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Executive Summary

Tasking

With the goal of better understanding how different countries implement innovation policies, the Office of the Director of National Intelligence asked the Institute for Defense Analyses (IDA) to examine the industrial and innovation policies of South Korea, Russia, and Brazil. A team of IDA researchers reviewed the literature and interviewed experts to provide an overview of the political, economic, demographic, and other factors that are brought to bear on each country's industrial and innovation policies, relative to other countries.

This report documents the outcome of this examination for Russia. It examines the

- Drivers behind Russia's innovation goals;
- Mechanisms Russia uses to execute its innovation policies aimed at achieving those goals;
- Trends that indicate the effectiveness of the mechanisms/policies;
- Socio-cultural characteristics that could affect success or failure;
- Primary partners in Russia's innovation activities;
- Implications of Russia's innovation policies for the United States, particularly U.S. national security; and
- Future vision relative to how changes in innovation policies translate to threats and opportunities for U.S. national security, innovation, and economy.

Russia's National Innovation System

By most generally accepted indicators, Russia's potential for science and technology-based innovation appears to be higher than that of other countries with similar levels of gross domestic product per capita. The country has a well-developed education system, particularly in science, technology, engineering, and mathematics fields, and proportionally graduates more scientists and engineers than most Organisation for Economic Co-operation and Development (OECD) countries (on par with Sweden and Finland). Russia also spends more on research and development (R&D) than most

emerging economies.[1] However, innovation indicators show a large imbalance between the input to knowledge creation processes (public resources) and the output of innovation. Closing this gap is one of the major challenges for Russian innovation policy; a second challenge is increasing the private sector's involvement in R&D, which is currently quite limited.

Government's Role in Innovation

Russia's abundant natural resources have made it a wealthy nation, but have also resulted in uncompetitive policy choices and elevated domestic costs, which impede development outside the resource-based economy. The ability of the Russian government to develop an innovation-based economy is hampered by the Soviet-era legacy of top-down control, along with corruption and excessive bureaucracy, which have dissuaded the growth of a culture of business and entrepreneurship.

The diminished strengths of the Soviet system—high standards in science and technology education and a formerly competitive defense industry—over the past two decades have resulted in the emigration of large numbers of scientists and engineers and a significant loss of human capital. In contrast to what is observed in OECD countries, the government is the primary funder of R&D in Russia; government and government-owned businesses account for up to an estimated 98 percent of funding for science by some estimates (including state-funded businesses).

Despite research cutbacks in the 1990s, Russia spends more on research than many emerging economies; however, the bulk of this spending goes to public research institutions that have little connection to universities and business. Academic research is not well integrated with industry or with international research networks, and lags in outputs, particularly publications. The government's policies to foster a Western model of innovation have spurred the development of special economic zones, incubators, and technoparks designed to enhance public-private partnerships.

Industry's Role in Innovation

Most industry in Russia remains in large, state-owned enterprises that are extraction-based and focus on natural resources. Receiving preferential treatment from the government, these companies stifle innovation-inducing competition. Manufacturing, particularly manufacturing of high-technology products, is low compared to Brazil, India, and China and declining, which signals a move towards growth fueled by redistribution of resources rather than creation of value.

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[1] For comparison, Russia's R&D intensity is 1.24 (2009); Brazil's is 1.16 (2008); India's is 0.76 (2007); China's is 1.70 (2009); and South Korea's is 3.36 (2008) (NSB 2013, appendix table 4-43).

Russia does not have a tradition of private property ownership or commercialization of innovations. Consequently, by most measures, the capacity and sophistication of the civilian commercial sector (as distinct from the defense sector) is not conducive to innovation. Weak intellectual property rights (IPR) protection and poor research-industry linkages have left the bulk of Russian firms geared towards innovation by imitation rather than commercialization of new products, and the current innovation policies have had little effect. Recent policies that facilitate knowledge absorption and diffusion of knowledge (critical for imitative strategies) are geared towards technoparks and business incubators, and have not benefitted the economy as a whole.

An exception is the information technology sector, which stands out as an example of growth in innovation despite the ground conditions, engendering venture capital networks and allowing innovation to occur outside the control of the government.

