STI Policy in Russia and China

– Mapping and comparisons in instruments, objectives and implementation

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Abstract: We study STI policy of Russia and China in this paper with a three-dimension framework for policy objectives, policy instruments and policy implementation. Analyzing a database of 418 STI policies issued between 1990 and 2013 in the two countries, 25 policy variables have been scrutinized for the two countries vis-à-vis the three policy dimensions. The paper then compares and contrasts Russia with China, revealing the differences and similarities between the two countries in STI policy instruments, objectives and implementation.

Key words: STI, STI policy, S&T, R&D, innovation

1. Introduction

Countries or economies are usually considered emerging because of their developments and reforms that are radical or, more precisely in practice, fanatical. Emerging economies are characterized as transitional by the west, meaning that they are in the process of moving from an economy closed to the west, to a market economy open to the west. They were keen on transforming their systems to match western advanced systems initially. They demand their rules be adopted equally whilst confidence growing. Owing to globalization, the division between developed and developing has become outdated; arriving have been emerging economies, merging with the developed world, evidenced by the protocol of the Group of Twenty (G20). "The G20 had become a more relevant economic grouping for the task to broaden the dialogue on key economic and financial policy issues among systemically significant economies", declared the G20 Meeting of Finance Ministers and Central Bank Governors (1999). Emerging economies have been playing an increasingly significant role in the world economic system since the beginning of the new millennium. The two most powerful examples are Russia, with its sophisticated military technologies second only to the US, and China, one of the world's economic powerhouses alongside the US.

We study science, technology and innovation (STI) policy of Russia and China in this study, given their status of the largest emerging economic powerhouse and STI engine. Science and technology (S&T) in this study overlap with innovation and research and development (R&D), to be elucidated in the next section. One of the major driving forces for economic development is R&D, while STI policy fosters R&D. Russia and China were two of the largest economies included in the Bloomberg top 30 most innovative countries in 2014, where Russia was ranked 18 and China 25 overall (Bloomberg, 2014). Among seven

contributing factors[1] to global innovators, Russian and China were respectively ranked top ten in three factors, and China was ranked number one in Manufacturing Capability. Coupled with their size, the impact and influence of Russia and China on the world economy and global innovative capacity are considerable and worthwhile examining.

Typified by emerging economies, Russia and China made every effort to transit to an economy modelled on the west at the early stage of transformation. They endured a planning economic system for the large portion of their post revolution period, in stark contrast to the US, Western Europe and Japan. They have transformed into market-oriented economies to a certain extent. As such, "state interference was pervasive (in Russia)" (Radosevic, 2003, p1106), and "few other countries (other than China) have intervened so systematically and invasively in their innovation system" (Liu *et al.*, 2011, p918). "Russia has inherited a large set of strengths and weaknesses of the Soviet S&T system… many of these strengths continue to guide the S&T system in Russia today", which "demonstrate particular path-dependencies from the times of the Soviet Union" (Klochikhin, 2012, p1624). Such similarities between Russia and China contrast major western developed countries strikingly meanwhile, which offer a different facet to explore R&D and innovation. Being the largest, most powerful emerging economy and R&D engine, Russia and China have been proactively integrating the rest of the world at this stage of development. It is timely to study STI policy of Russia and China while their R&D and innovation activity is making impact beyond the national borders.

The rest of the paper proceeds as follows. The next section provides a literature review in STI policy studies centered on the theoretical framework in which the present study is carried out. It is followed by research design, introducing our samples and variables, together with their sources, features and coding. The paper then proceeds to implement the

[1] They are R&D Intensity, Manufacturing Capability, Productivity, High-Tech Density, Tertiary Efficiency, Research Concentration, and Patent Activity.

empirical work in conformity to the theoretical framework, analyzing and contrasting the results between the two countries. The last section summarizes this study.

