS remains far from ideal, and there are several issues that need to be addressed to improve its effectiveness (Lee et al. 2021).

The Russian NIS comprises a range of institutions, including universities, research institutes, innovation centres, and government agencies. These institutions are responsible for promoting and supporting innovation in the country. However, despite the significant investments made in these institutions, there are several challenges that are hindering the development of a strong innovation ecosystem in Russia (Tsygankov et al. 2021).

One of the main issues facing the Russian national innovation system is a lack of coordination and cooperation between the various institutions. There is a need for greater collaboration between universities, research institutes, and industry to ensure that research is relevant to the needs of industry and society. Additionally, there is a need for better coordination between government agencies to ensure that policies and initiatives are aligned and that resources are being used effectively (Paptsov et al. 2019).

Another issue facing the Russian NIS is a lack of entrepreneurial culture. Although there are a growing number of startups in the country, there is still a lack of entrepreneurial mindset among researchers and academics. There is a need to promote entrepreneurship and innovation within universities and research institutes, and to provide support for startups and small businesses (Lupova-Henry et al. 2021).

Overall, there is a clear need to improve the quality of research and development (R&D) in Russia. Although the country has a large pool of talented researchers and scientists, there is still a need to boost the quality of research and ensure that it is relevant to the needs of industry and society (as well as towards the outside world). This can be achieved through greater collaboration between universities and industry, as well as by promoting international partnerships and collaborations which might be quite problematic at the moment due to the current geopolitical situation in the world.

3. Materials and Methods

In this paper, our modelling of the dependence of the level of development of national innovation systems on institutional factors is based on the analysis of the panel data for countries listed in the WVS Database (World Values Survey 2022). The World Values Survey is a research project that examines values and their impact on the social and cultural life. It is the largest university-based comparative study of values and beliefs in the world.

The World Values Survey (WVS) data cover several important aspects (Kołczyńska 2020). While instrumental and intrinsic values tend to focus on the individual ways of thinking about the world, we suggest that relational frames are capable of establishing or reinforcing social influences that drive action. Those intrinsic, relational, and metaphorically-formulated value statements emerge from studies of cultural ecosystem services (Klain et al. 2017). Responses to the relative value statements can be compared with the additional statements formulated to represent instrumental, intrinsic, and metaphorically-formulated value statements. Different types of socio-environmental value claims can be tested, including instrumental, intrinsic, and relational value claims that use metaphors to convey value. The comparison between relational value and metaphorical statements is instructive, suggesting that while socio-environmental relationships can be lower in certain populations, the associated values might remain strong.

In our study, we used the data from two waves of questionnaires contained in the WVS covering the population of 68 countries: Wave 6 (2010–2014) and Wave 7 (2017–2021). The basic specifications of the model can be presented as follows: The variables used for the econometric analysis were those describing the attitudes towards science and technology

in the society. As a result of the regression analysis, the relationship between the level of interpersonal trust and the level of development of the NIS was revealed. In narratives, we are primarily interested in how the actors interpret the nature of this connection. We analyse the narratives that were selected from the mass media and the online sources. The sources of the narratives were selected using the ranking "Federal Media: 2020", created by Medialogy and publicly available on the Internet. In order to identify the media sources, the rankings "Top 10 Most Cited Newspapers 2020" by the indexes of citation in the media and "Top 10 Most Cited Newspapers 2020" by the hyperlinks in the social media were used. The result of combining the results of these two rankings is a sample of 11 media sources. Similarly, magazine sources were identified using the rankings of 'Top 10 Most Cited Journals—2020' by the media citation indexes and 'Top 10 Most Cited Newspapers—2020' by the hyperlinks in the social media, resulting in a combined total of 16 magazine sources. The first 10 places of the rankings "Top 30 most cited Internet resources—2020" by the citation index in the media and "Top 30 most cited Internet resources—2020" by the hyperlinks in the social media were used to identify sources from the Internet resources, the result of which was the association of 16 Internet resource sources. A total of 43 sources of information were selected in the first stage. Then, 30 keywords selected on the basis of content analysis, were searched in the electronic database of the periodic sources of information called "Integrum". The time period for searching narratives was set from 1 January 2010 to 1 July 2021. The search resulted in the selection of 33491 articles (without reprints). The analysis of the selected texts further identified 1149 narratives which were used for our qualitative analysis.