A large pool of scientists and engineers (a legacy of the Soviet-era education system), in conjunction with a fast growing and demanding middle class, is bringing increasing foreign investment in high-technology products. Foreign direct investment and collaborations with Boeing, General Electric, IBM, General Motors, and others have created new market-driven mechanisms. Further, Russia's recent entry into the World Trade Organization is anticipated to improve the business climate.

Summary and Conclusion

By most commonly accepted indicators, Russia is lacking in drivers for innovation (sophistication of the commercial sector, competition, customer demand), mechanisms for innovation (research-industry linkages, avenues for commercialization of R&D outputs) and the framework conditions that can enable and foster innovation (effective governance and rule of law, support for business and entrepreneurship, and trade and intellectual property laws), where Russia most lags behind other countries. Government rules and regulations raise the cost of doing business in Russia relative to peer countries. Consequently, the domestic sector's involvement in innovative activities is lower than in the OECD countries and has not improved over the past decade. Only one in ten businesses invests in R&D and innovation.

Corruption and lack of transparency thwart the intent of government action, making it difficult to gauge the true impact of planned policies. Recent government policies have attempted to create a business-friendly environment by mandating special economic zones around technoparks and business incubators; however, without linkages to the production economy and better enforcement of IPR, the impact of these policies on the economy at large may be minimal. Emerging areas such as nanotechnology and biotechnology, where the Russian government has recently made large investments, may suffer from the absence of links to the private sector and other avenues for commercialization.

An underdeveloped financial sector and limited access to capital hinders industrial innovation; however, improving regulations and the presence of foreign companies have contributed to the recent growth of the banking industry. With the exception of the information technology sector, venture funding in Russia is largely public and still nascent, despite some growth in areas such as nanotechnology, biotechnology, information technology (IT), and telecommunications.

Russia's traditional strengths in state-supported nuclear, aerospace, and electronic technology sectors have diminished as a result of the large-scale emigration of engineers and scientists. On the other hand Russia is a growing destination for foreign investment, and multi-national corporations in aerospace, automotive, and other technology-intensive sectors are leveraging existing technical expertise by setting up research centers and other collaborative ventures. This trend is substantiated by a steady increase in patent filings by nonresidents in the past decade. A fast-growing middle class is expected to bring increasing competition and growth in the consumer-driven economy.

IDA's analysis shows that commercialization of R&D output in the civilian sector is one of the weakest aspects of Russia's national innovation system. Russia's rate of patent applications by residents is above the OECD average (on par with the United Kingdom and France), while industry participation in R&D-intensive innovation activities (as opposed to innovation by technology adoption or imitation) is lower than all OECD economies, suggesting that the country's substantial R&D investments are not being realized to the benefit of the civilian economy. A major barrier is weak enforcement of IPR. Recent innovation policies have had little to no impact on closing this gap.

On the other hand, a knowledge-intensive and nonproduction-driven sector like information technology is able to draw upon the technological expertise of the Russian workforce and thrive at the margins of the bureaucracy. IT has grown rapidly into an innovative sector in Russia with increasing share in the global market, despite the ground conditions that inhibit other areas of the economy. For future sectors that are built on an underlying IT platform, Russia might be well poised for successful participation.

Underlying both successes and nonsuccesses in innovation is the role of governance and culture. Where firms are hindered by excessive bureaucracy, corruption and weak framework conditions, innovation is marginalized. A slow but increasing influx of foreign direct investment in knowledge-intensive industries may succeed in capitalizing on Russia's science and technology strengths and increase Russia's capacity for innovation, if the firms are able to adapt to the conditions on the ground.

The following table summarizes the strengths and weaknesses of Russia's national innovation system and the opportunities and threats that are of potential relevance to U.S. interests.