2. Review of the literature and theoretical framework for STI policy studies

STI policy and innovation policy are adopted interchangeably by international organizations, academic researchers and practising bureaucrats. The former is represented primarily by the Organization for Economic Co-operation and Development (OECD) and the European Commission (EC) or the European Union (EU). While OECD (2012) adopts innovation policy and STI policy interchangeably, OECD (2014) assumes the usage of STI policy consistently. For example, in its 2012 executive summary under the heading of innovation in times of crisis, STI gets the first full appearance accompanied by its acronym "The economic crisis which started in 2008 has had a significant impact on science, technology, innovation (STI) domains and policies" (OECD, 2012, p13). These do not occur in OECD (2014) where STI and STI policy are used consistently throughout the whole document. Moreover, the combined term "R&D and innovation" appears in the document frequently. The EC (2012) also associates S&T and R&D closely. It suggests that "The STI internationalisation processes thus include on the input side the international mobility of human capital (S&T employees and researchers) as well as the international mobility of physical and financial capital with R&D facilities and funds controlled from abroad" (ibid, p21). These shared attributes are also reflected in the stated aims and scope of the leading journals in the field. One of them, *R&D Management*, publishes articles which address the interests of both practicing managers and academic researchers in R&D and innovation management (R&D Management, 2015), extending R&D to cover innovation. A more policy focused journal, *Research Policy*, is a multi-disciplinary journal devoted to analyzing, understanding and effectively responding to the economic, policy, management, organizational, environmental and other challenges posed by innovation, technology, R&D

and science (Research Policy, 2015). All these indicate high degrees of overlapping and interchangeability in the content of R&D and innovation in STI policy. We consider that the use of STI policy is right in scope and exactness relative to innovation policy in recent trends and for the future.

In general a policy is a principle that guides decisions to achieve rational outcomes. Policy makers set to achieve policy objectives by means of policy instruments. Addressing innovation policy issues, Nill and Kemp (2009) argue that "an analytically meaningful assessment of evolutionary policy approaches has to go beyond the objective and means dimensions and should be placed in a broader "problem - objective - means – constraints" framework" (p670), involving four dimensions of why? what? how? and what not. This four dimension approach effectively invokes an "implementation" problem as in Peters (2000). "That is, when an instrument is selected to achieve a particular public purpose, what implementation problems are presented?" (Peters, 2000, p41). While it has always been the case that policy instruments have to be implemented to achieve policy objectives, recent studies such as Peters (2000) and Nill and Kemp (2009) make policy implementations explicit. This is particularly valuable for assessing the effectiveness of policy instruments, because "discussions about the relative merits of policy instruments are often conducted as if they were self-implementing and administration was irrelevant to their success or failure" (Peters, 2000, p36). The additional two dimensions of "problem – constraints" in Nill and Kemp (2009) can be fittingly considered to be the implementation problem in Peters (2000); their what? and what not? are in fact one dimension as well. Therefore, this study is carried out with a three-dimension framework for policy objectives, policy instruments and policy implementations.

Policy instruments are the carrier of policy. "The choice of policy instruments constitutes a part of the formulation of the policy, and the instruments themselves form part of the actual implementation of the policy" (Borrás and Edquist, 2013, p1513). Bemelmans-

Videc *et al.* (1998) offer a comprehensive analysis of categories and typologies of policy instruments. It presents examples of studies of the three categories of policy instruments: regulation (sticks), economic means or subsidies (carrots), and information campaigns (sermons) (ibid, pp10-12). Rothwell and Zegveld (1981) classify policy instruments into three types, namely, supply side, environmental side, and demand side instruments. With regard to innovation policy, the typology of Edler *et al.* (2013) distinguishes between supply side instruments and demand side instruments, the former influences innovation generation and the latter influences those requesting, buying or applying innovations (p1). "There is strong theoretical reasoning and empirical evidence that demand is crucial for innovation activities" (Edler, 2013, p2). The EU has stressed the role of demand side measures, policies and measures to foster the market uptake of innovations, in recent years. The Communication on "Europe 2020 Flagship Initiative Innovation Union" highlights that: "The potential of the single market should also be activated through policies that stimulate the demand for innovation, starting with an effective competition policy" (EC, 2010, P15). It points out: "Whereas most previous EU policy initiatives have focused on supply side measures which tried to push innovation, demand side measures give markets a greater role in "pulling" EU innovation by providing market opportunities" (ibid). Demand side innovation policy tools and measures complement supply side innovation policy tools; therefore, effective links between them should be established, maintained and developed. The OECD and the World Bank take the similar stance. "In recent years, OECD countries from Finland to Australia and emerging economies such as China and Brazil have used more targeted demand side innovation policies such as public procurement, regulation, standards, consumer policies and user led innovation initiatives, as well as "lead market" initiatives, to address market and system failures in areas in which social needs are pressing" (OECD, 2011, p9). "This interest in demand side innovation policy has emerged as part of a greater awareness of the importance of feedback linkages between supply and demand in the