The fixed effects model ("within" estimates) is outlined in Equation (1):

$$GII_{i,t} = \alpha + \delta \times S_{i,t} + \gamma \times T_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t}, \quad (1)$$

The model with random effects is depicted in Equation (2):

$$GII_{i,t} = \alpha + \delta \times S_{i,t} + \gamma \times T_{i,t} + u_i + \tau_t + \varepsilon_{i,t}, \quad (2)$$

where:

i—country number;

t—survey wave number;

GII (Global Innovation Index)—dependent variable yielding the indicator of the development of the national innovation system of the i-th country;

S—vector of variables characterizing the attitude towards science and technology in society;

T—vector of variables characterizing the level of trust in society;

μ—country-specific features (fixed effects), allowing to take into account the heterogeneity of countries which is not captured by other control variables;

u—individual country specifics (individual effects),

τ—time effects included in the model to reflect the structural shifts faced by the economies of the countries during the analysed period (accounting for time effects is important as our dataset spans two five-year waves);

ε—random errors,

α—constant.

The mean values were used as variables of the vector S, excluding missing values, calculated based on the answers of respondents from the i-th country to the questions characterizing their attitude towards science and technology in society (Table 1). These averages were calculated as a weighted average of the proportions of the selected response options for each country. The maximum possible value was 10. Thus, the closer the value is to 10, the more often respondents agree with the statement in the WVS.

We use variables in our model given by the characterization of the attitudes towards science and technology in the society based on WVS data. All simulation estimates are based on a fixed and random effects model without the use of instrumental variables, which

retains some risk of regressor endogeneity despite country and time effects. This choice of empirical strategy is explained by the lack of valid tools at our disposal.

Table 1. List of variables characterizing attitudes towards science and technology in society.

Variable	Questions from WVS Database	Answers
Comfortable	Science and technology are making our lives healthier, easier, and more comfortable	A scale from 1 to 10, where 1—totally disagree, 10—totally agree
Opportunities	Because of science and technology, there will be more opportunities for the next generation	
Science_faith	We depend too much on science and not enough on faith	
Bad_effects	One of the bad effects of science is that it breaks down people's ideas of right and wrong	
Importance	It is not important for me to know about science in my daily life	
World_better	The world is better off, or worse off, because of science and technology	A scale from 1 to 10, where 1—is much worse, 10—is much better

Source: Own results.

As variables of the vector T, we used average values, excluding missing values, calculated based on the answers of respondents of the i-th country to questions characterizing the level of trust in society (Table 2).

Table 2. List of variables characterizing the attitude towards science in society.

Variable	Questions from WVS Database	Answers (Answer Types in the Survey)
People_trust	Most people can be trusted	% of respondents in i-th country who believe that most people can be trusted
Confidence_Press	Confidence: The Press	scale from 1 to 4, where 1—completely trust, 4—do not trust at all
Confidence_TV	Confidence: Television	scale from 1 to 4, where 1—completely trust, 4—do not trust at all

Source: Own results.

4. Main Results

Table 3 presents the values of the intra-group and between-group standard deviations, as well as the coefficients of variation for all the indicators used in the model. As can be seen in Table 3, there is heterogeneity of indicators both over time and across countries in general.

Table 3. Indicators of variation of variables.

Variable	Within Standard Deviations	Between Standard Deviations	Coefficients of Variation (Wave 6)	Coefficients of Variation (Wave 7)
GII	3.194	11.504	0.277	0.344
Comfortable	0.338	0.568	0.068	0.087
Opportunities	0.339	0.551	0.068	0.080
Science_faith	0.378	0.919	0.169	0.155
Bad_effects	0.464	0.727	0.132	0.132
Importance	0.424	0.758	0.155	0.179
World_better	0.400	0.727	0.095	0.113
People_trust	4.739	14.964	0.695	0.713
Confidence_Press	16.365	32.398	2.511	2.010
Confidence_TV	16.653	37.070	17.274	4.677

Source: Own results.