Strengths, Weaknesses, Opportunities, and Threats of Russia's Innovation System

Strengths	Weaknesses
• Plentiful natural resources widely distributed through country • Highly educated population with strong education system for science and technology • Balanced national budget with funds available for innovation projects • Federal government commitment to innovation and strong federal investment in innovation budgeted • Strong presence in select innovation sectors such as space and energy technology • Increasing number of multinational firms establishing R&D and other facilities	• Corruption and excessive bureaucracy pervasive • Lack of political and judicial transparency deters business and investment climate • Weak enforcement of intellectual property rights • Business sector lacks capacity and sophistication needed for technological innovation • Economy suffers from "resource curse" (excessive reliance on natural resources at the expense of developing the nonresource economy) • Inefficient state-owned enterprises dominate economy and hinder innovation • Economy dominated by oil and natural gas exports • Low levels of private investment in R&D and marketing; low demand for innovation products; lack of entrepreneurial culture in business and education; lack of domestic competition
Opportunities	**Threats**
• Expanding global need for science and engineering services offer growth markets for R&D firms • Strong institutions in technology research and education offer good candidates for collaboration with domestic and foreign firms • Collaborations with Russian and foreign organizations offer the transfer of more knowledge into the country • Participation in the digital economy presents opportunities for innovation-driven economic growth	• Outside opportunities for highly skilled Russians causing high emigration for the best workers • Growing competition for key energy markets such as Europe • An ageing population will drain economy and limit technical skills of engineers and scientists • Those with control of R&D, including the national academies, are reluctant to give up power and embrace needed reforms • Lack of competition and state control of R&D drives innovation in wrong directions • Growing competition in global marketing of innovations from foreign countries

Contents

1. Introduction

A. Tasking

Industrial and innovation policies are designed to give a country a competitive advantage in a particular industry or sector. Some countries have made significant leaps in industrialization and technological advancement in the last two decades by strategically combining sustained investments in research and development, infrastructure, and human capital along with policy frameworks that support nascent industries through tax breaks, export support, and access to capital and markets. Others follow a less rapid and more organic path to industrial growth. In all cases, socio-economic, cultural, and political factors influence how effectively a country is able to capitalize on its natural advantages, be it supply of raw material, large population, or market size.

With a goal of better understanding how different countries implement innovation policies, the Office of the Director of National Intelligence asked the Institute for Defense Analyses (IDA) to examine the industrial and innovation policies of Russia.

B. Approach

The study addresses the following broad questions:

- What are the emerging trends in Russia's innovation system?
- What are the challenges to advancing the innovation system?
- What are the possible transformative innovation events?

To answer these questions, a team of IDA researchers reviewed the literature and interviewed experts on Russia to develop an overview of the political, economic, demographic, and other factors that are brought to bear on Russia's innovation policy, relative to other countries. The themes addressed in this report are:

- Drivers: What are the factors behind Russia's innovation goals?
- Mechanisms: How is Russia executing its innovation policies?
- Trends: Have any of the mechanisms or policies been effective?
- Socio-cultural influence: Are there socio-cultural characteristics that might accelerate or inhibit Russia's ability to execute its innovation goals?
- Partnerships: Who does Russia view as key partners?

- Future vision: Looking to the future, how do changes in innovation policies translate to threats and opportunities for U.S. national security, innovation, and economy?

From discussions with experts and the literature, the team collected data along the following dimensions:

- Education policies and policies to attract talent
- Focus and level of research and development (R&D) spending, with emphasis on emerging or high-risk technologies
- Quality of civil infrastructure
- Intellectual property rights (IPR), trade policy, and regulations
- Focus on national security

Chapter 2 begins with a discussion of Russia's innovation system following the premise that primary components of a national innovation system are a country's endowments and how government and industry leverage those endowments. Countries like Russia with abundant natural resources benefit from revenues and foreign investment that leverage those resources. Chapter 3 provides an overview of how Russia's history and geography have shaped its innovation trajectory. It also describes the natural resources that are the source of much of the country's economy and wealth.

Chapter 4 introduces the institutions involved with science, technology, and innovation governance through an examination of the current status of Soviet legacy systems in defense innovation and education. Chapter 5 discusses the role of industry in the national innovation system, highlighting recent transnational collaborations and investments. Chapter 6 shows the impacts of government policies on innovation outputs. Chapter 7 examines some factors that are important for Russia's continuing success in innovation and the challenges that lie therein. These findings are examined in the context of how Russia adapts in an ever-changing environment and its effect on innovation. Chapter 8 provides a summary of findings and conclusions, including strengths, weaknesses, opportunities and threats identified as a result of this study

2. Russia's National Innovation System

A. Background

A national innovation system emerges from the belief that a nation's technological capabilities are its primary source of competitive performance and that these capabilities can be built through national action (Nelson 1993). A nation's innovation system is shaped by how the nation leverages its endowments—natural resources, culture, history, geography, and demographics—through policies that create a thriving market-oriented (firm-centric) economy and accelerate the transition of new technologies, processes, and services to the market (Branscomb and Auerswald 2002). The core of a nation's innovation system, then, are its endowments and how government and industry leverage these endowments—the nation's government through policy investments, incentives, and, regulations and industrial firms through strategies, investments, and training.