innovation process" (ibid). Given such policy initiatives by leading international organizations, we adopt demand side, supply side, and environmental side policy instruments as the three major policy instrument categories in this paper.

Policy goals are specific and measurable while policy objectives are broad and general. To organize innovation policies into typologies, Edler *et al.* (2013) have reviewed a total of 1402 reference items, including 197 evaluation reports, 584 academic analyses with evaluation evidence, and 621 other documents. They have identified seven major innovation policy goals through synthesizing the key findings and insights in these reports and documents. With specific reference to innovation voucher schemes, there are five stated policy goals in Flanagan *et al.* (2011). Suriñach *et al.* (2011) point out: "It is important to notice, in fact, that the IM (Internal Market) regulations designed by the European Commission are generally aimed at achieving specific goals which usually abstract from the direct objective of fostering innovation adoption or creation" (p99). There is the vast literature on diffusion of technology, innovation and/or R&D, and Suriñach *et al.* (2009) provide a comprehensive review of the diffusion/adoption literature, as well as empirical evidence. They reveal that: "Generation of innovation would be mainly driven by some sectors and then adopted in other sectors" (ibid, p44). Pierce and Delbecq (1977) define "innovation is a process including three stages: generation, acceptance, and implementation" (p29). Synthesizing the above objective of fostering innovation adoption or creation with the diffusion literature and the stages conjecture of innovation, (fostering) generation of innovation, diffusion of innovation, and adoption of innovation are adopted as the three broad innovation policy objectives in this study, into which specific policy goals are categorized.

It is revealed that, given the complexity in policy implementation and the need for reducing ambiguity and conflict in policy implementation, the institutional and policy characteristics have been considered to be paramount in theory and practice, with which we

examine policy implementation in this study. Policy implementation "is what develops between the establishment of an apparent intention on the part of government to do something, or to stop doing something, and the ultimate impact in the world of action" (O'Toole, 2000, p264). "Policy implementation as a field of scholarly inquiry and practical recognition has come and gone like an elusive sprit" (deLeon and deLeon, 2002, p467), because "it was either too difficult to study or, conversely, too simple" (ibid, p469). Thus, the implementation issue or dimension is either circumvented – being too difficult, or ignored – being too simple, in much of actual policy research. deLeon and deLeon (2002) examine three generations of policy implementation theory research. The first generation of implementation studies usually consisted of case study analyses that considered the immense vale of troubles that lay between the definition of a policy and its execution (ibid, 469). The second generation "… assumed a command and control orientation, … known as a top-down perspective", … and "an alternative approach … claimed to be bottom-up orientation" (ibid, p470). Top-down and bottom-up models are mostly recognized but have met much criticisms; now they have rarely been adopted in practice and only mentioned as a theory in textbook materials. The third generation "sought to explain 'why behavior varies across time, across policies, and across units of government and by predicting the type of implementation behavior that is likely to occur in the future'" (ibid, p471). Contingency theories are typical of the third generation of implementation research. Matland (1995) has proposed a kind of contingency model with two dimensions of ambiguity and conflict. "Four implementation perspectives are developed in the ambiguity/conflict model, based on a policy's ambiguity and conflict level" (ibid, p155). His model draws extensively on the work of organizational theorists and decision-making scholars, along the line of Sorg (1983) who has recognized "the contributions of institutional and policy characteristics to the success, failure, or modification of policies" (p391). Developing further the two by two general typology of Sorg (1983) for policy implementation, Matland (1995) exhibits the four