The results of estimating models with fixed and random effects that take into account time effects are presented in Table 4.

Table 4. Model evaluation results (dependent variable—*GII*).

Variable	FE Model	RE Model
Const	33.005 *** (11.602)	50.392 *** (9.912)
Comfortable	−7.309 *** (1.999)	−5.665 *** (1.570)
Opportunities	2.277 (1.656)	0.066 (1.479)
Science_faith	4.002 ** (1.691)	1.583 (1.317)
Bad_effects	−0.723 (0.930)	−0.185 (1.091)
Importance	−2.490 ** (1.026)	−1.718 ** (0.849)
World_better	4.528 *** (1.211)	3.229 *** (1.087)
People_trust	0.200 *** (0.074)	0.365 *** (0.072)
Confidence_Press	0.0628 * (0.036)	0.112 ** (0.050)
Confidence_TV	−0.020 (0.049)	−0.104 ** (0.046)
τ	−2.232 *** (0.821)	−3.177 *** (0.721)
N	136	136
R^2-within	0.697682	-
LSDV R^2	0.991971	-
Wald joint test on time dummies - Null hypothesis: No time effects Asymptotic test statistic: Chi-square (1) = 7.384 with *p*-value = 0.0066		
Robust test for differing group intercepts - Null hypothesis: The groups have a common intercept Test statistic: Welch F (67, 45.8) = 88.840 with *p*-value = P(F(67, 45.8) > 88.8403) = 5.7572×10^{-34}		
Breusch-Pagan test - Null hypothesis: Variance of the unit-specific error = 0 Asymptotic test statistic: Chi-square (1) = 15.579 with *p*-value = 7.91149×10^{-5}		
Hausman test - Null hypothesis: GLS estimates are consistent Asymptotic test statistic: Chi-square (10) = 89.853 with *p*-value = 5.72882×10^{-15}		

Note: standard errors are shown in parentheses. *, **, ***—significance at 10th, 5th and, 1st significance levels, respectively. Source: own results.

According to the robust test for differing group intercepts, Breusch-Pagan test and Hausman test, the fixed effects model is the best specification. The Wald joint test on time dummies confirms the need to include time effects in the model.

Based on the obtained estimates of the fixed effects model, the following conclusions can be drawn: The following factors characterizing society's attitude to science and technology have a positive statistically significant influence: Science_faith and World_better (the higher the level of agreement among people in the country with the statements "We depend too much on science and not enough on faith", "The world is better off, or worse off, because of science and technology", the higher is the level of development of the national innovation systems (NIS)). At the same time, the Comfortable factor has a negative statistically significant effect: the higher the average level of agreement among people with the statement that "Science and technology are making our lives healthier, easier, and more comfortable", the lower is the level of development of NIS. The identified relationship confirms the existence of the positive externalities which is manifested in the underestimation of the importance of science and technology in terms of their impact on the quality of life. The Importance factor also has a negative statistically significant effect: the lower the average level of agreement among people with the statement that "It is not important for me to know about science in my daily life", the higher is the level of development of NIS, that is, actors in countries with a high level of development of NIS perceive positive externalities from the development of science and technology as something self-evident and familiar in their everyday life. In addition, the influence of the level of interpersonal trust on the development of NIS turned out to be positively statistically significant (People_trust variable). Thus, we have obtained evidence that an increase in the level of interpersonal trust is associated with an increase in the level of development of NIS. This finding can surely be important for focusing on the institutional structure that promotes trust but is otherwise out of the scope of our study. Our paper looks at narratives as the sources of qualitative data on specific rules and institutions that actors consider relevant for structuring their social interactions.