For this report, we define innovation as the introduction of a new, or improved upon, product, process, model, or service in any field that produces a new advantage or value, and is either widely disseminated into the market, or influences the market such that economies are impacted (OECD 2005). Stone et al. (2008) describe the breadth of the term by pointing to its presence in new or improved products, processes, experiences, or business models, and this definition covers a broad spectrum of business activity. Innovation is often spoken of as an interconnected innovation system because it is not limited to only science and technology but can cross over into many fields, such as business practices, design, and services. By definition, it requires successful transition into the economy.

The concept of a *national* innovation system was proposed in the 1990s by economists such as Freeman (1995), Lundvall (1992), and Nelson (1993). These and other economists attempted to explain the relationship between a nation's investment in science and technology and its economic development. By contrast to an innovation system in general, a national innovation system is made up of primary actors whose relationships and interactions foster innovation within a nation.

B. Elements of a National Innovation System

Figure 1 shows the interconnections between the three primary components of a national innovation system—endowments, government leverage, and industry leverage—and illustrates their influence on each other.

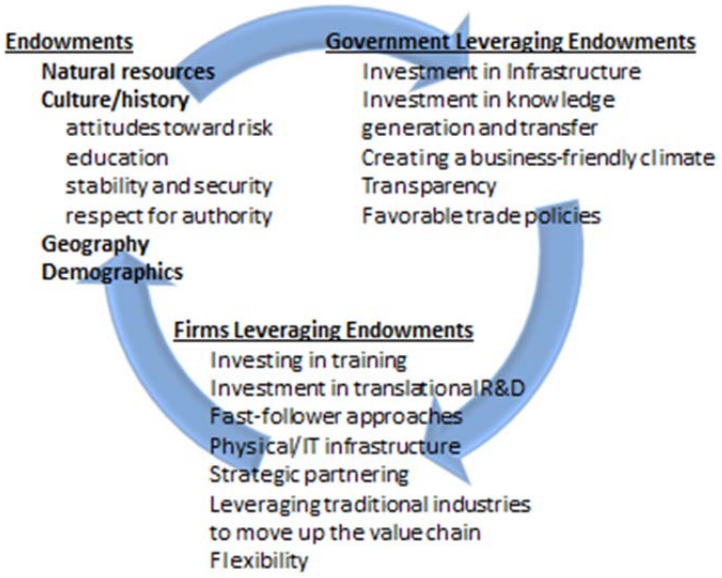

Figure 1. Core Components of a National Innovation System

A national innovation system also encompasses many innovation "pipelines," which are strategies for advancing innovation to industrial output. Such strategies are not necessarily linear. These pipelines aim to create a healthy innovation ecosystem through functional policies that guide primary actors to foster innovation.

National governments may have a range of motives for pursuing innovation. Chief among them is economic development to increase national wealth and prosperity via the creation of new products and services and, in turn, high-paying jobs. Endowments such as a nation's size and natural resources provide comparative advantages and drive conscious decisions to develop and sustain economic strength in certain areas. Russia has relied on its natural oil and gas resources at the expense of developing other sectors, resulting in what is sometimes called a "resource curse."[2]

Differences in endowments change how a government structures its innovation policies. Russia, with its well-educated populace, especially in science and engineering, is creating special economic zones to encourage bottom-up entrepreneurship. It has also set up two new innovation centers to shield foreign investors from corruption and demands of local governments. Innovation is, in large part, driven by external competition, thus putting firms at the forefront of a nation's innovation system.

[2] This resource curse explains the relationship between the increase in exploitation of natural resources and a decline in the manufacturing sector. The increases in revenues from natural resources makes the nation's currency stronger, resulting in exports being more expensive for other countries to buy, thus rendering the manufacturing sector less competitive.

Businesses leverage external resources such as research conducting institutions (universities and laboratories), government investments in education and training, policies and regulation that nurture industrial growth, and networks and partnerships that enable a firm to enhance its value in the supply chain.