implementation processes or perspectives in the four cells in the conflict-ambiguity matrix. The first is named "administrative implementation" with low policy ambiguity and low policy conflict. "The central principle in administrative implementation is outcomes are determined by resources" (ibid, p160). The second is "political implementation" with low policy ambiguity and high policy conflict. "The central principle in political implementation is that implementation outcomes are decided by power" (ibid, p163). The third is "experimental implementation" with high policy ambiguity and low policy conflict. "The central principle driving this type of implementation is that contextual conditions dominate the process" (ibid, pp165-166). Lastly, there is "symbolic implementation" where both levels of policy ambiguity and policy conflict are high. "The central principle is that local level coalition strength determines the outcome" (ibid, p168). Reviewing the OECD science policy-making model, Henriques and Larédoc (2013) suggest that "OECD science policy reviews in the 1960s addressed the issue of how, with whom and in which format policy-making in S&T policy should be implemented by national governments to favour knowledge production and exploitation linked to economic growth" (p804). They stress that the OECD model "is centred on the creation of structures, actors and functions that enable the policy cycle to deploy in the field" (ibid). Thus, the institutional and policy characteristics have been considered to be paramount. At national level, these are translated into the authorities of policy issuers and the degrees of enforcement, with which we examine policy implementation in this study.

3. Research design, samples and variables

Our sample covers the period between 1990 and 2013. There are 339 policy items for China, issued by the People's Congress of China and its Standing Committee, the legislature; the State Council, the executive; the Ministry of Science and Technology, the Ministry of Commerce, the Ministry of Finance, the Ministry of Education and other ministries that

form the State Council; and non-cabinet departments and agencies. There are 79 policy items for Russia, issued by the Federal Assembly of the Russian Federation (Federation Council and State Duma), the legislature; the Russian Government, the executive; the Ministry of Education and Science, the Ministry of Energy, the Ministry of Economic Development, the Ministry of Finance, the Ministry of Industry and Trade and other cabinet and non-cabinet departments and agencies.

The policy variables describe policies in three dimensions of policy instruments, policy objectives/goals and policy implementation. Table 1 lists these policy variables with their narratives. The demand side policy instruments include three elements: public procurement, industry-HE institution-R&D institution collaboration, and international collaboration. There are four items included in the supply side: support for medium and small enterprises (MSEs) and small and micro enterprises (SMEs), fiscal support and subsidies, financial support, and human resources. The environmental side instruments consist of six items: administrative support, infrastructure support, information support, enhancement in intellectual property protection, tax incentives, and standards setting. With regard to policy objectives, there is one policy goal of S&T development for the innovation generation objective. There are two policy goals of technological transformation and technical exports for the diffusion objective. The adoption objective includes two goals: technical absorption and technical imports. On the policy implementation dimension, institutional characteristics are featured by legislature, executive, ministry and bureau or agency. The legislature is the National People's Congress of China and its Standing Committee, and Federal Assembly of the Russian Federation (Federation Council and State Duma); the executive is the State Council of China and the Russian Government; ministries are departments that form the executive; bureaus or agencies are non-cabinet government departments. Policy characteristics are reflected by the degrees of enforcement in two variables: whether it is a law and whether it is jointly issued by more than one entity.

{Table 1 about here}

The coding of the policies and their representative variables is as follows. Dummy variables are adopted for all policy instruments and policy goals. For example, the public procurement variable is 1 when a policy instrument is concerned with public procurement, 0 otherwise; the technological transformation variable is 1 when a policy instrument addresses technological transformation, 0 otherwise. For institutions, legislature, executive, ministry and bureau are coded as dummy variables; the legislature variable is 1 when the policy is issued by the legislature, 0 otherwise; the same coding is adopted for the executive, ministry and bureau variables. For policy characteristics, the value of the variable of joint issues is 1 when the policy is jointly issued by more than one entity, 0 when it is issued by one entity; the law variable takes the value of 1 when a policy is issued by the legislature and passed as law, 0 otherwise. Policy instruments are not mutually exclusive; e.g., a policy item for financial support can, at the same time, be on infrastructure support within the supply side. A policy item can also contain two or more instruments on different sides; e.g., a policy item for infrastructure on the supply side can also involve administrative support on the environmental side. The sum of such percentages, where the denominator is the number of total policies, can therefore be over 100 percent and each percentage figure can be overstated. Therefore, adjusted percentages are provided where the denominator is the number of total instruments, producing the sum of adjusted percentages that is 100 percent. Similarly, a policy item can be issued to achieve more than one goal; it can also be issued by more than one entity. Accordingly, adjusted percentages that sum to 100 percent are likewise provided for policy goals and policy implementation. Since every policy item has three dimensions, it must take the value of 1 in at least three dummy variables, e.g., it is a supply side instrument of financial support, its policy goal is technical transformation and it

is issued by the executive. In addition, a policy item is reflected by a non-dummy, the number of entities involved in the issue of the policy.