5. Discussion of Results

In this section, we are looking into the institutional factors in the development of NIS through the prism of narratives. As it has been already noted, according to the approach of original institutionalism and narrative economics, stories or narratives can serve as an important source of empirical data. In the texts of articles and interviews, we are primarily interested in how actors interpret specific norms and rules that are associated with the institutions and institutional structure of the national innovation system. Social values are also associated with the institutional structure. The nature of this connection can also be interpreted from the statements of the actors.

The following major issues related to institutional factors can be identified: trust and instrumental values in the interpretation of the original institutionalism (Bush 1987; Edgren 1996; Lacasa 2014). Through narratives, it can be shown how social values influence attitudes towards innovative entrepreneurship and institutions of property, including intellectual property.

In our model, significant factors are represented by interpersonal trust, as well as attitudes towards science and technology. Trust is a critical factor not only for innovation but for all economic activity. It is not for nothing that in institutional economics and economic sociology the quality of social capital is associated with trust (Didenko et al. 2020).

The problem of trust becomes central in the implementation of long-term projects requiring significant investment in specific assets. Technological innovations are exactly such projects where the outcome is associated with significant uncertainty.

Regarding innovations, it must be remembered that their implementation is associated with the processes of increasing returns. Business systems that feature increasing returns operate on different principles from traditional industry with vertical ties and rigid management structures. Innovative activity is also associated with creativity, and here the problem of the horizontal organization of project teams arises, since their cooperation and interactions are also regulated by often informal practices associated with a high level of trust (Jewell et al. 2022).

Another important aspect of trust between the actors of innovation activity is related to the mechanisms for the development and promotion of grassroots initiatives within scientific groups, research organizations, and industrial enterprises (Tolstykh et al. 2020). It is the quality of such communication mechanisms that determines whether the organization would be able to respond effectively to any arising changes. Grassroots innovation occurs best in an environment where effective organizational values exist and where the external institutional environment promotes interpersonal and institutional trust.

Innovative activity in markets with increasing returns is also associated with the action of positive feedback mechanisms, which in turn determine the development of nonequilibrium processes. Under such conditions, the sustainability of economic orders depends on the adaptively emerging institutions and values.

Modelling has shown that actors positively associate the development of technology with the economic development of the country. However, the technologies themselves and the economic processes associated with them have significant specifics depending on the national institutional structure.

A certain distrust in the development of technologies may arise in the context of their impact on personal and political freedoms in society, primarily this applies to the spread of the Internet and social networks (Del Canto Viterale 2021). The penetration of the Internet and related systems of actor tracking, governance, and public opinion formation has led to the evolution of modern economic orders towards a system of so-called "surveillance capitalism" (Zuboff 2019). However, technologies in such processes only constitute an important tool of control in a society where the evolution of ways to realize the interests of various groups through the new capabilities of information systems is taking place, through the prism of which society is viewed as an object for digitization, computing, modification, monetization, and control (West 2019). The "success stories" are also contained in the narratives of the actors of the national innovation system such as the following one:

> *"In Russia, distrust between various actors of the innovation system leads to an increase in transaction costs and a slowdown in development. It is obvious that Russia needs a conditional "exchange", where, on the one hand, business representatives would come and form a request for innovative developments necessary for their companies, and on the other hand, scientists would offer their technological solutions. In today's Russia, there exists certain distrust between these two parties: it seems to business that it is more reliable to invest in the search for new technologies abroad, and researchers believe that companies cannot formulate a task. If this distrust is not overcome, then it will be very difficult to change the situation. Thence, many stakeholders believe that in order to build trust between business and science, we need concrete examples of successful cooperation between them, success stories that we definitely have"*. (Mikhail Kotyukov, Head of the Federal Agency for Scientific Organizations) (Khlyustova and Podorvanyuk 2016)

In general, low interpersonal and institutional trust leads to high risks of uncertainty. In Russian conditions, it is the high level of uncertainty that hinders the creation of complex innovative projects that require long-term investments. Here is how the actors representing the academy describe this problem:

> *"Our economy and its main agents have a high inertia. For many reasons, they still live in a model that does not encourage them to plan ahead and innovate ahead of time. Here and the absence of a real competitive environment, and the complexity of relations with the state. On the one hand, there is distrust and high risks of unpredictability, on the other hand, there is a consumer position in relation to the state and the expectation that the state will not quit in difficult times"*. (Belova 2015)

The Russian innovation system allocates significant public funds for venture capital investments to innovative companies. However, an interesting effect of "misuse and inefficient use of funds" arises here. The following attitude of Russian law enforcement agencies towards such situations can be quite indicative:

> *"In 2010, [then] President Dmitry Medvedev instructed to prepare proposals for accounting for failed projects in the field of venture investments. But not only Rusnano is working on this order. "The other day I received a wonderful letter from the Prosecutor General's Office, where they ask for a complete list of projects that ended in failure, and a complete list of people who carried out this project," Anatoly Chubais said. After these words, the venture investors sitting in the hall laughed nervously: apparently, the letter from the Prosecutor General's Office discouraged some from investing in start-ups. Thus, modernization plans are hampered by a lack of trust"* . (Tanas 2010)

Entrepreneurs' distrust of government support programs for innovative projects triggers the mechanisms of adverse selection (Dahlstrom and Ingram 2003; Yerznkyan 2012). The operation of such mechanisms makes it difficult or even blocks the access to programs of conscientious innovators and, in turn, facilitates the participation of entrepreneurs who choose a model of opportunistic behaviour. This is confirmed by the relatively high level of corruption in the innovation sector and the insufficient effectiveness of government programs aimed at supporting entrepreneurship.

One of the main obstacles to innovative development in Russia is the lack of proper quality of the institutional infrastructure which leads to the traditional low demand for innovations from business in the Russian business environment:

> *"In the Russian business environment, value orientations have already been formed, focused on the priorities of the innovation economy. A pragmatic business audience believes that it is impossible to create competitive products without innovation (90%). Such attitudes are typical both for Moscow and for the regions. Despite the established value orientations, the interest in introducing new technologies into production among businesses remains at a low level. The reason is the poor development of the innovation infrastructure in Russia. Until a legal framework for innovation is created in the country, an effective patenting system is developed, a system for financing innovation is debugged, the risks of opening innovative production are reduced, the question of the reasons for the low level of business interest in innovation will remain rhetorical"*. (Baeva 2010)

From the narratives listed above, one can learn how actors not only relate to the property rights associated with the national innovation system, but also how they interpret the rules associated with their effective or inefficient use. For example, the problem of using patents in the practice of innovation is very acute in Russia:

> *"When preparing an application for a patent for an invention, it is necessary to remove the "zest" of technology from the patent application. < . . . > Then a potential competitor who decides to copy the patented technology in practice according to the description published in the patent will not be able to get the desired result. Therefore, the presence of our own R&D centre and vertically integrated production becomes an advantage—secrets and know-how remain inside the holding"*. (Ziablov 2019)

It is not uncommon for patents to be used for blocking the use of an invention which negatively affects the rate of implementation of these patents in real production. In the Russian innovation system, the blocking of the use of patents is also associated with the actions of foreign firms:

> *"After the publication of an invention on the website of the federal service, intermediaries contact you with an offer to sell copyrights to third parties abroad. But what is sold is not always introduced abroad. Often a foreign company, seeing a threat to its established business, buys copyright and blocks the invention"*. (Khodyrev 2010)

As can be seen from the above narratives, the Russian innovation system of intellectual property rights which include patents for inventions does not create strong incentives for innovation. This situation can also be associated with the characteristics of the institutional environment and the social capital in Russia. Traditionally, low indicators of institutional trust led to the fact that actors were not ready to invest into the long-term projects associated with fundamental uncertainty. However, every innovation activity is precisely connected with such investments and entrepreneurial initiative. In addition, representatives of the

Russian academia often do not receive proper incentives for the implementation of inventions in specific business solutions focused on market mechanisms. For example, in Russia, there are traditionally more discussions about "innovation implementation" which is associated more with the administrative decisions than about the demand for innovation, which implies the operation of market mechanisms.