C. Russia's Endowments

Russia has natural resources that are widely distributed throughout the country, an educated population with an education system focused on science and technology, and funds available for innovation projects. Russia has a presence in space and energy technology and an increasing number of multinational corporations are establishing R&D and other facilities within its borders. One of the world's biggest suppliers of oil, Russia's economy is highly dependent on its natural resources. This "resource curse" is believed to have inhibited the creation of knowledge-based sectors, unlike countries like Australia, Norway, and Canada, which have done so despite a heavy dependence on natural resource income.

Russia exemplifies the challenges of aspiring for economic security through innovation. Successes in business and innovation are usually achieved by adapting to, and functioning within, the prevailing conditions or circumventing the reach of authority. The following chapters describe government and business leveraging of endowments in Russia.

3. Historical Perspective

A. History and Demographic Composition

For most of its history, Russia has been a diverse and socially volatile country. The 185 ethnic groups[3] that make up the country were united around 1921 by referring to them as "Soviets" and creating an identity that superseded division created by ethnicity, religion, and political ideology. The government recognizes only one official language, Russian, even though there are over 100 minority languages in the various regions.[4] Although the country is considered politically Russian, 20 percent of its population is ethnically non-Russian minorities.

The legacy of a nation's history often establishes the desires and temperament of the nation, setting the tone for what people will tolerate and their expectations from government and the economy. Russia's history as a world power provides context in which to view its current situation and insight into its aspirations for the future. Russia's modern historical roots can be categorized into the seven evolutionary stages shown in Table 1. (See Appendix B for a more detailed timeline.)

With 2.2 percent of the world's population, Russia is the sixth most populous country in the world. As Figure 2 shows, its population is concentrated in the western part of the country. Since 1992, the country's population has been in continual decline, with a net loss of 13 million over the past 19 years (Svetlana 2012). The current population of 141.9 million is expected to continue to drop another 5–10 million by 2025 (Svetlana 2012). Moreover, the population is aging with low life expectancies (Bobrik et al. 2012).[5] Russia is not open to immigration, although the influx of people from Asia and the Middle East is increasing. Gross domestic product (GDP) per capita, a proxy for the standard of living, has steadily increased since the mid-1990s (see Figure 3). Table 2 shows Russia's demographic breakdown, GDP per capita, and labor force strength.

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[3] Nearly 20 percent of the population is ethnically non-Russian minorities. According to the Russian Census of 2002, 3.8 percent are Tatars, 2 percent are Ukrainians, 1.2 percent are Bashkirs, 1.1 percent are Chuvash, and 12.1 percent are unspecified.

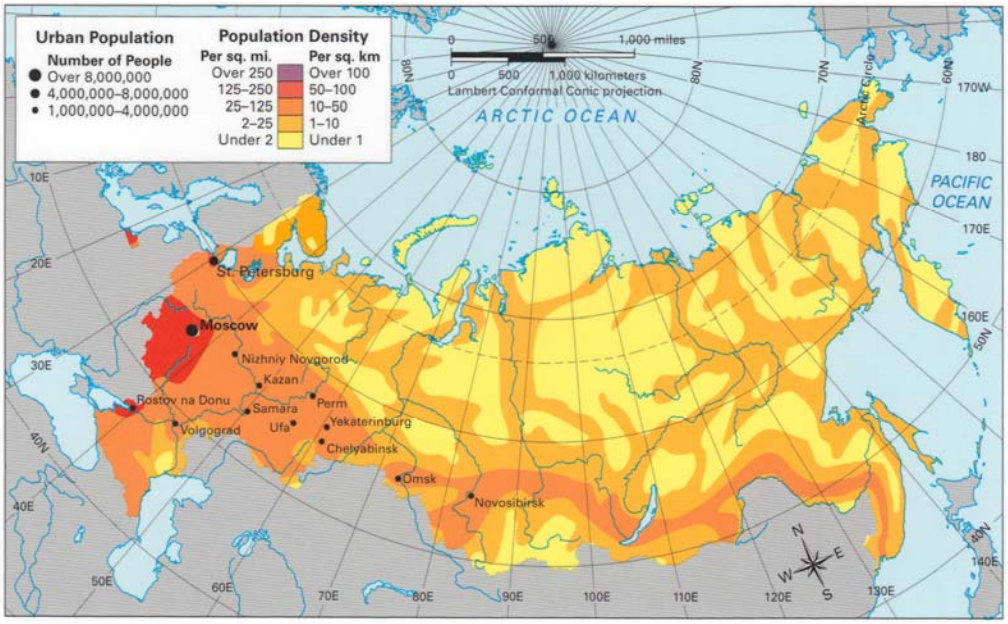
[4] "Russia—Language, Culture, Customs, and Etiquette," Kwintessential, accessed December 5, 2012, http://www.kwintessential.co.uk/resources/global-etiquette/russia-country-profile.html.