4. Mapping and comparing countries in instruments, goals and implementation

This section maps and compares the two countries in STI policy instruments, goals and implementation. It attempts to differentiate Russia from China in their choice of policy instruments, their devotion to policy goals and their approaches to policy implementation. To this end, state (Russia and China) is the dependent variable, and policy variables of policy instruments, goals and implementation are the independent variables or determinants. A statistical summary of policy variables is presented in the next sub-section, prior to formal estimation and analysis that follows.

4.1. Overview

Table 2 reports the summary statistics of the variables for both China and Russia. The first column under each country is the number of policies in each category, the second column is the percentage of the policy instrument, the policy goal or the type of issuer in that category, except average number of joint issuers, and the third column is the adjusted percentage.

In terms of distributions of policy instruments, both Russia and China valued the importance of environmental side instruments and supply side instruments were used predominantly relative to demand side instruments. Transitioned from planning economies, fiscal support and subsidies were heavily exercised in both countries. Being the first planning economy who endured the longest period of the planning system in the world, Russia resorted to fiscal support and subsidies more than China; over 30 percent policy instruments were for fiscal support and subsidies in Russia, while the figure for China was 18 percent. The human resources instrument accounted for approximately 13 percent of policy instruments in both countries. For environmental building, Russia paid attention to

infrastructure and administrative support while China resorted to administrative and tax incentives measures. These features also reflected their respective historical heritages as the paramount investment driven planning economy and the oldest bureaucrat in the world.

China and Russia differed in policy implementation. On the institution side, the degree of authority in Russia was higher than China. Policies were issued predominantly by ministries and bureaus, the former accounting for nearly 70 percent of total policies. The share of ministries in policy issuance was the largest, accounting for nearly 58 percent, followed by a share of over 32 percent for bureaus. The legislature's share in policy issuance was less than 2 percent and that of the cabinet accounted for around 8 percent. In contrast in Russia, the legislature, executive and cabinet ministries issued comparable numbers of policies and their shares in policy issuance were also comparable. The legislature had a quarter of share in policy issuance, while the executive and ministries took approximately a one third share each. Unlike China, non-cabinet bureaus or agencies played little role in policy issuance. On the policy characteristics side, the degree of enforcement in Russia was higher than that in China, i.e., much more policies were laws in Russia than in China. In contrast, China resorted to joint issues to strengthen policy enforcement. There were 109 policies that were jointly issued by two or more entities in China, accounting for nearly one third of total policies issued, while six policies were jointly issued in Russia, accounting for less than 8 percent of total policies. The average number of government entities involved in joint issues of policies was 1.61 in China, while the average number of government entities involved in joint issues of policies was as low as 1.13 in Russia.

{Table 2 about here}

Both China and Russia paid great attention to S&T development for the fulfilment of the objective of innovation generation, accounting for half of all policy goals. Transitioned

from the planning economy and system, fundamental research traditionally enjoyed higher priorities, being dominated by the state sector. In contrast, technical diffusion and adoption of innovation were regarded less important, at least from the point of view of policy formation. These objectives were largely left for enterprises and R&D establishments to achieve for themselves. Nonetheless, both countries were keen on the commercialization of military technologies - transforming military technologies for commercial utilization to generate earnings. As such, technical transformation accounted for around 27 percent among all policy goals in the two countries.