The Russian innovation system has largely inherited its peculiarities from the Soviet era. Today, Russia retains an extensive network of research institutes that operate within the system and under the umbrella of the Russian Academy of Sciences. Traditionally, research and innovation activities in the Russian universities have been weaker than in the academic research institutes. However, in recent decades there has been a tendency to develop and increase research and innovation activities specifically in universities. The institution of "national research universities" was established in 2008, of which 29 were established by 2023. Among the features directly derived from the Soviet legacy are low competition and the dominance of the state and state-owned companies in shaping the demand for innovation.

All in all, the Russian innovation system is characterised by imperfect institutions and an institutional environment which is associated with high transaction costs. One of the most important institutions—intellectual property—does not actually create strong incentives for innovative activity in the Russian context. The narratives of actors in the Russian innovation system, for example, do not associate patents with effective innovation and production, but are mostly viewed as a form of accountability or achievement of KPIs for the numerous state R&D incentive programmes.

6. Conclusions and Implications

Overall, based on the comprehensive literature review and the empirical results stemming from our model, we demonstrate that the traditionally strong science and historically solid traditions of technological inventions are not sufficient for the sustainable development of the Russian innovation system. Sustainable development is a complex concept that encompasses economic, social, and environmental dimensions. At its core, sustainable development seeks to ensure that development meets the needs of the present without compromising the ability of future generations to meet their own needs (Cecchin et al. 2021). This requires careful consideration of the economic, social, and environmental impacts of development, and a focus on finding solutions that balance these different dimensions. Furthermore, the problem of institutions and social values in the development of NIS in this case comes to the fore. As noted by Douglass North, the issue of institutional change should be viewed through the prism of the actors' intentionality. However, the intentions of innovators must correspond to an adequate understanding of the system of existing institutions and the incentives they tend to create.

In order to enhance the successful creation and development of a national innovation system, it is necessary to have such well-functioning institutions and organizations as universities and other institutions of higher education, research organizations, scientific infrastructure, both tangible and intangible, institutions for the dissemination of scientific information, institutions for the protection of intellectual property rights, as well as institutions for the targeted financing of science and experimental design developments. During the functioning of most institutions and organizations of the national innovation system, positive external effects can be observed. The existence of strong externalities, for example from the institution of higher education, can hypothetically be expressed in the underestimation of the importance of science and technology in terms of their impact on the quality of life.

In general terms, it becomes clear that the actors from the developed countries perceive positive externalities from, for example, the education and science systems as something taken for granted and familiar in the everyday life of citizens of developed countries. However, the lack of educational and scientific infrastructure in developing countries, on

the contrary, is an important reason for actors that will affect development prospects and the quality of life.

The most important barriers for the effective functioning of the Russian innovation system lie in the quality of institutions. A WVS study of social values shows that the level of interpersonal trust has a positive and statistically significant impact on the development of the NIS. The level of trust is directly related to the fact that the existing institutional environment is characterized by imperfection and fragmentation. Narrative analysis, due to the specifics of this research area, was associated with a time-consuming search and analysis of narratives about the Russian innovation system in the Russian media which determined the focus on the Russian case study only. The narrative research confirmed the general conclusion about the dysfunctions of institutions in the Russian innovation system related to competition, fundraising, and intellectual property.

The results of our empirical modelling provide the evidence that the growth of interpersonal trust is associated with a higher level of development of the NIS. Despite the existence of positive externalities manifested in the underestimation of the impact of positive externalities from the development of science and technology on the quality of life, actors associate a higher level of development of NIS with the development of science and technology. When it comes to the pathways for further research, the study of the influence of social values on the behaviour of actors in national innovation systems can make wider use of the potential of narrative economics in analysing the virality of certain ideas, as well as help to obtain a variety of qualitative data on the institutions and social contexts in which innovation systems develop in different countries and different historical periods.

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