[5] See Appendix C for a summary of Russia's economic and social indicators.

Table 1. Russia's Historical Roots, 1861–2010

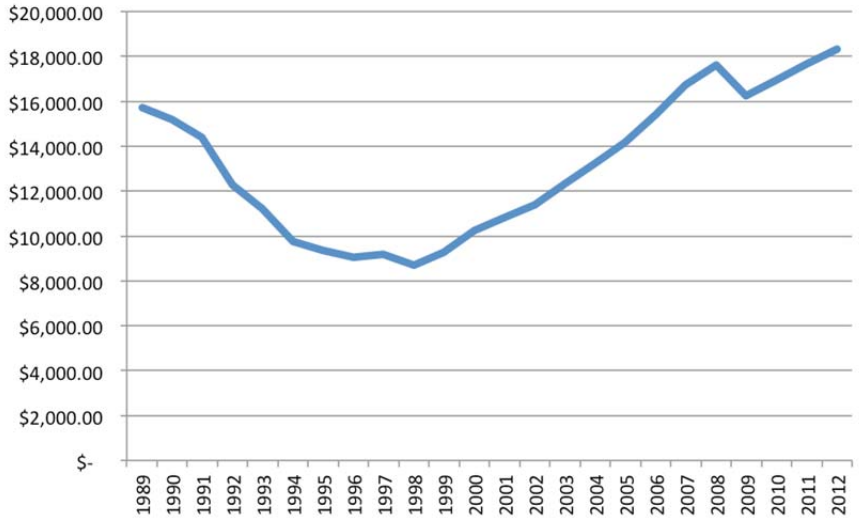
Stage 1	*Introduction as a World Power*. From the reforms of Peter I until the abolition of serfdom in 1861, Russia experienced a transformation that involved a slow adaptation of basic equality and freedom concepts in the feudal system.
Stage 2	*Brewing of Revolution*. The reforms and adaptations implemented following the feudal system were insufficient to alleviate people's frustrations and often failed to meet the needs of peasants and landowners, especially peasants. The efforts to achieve liberty and equality transformed into revolt, making this a short and unstable stage.
Stage 3	*Socialist Revolution of 1917*. The new Soviet regime was established. Though freedom and equality were proclaimed, the declarations more often camouflaged exploitation and totalitarian power (especially under Stalin's regime). The national collectivization of farms deteriorated living conditions in the countryside and drove desperate peasants into the urban areas where they provided cheap labor to fuel the state controlled industrialization. This period ended as the inflexible Soviet system began to collapse in the mid-1980s.
Stage 4	*Implementation of a European-like System*. In 1985, the last Soviet president, Gorbachev, implemented a new system based on a combination of liberalism and high social guarantees from the State. The economic changes were insufficient and the planned Soviet economy could not bear the load that the political and social reforms placed on it. The fragile economy collapsed in the early 1990s.
Stage 5	*Transition to a Market Economy*. This period was characterized by severe socio-economic crisis as political leaders attempted to manage the transition to a market economy. The 1990s were not a time of inequality and pauperization of the population.
Stage 6	*Economic Stabilization*. Not until the early 2000s did the Russian economy become stable and grow, primarily due to high oil prices and cheap ruble. Young scientists and engineers emigrated in search of greater opportunities. This stage may already be finished due to the current world economic crisis.
Stage 7	*Economic Diversification and Innovation*. It is not clear to what extent the Russian economy will be changed by the ongoing world economic downturn. Leaders proclaim policies that they declare will diversify the economy and spur innovation.

Source: Adapted from English translation of Zaichenko (2010).



Source: Kristin Magavero, Boston University School of Education (2012).

Figure 2. Population Distribution in Russia



Source: The Conference Board, Total Economy Database - Output, Labor, and Labor Productivity, 1950–2012, http://www.conference-board.org/data/economydatabase/.