4.2. Results, analysis and discussion

Binary logistic regression is adopted for empirical estimation in this study, given the property of the data. Estimation and analysis are conducted in three parts or dimensions of policy instruments, policy goals and policy implementation. Table 3, Table 4 and Table 5 report the estimation results for the three dimensions respectively. China is coded 1 and Russia 0. Therefore, a significantly positive coefficient estimate indicates that China was in favor of the instrument, goal, institution or characteristic associated with the coefficient. With a logarithmic operation involved, the exponential of the coefficient that is always positive is also reported, which has more straightforward quantitative meanings. e.g., a figure of 2 for an exponential coefficient indicates that China is twice likely to issue that type of policy instrument than Russia, or set a particular policy goal, and so on; while an exponential coefficient of 0.5 indicates that Russia is twice likely to be the case than China.

Instruments

China and Russia differed significantly in the issuances of policy instruments of infrastructure support, tax incentives, administrative support, and industry-HE institution-R&D institution collaboration, revealed by the results in Table 3. Russia was 5 times (5.319

= 1/0.188) more likely to adopt a policy instrument for infrastructure support, with the corresponding coefficient being highly negatively significant at the 1 percent level. On the other hand, China was over twice more likely than Russia to adopt policy instruments for administrative support (2.409) and financial support (2.436); and 3 times more likely to adopt policy instruments for industry-HE institution-R&D institution collaboration (3.049) and tax incentives (2.979), all at the 5 percent level of significance. There are no significant differences in the adoption of the rest of policy instruments. That being said, Russia was more inclined to implement policy instruments for fiscal support and supporting medium, small and micro firms; whereas China showed more interest in international collaboration and public procurement.

{Table 3 about here}

Goals

Table 4 shows the differences and similarities between the two countries in policy goals. Relatively less developed, China was 3 times more likely to implement policies aiming at technical import (3.320) than Russia, with the coefficient being positively significant at the 5 percent level. China was more commercialized and keener on the commercialization of military technologies than Russia – transforming military technologies for commercial utilization to generate earnings. As such, China was nearly 2 times more likely to implement policies for promoting technical transformation (1.766) than Russia, with a positive coefficient modestly significant at the 10 percent level. In contrast, Russia was twice more likely to issue policies to promote and encourage the absorption of new techniques (2.023 = 1/0.492) than China. Russia and China did not differ significantly in policy goals for S&T development and technical export.

{Table 4 about here}

Implementation

Policies issued by the legislature in Russia and China are passed as laws, so the law dummy is excluded from estimation here. The most striking difference in policy implementation between the two countries is the involvement of legislature, highlighted in Table 5. As previously noted in sub-section 4.1, only a tiny portion of policies were issued by the People's Congress of China or its Standing Committee, while a quarter of policies were issued by the Federal Assembly of the Russian Federation (Federation Council and State Duma) as law. Consequently, Russia was 13 times more like to implement policies by the legislature (12.821 = 1/0.078) than China. There was the tendency for the cabinet, the highest executive organ, to issue policies in Russia compared with China; and there were also the tendencies for ministries and non-cabinet bureaus, the low level executive and administrative organs, to issue policies in China compared with Russia. China had a striking habitat to issue a policy jointly by several government entities, as many as 12 on occasions. With the average number of issuers being 1.71, China was twice more likely to adopt the practice of joint issues (2.215) than Russia, to fortify the authority of issuers and strengthen policy enforcement.

5. Conclusion

In this paper we have studied STI policy of Russia and China in a three-dimension framework for policy instruments, policy goals and policy implementation. Adopting logistic regression for empirical estimation, 418 STI policies between Russia and China have been modelled with 25 policy variables and scrutinized vis-à-vis the three policy dimensions. The differences and similarities in STI policy instruments, goals and implementation have been analyzed, compared and contrasted. The empirical work carried

out in this study has differentiated Russia from China in their choice of policy instruments, their devotion to policy objectives and their approaches to policy implementation.

It has been observed that China and Russia differed significantly in their choice of five policy instruments and the two countries share similarities in the rest eight policy instruments. Russia was very much more likely to adopt a policy instrument for infrastructure support. On the other hand, China was more likely than Russia to adopt policy instruments for administrative support, financial support, industry-HE institution-R&D institution collaboration and tax incentives. Nonetheless, Russia was more inclined to implement policy instruments for fiscal support and support for medium, small and micro firms; whereas China showed more interest in international collaboration and public procurement. Transitioned from planning economies, fiscal support and subsidies were heavily exercised in both countries. However, Russia was the first planning economy who endured the longest period of the planning system in the world. As such, Russia resorted to fiscal support and subsidies more than China. The features in the choice and issuances of policy instruments also reflected the two countries' respective historical heritages as the paramount investment driven planning economy and the oldest bureaucrat in the world.