Notes: GDP per Capita, in 2012 EKS$ (converted to 2012 price level with updated 2005 EKS Purchasing Power Parities (PPPs). The GDPEKS series is based on PPPs for 2012, which cover 122 countries in the database, and it is updated with deflators from 2005 PPPs from the World/ICP PPP-round, but with adjustments obtained from Alan Heston (University of Pennsylvania, Penn World Tables).

Figure 3. Growth in GDP per Capita in Russia, 1989–2012

Table 2. Population, Urban Population, and Age Distribution, Russia 2012

Population (9)*	142,500,482 (July 2013 est.)
Urban population	73% of total population (2010)
Major cities (2009 est.)	Moscow (capital) 10.523 million St. Petersburg 4.575 million Novosibirsk 1.397 million Yekaterinburg 1.344 million Nizhniy Novgorod 1.267 million
GDP adjusted for purchasing power parity (PPP)	$2.509 trillion (2012); $2.422 (2011); $2.322 (2010)
GDP real growth rate	3.6% (2012); 4.3% (2011); 4.3% (2010)
GDP per capita adjusted for PPP (71)*	$17,700 (2012); $17,000 (2011); $16,300 (2010)
GDP adjusted for PPP as a percentage of world total**	23.2% of GDP
Median age	38.8 years
Age structure	0–14 years: 15.7% 15–24 years: 12.4% 25–54 years: 45.8% 55–64 years: 13.1% 65 years and over: 13%
Labor force	75.24 million workers (52.8%)
Unemployment rate	6.2%
Population below poverty line	13.1% (2010)
Gini index (51)*	42 (2010)
Household income by percentage share	Lowest 10%: 2.8% Highest 10%: 31.7% (2009 est.)

Source: Central Intelligence Agency (2013), unless noted otherwise.

Note: Unless noted otherwise, estimates are for 2012 (USD2012).

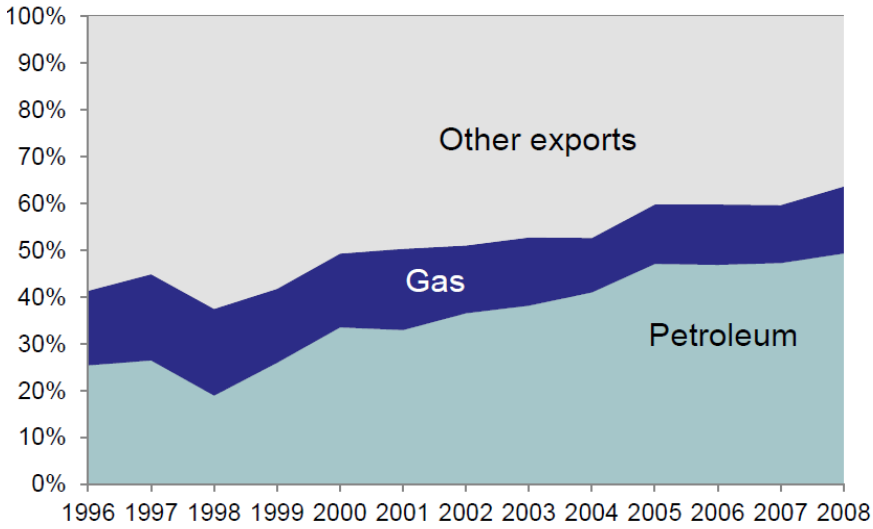
* Number in parentheses is Russia's ranking compared to other countries.

** World Economic Forum (2012).

B. Impact of Natural Resources on Russia's Economic Development

Russia is the largest country in the world in terms of area and has access to three oceans. Despite its size and ocean access, it is unfavorably located in relation to the world's major shipping lanes, and much of the country lacks the proper soils and climates (either too cold or too dry) for agriculture. Russia has the largest known proven natural gas reserves, second largest coal reserves (Zaichenko 2010) and the ninth largest oil reserves on Earth (U.S. Energy Information Administration 2012), which allowed the Russian state-corporation *Rosneft* to grow into the largest oil producer in the world (Unger 2012). Russia's wealth in natural resources is not limited to hydrocarbons; it also controls 8.4 percent of the world's water reserves, 8.1 percent of its arable land, 23 percent of its forest

cover, and more than 30 percent of its fresh lake water. Many of these natural resources are geographically widespread throughout the country, and much of Russia's recent economic success has been based on the exploitation of these resources. Natural gas and oil have been the most significant (see Figure 4), where potential reserve quantities continue to grow as new technology provides access to new deposits.