Both China and Russia paid great attention to S&T development for innovation generation. Nevertheless, the two countries did not differ significantly in the policy goal for S&T development, because both of them were very keen and invested heavily in this field. In the last few decades, China was a learner, less developed compared with Russia. Therefore, China took more measures for technical import than Russia. China was more commercialized and keener on the commercialization of military technologies and was more likely to implement policies for promoting technical transformation than Russia. In contrast, Russia was more likely to issue policies to promote and encourage the absorption of new techniques than China.

Russia and China differed starkly in the involvement of legislature in policy implementation. Only a tiny portion of policies were issued by the People's Congress of China or its Standing Committee, while a quarter of policies were issued by the Federal Assembly of the Russian Federation, Federation Council and State Duma as law. Consequently, Russia was unambiguously more like to implement policies by the legislature than China. Policies in the form of administrative regulations tended to be issued the cabinet, the highest executive organ, in Russia; they tended to be issued by ministries and non-cabinet bureaus, the low level executive and administrative organs, in China. China had a striking habitat to issue a policy jointly by several government entities and was more likely to adopt the practice of joint issues than Russia, to fortify the authority of issuers and strengthen policy enforcement, which may incur conflicts between departments/agencies.

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Tables

Table 1. Policy variables and their narratives

	Type	Name	Narrative
Policy instruments	Demand-side	Public procurement	Regular and strategic public procurement, shaping innovation directly and indirectly
		Industry-HE institution-R&D institution collaboration	Collaboration between industry, HE institution and R&D institution, promoting commercialization of R&D products
		International collaboration	International collaboration and exchange programs, boosting R&D capabilities
	Supply-side	Support for MSEs and SMEs	Technological training and consultancy for MSEs and SMEs, improving technological infrastructure in MSEs and SMEs
		Fiscal support and subsidies	Funding and subsidies for R&D, depreciation subsidies
		Financial support	More funding channels, loans on favorable terms, insurance and support for risk control
		Human resources	Education and training, favored remuneration, welfare and bonus to attract and reward the talented domestically and overseas
	Environmental	Administrative support	Streamlining procedures for approvals, easing restrictions on quotas and licensing, planning, organization, control and supervision of R&D activities
		Infrastructure support	Provision of public infrastructure and facilities in the field, including the internet, libraries and databases for information sharing
		Information support	Information provision and sharing including networking, libraries and databases
		Enhancement in intellectual property protection	Legislation and regulation for intellectual property protection, provision of legal services
		Standards setting	Standardization, facilitating diffusion of innovations and market entry
		Tax incentives	Tax exemption, tax reduction and other incentives
Policy objectives	Generation	S&T development	R&D development, product development and design
	Diffusion	Technical transformation	Application and promotion of new scientific and technological achievements, technicalization and commercialization of R&D
		Technical exports	Exports of advanced technologies to foreign territories
	Adoption	Technical absorption	Encouragement and promotion of absorption of new techniques
		Technical imports	Imports of advanced technologies from foreign territories
Policy implementation	Institutional characteristics	Legislature	National People's Congress of China and its Standing Committee, Federal Assembly of the Russian Federation (Federation Council and State Duma)
		Executive	State Council of China, Russian Government
		Ministry	Constituents of, the state executive, or cabinet ministries/departments
		Bureau or agency	Non-cabinet departments
		Joint issue	Number of departments who jointly issued the policy
	Policy characteristics	Degree of enforcement	Law or not

Table 2. Summary statistics of policy variables

	Type	Name	China			Russia		
			No	%	adj %	No	%	adj %
Policy instruments	Demand-side	Public procurement	17	5.01	2.19	1	1.27	0.63
		Industry-HE institution-R&D institution collaboration	42	12.39	5.40	5	6.33	3.13
		International collaboration	47	13.86	6.04	8	10.13	5.00
	Supply-side	Support for MSEs and SMEs	44	12.98	5.66	10	12.66	6.25
		Fiscal support and subsidies	143	42.18	18.38	49	62.03	30.63
		Financial support	66	19.47	8.48	9	11.39	5.63
		Human resources	99	29.20	12.72	22	27.85	13.75
	Environmental	Administrative support	98	28.91	12.60	13	16.46	8.13
		Infrastructure support	28	8.26	3.60	19	24.05	11.88
		Information support	48	14.16	6.17	6	7.59	3.75
		Enhancement in intellectual property protection	48	14.16	6.17	8	10.13	5.00
		Standards setting	22	6.49	2.83	2	2.53	1.25
		Tax incentives	76	22.42	9.77	8	10.13	5.00
Policy objectives	Generation	S&T development	253	74.63	48.28	58	73.42	54.21
	Diffusion	Technical transformation	142	41.89	27.10	28	35.44	26.17
		Technical exports	29	8.55	5.53	4	5.06	3.74
	Adoption	Technical absorption	39	11.50	7.44	10	12.66	9.35
		Technical imports	61	17.99	11.64	7	8.86	6.54
Policy implementation	Institutional characteristics	Legislature	8	2.36	1.97	20	25.32	24.69
		Executive	33	9.79	8.11	27	34.18	33.33
		Ministry	235	69.32	57.74	29	36.71	35.80
		Bureau or agency	131	38.64	32.19	5	6.33	6.17
		Joint issue	109	32.15	32.15	6	7.59	7.59
		Joint issue (average No of issuers)		1.71	1.71		1.13	1.13
	Policy characteristics	Law	8	2.36	2.36	19	24.05	24.05

Table 3. Mapping in policy instruments

	Coef	Std Err	*t*-stat	Sig	Exp(Coef)
Information	.681	.532	1.280	.200	1.975
MSM	-.622	.459	1.355	.176	.537
Fiscal	-.467	.319	1.464	.143	.627
Infrastructure	-1.672***	.402	4.159	.000	.188
Financial	.890**	.450	1.978	.048	2.436
Tax	1.092**	.438	2.493	.013	2.979
HR	.362	.324	1.117	.264	1.437
Standard	.645	.796	0.810	.417	1.906
Admin	.879**	.397	2.214	.027	2.409
IPP	.124	.463	0.268	.789	1.132
Procurement	1.687	1.143	1.476	.140	5.402
IndCo	1.116**	.569	1.961	.050	3.052
IntCo	.479	.456	1.050	.294	1.615
Constant	1.115***	.323	3.452	.001	3.049

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Notes to variable abbreviations:
Information = Information support, MSM = Support for medium, small and micro firms, Fiscal = Fiscal support, Infrastructure = Infrastructure support, Financial = Financial support, Tax = Tax incentives, HR = Human resource support, Standard = Standard setting, Admin = Administrative support, IPP = Intellectual property protection, Procurement = Public procurement, IndCo = Industry-HE institution-R&D institution collaboration, IntCo = International collaboration

Table 4. Mapping in policy goals

	Coef	Std Err	*t*-stat	Sig	Exp(Coef)
S&T Dev	.564	.344	1.640	.101	1.758
TechXp	.511	.592	0.863	.389	1.667
TechIm	1.165**	.474	2.458	.014	3.206
Absorption	-.709*	.428	-1.657	.098	.492
Transformation	.569*	.304	1.872	.062	1.766
Constant	.720**	.361	1.994	.046	2.053

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Notes to variable abbreviations:
S&T Dev = S&T development, TechXp = Technical export, TechIm = Technical import, Absorption = Technical absorption, Transformation = Technical transformation

Table 5. Mapping in policy implementation

	Coef	Std Err	*t*-stat	Sig	Exp(Coef)
Legislative	-2.557**	1.039	-2.461	.014	.078
Executive	-1.471	.957	-1.537	.124	.230
Ministry	.066	.960	0.069	.945	1.068
Bureau/Agency	1.341	.836	1.604	.109	3.822
Joint Issue	.795	.550	1.445	.148	2.215
Constant	1.609**	.940	1.712	.087	4.996

* significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.