Source: World Bank (2012).

Figure 4. Oil and Gas Continue to Dominate Russia's Exports

Research suggests that countries endowed with great natural wealth tend to suffer from a resource curse in which they lag behind comparable countries in terms of long-run real GDP growth (OECD 2011). This resource curse explains the relationship between the increase in exploitation of natural resources and a decline in the manufacturing sector. The increase in revenue from natural resources makes the country's currency stronger, resulting in the nation's other exports being more expensive for other countries to buy, thus rendering the manufacturing sector less competitive. Studies of countries (such as Norway, Canada, Australia, and the United States) that have escaped the resource curse suggest strength of institutional structures, high levels of transparency, and long-term planning as factors that predispose a nation to invest wealth generated by natural resources in a way that brings long-term benefits to society (Humphreys, Sachs, and Stiglitz 2007).

Natural resources can be a competitive advantage when used to create value through a knowledge industry. The Soviets developed excellent schools of geology and engineering (Gustafson 2012) and encouraged mapping of natural resources and systematic exploration of the country's mineral base and developed pioneering techniques for exploration and production Today, Russia's oil and gas industries are state owned (*Economist* 2012), and production is highly inefficient compared to a brief time in

the 1990s when the oil companies were privatized and demonstrated more innovative capacity than the large state-owned-enterprises in applying hydraulic fracturing and horizontal drilling techniques (Gustafson 2012).

Russia depends on revenue from its natural resources to balance its budget and fund its state-mandated investment programs and state-funded welfare, pensions, and subsidies. In the coming years, oil and gas profits are more likely to shrink than grow as the shale-gas, liquid natural gas, tight-oil revolutions, and other energy developments[6] occurring in other parts of the world give Europe more choices in the future, threatening the Russian dominance of the European market (European Energy Review 2012).[7] Experts at the Energy Center of the Skolkovo Business School state that Russia's reliance on the European market is an increasing risk factor (Kuzmin 2012).

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[6] The Desertec project is aimed at bringing solar power from North Africa to Europe (Beckman 2012).

[7] Tight oil (also known as shale oil or light tight oil) consists of light crude oil contained in petroleum-bearing formations of low permeability, often shale or tight sandstone. Economic production from tight oil formations requires the same hydraulic fracturing and often uses the same horizontal well technology used in the production of shale gas. It should not be confused with oil shale, which is shale rich in kerogen (IEA 2012).

4. Governance and Innovation

State governance and policies influence technological development and innovation in all countries but perhaps especially so in Russia, a powerhouse of space and defense related S&T development during the cold war. Following the breakup of the Soviet Union, Russia had low economic growth in the 1990s, which improved to an average 7 percent growth rate in the 2000s. The 2008–2009 global financial crisis highlighted Russia's dependence on natural resources (OECD 2011), and the government acknowledged that modernization through innovation was essential to maintaining a strong economy (Johnson 2012).

By most generally accepted indicators, Russia's potential for science and technology based innovation appears to be higher than that of other countries (such as Malaysia and Croatia) with similar levels of GDP per capita. However, innovation indicators show a large imbalance between the inputs and outputs of innovation. For example, Russia's ranking on innovation indicators which are weighted towards R&D inputs is comparatively much higher than those related to market incentives (such as technological advantage and business conditions) (Porter and Ketels 2007). Closing this gap is one of the major challenges for Russian innovation policy; another is increasing private sector involvement in R&D, which is currently quite limited (Gianella and Tompson 2007).

A. Current Innovation Leadership Structure

After the fall of the Soviet Union in 1991, Russia became a federal state with a republican form of government. According to the 1993 *Constitution of Russia*, the President of Russia is head of state and leads the multi-party system with executive power exercised by the government. The Russian Government is appointed by the Prime Minister, who in turn is appointed by the President with the parliament's approval. Legislative power is vested in the two houses of the Federal Assembly of the Russian Federation: the State Duma and the Federation Council. Russia also holds a judicial branch and maintains a Central Bank, as Figure 5 shows.

The President and Prime Minister play lead roles in Russia's science, technology, and innovation system. Together they appoint the federal ministers, chair important councils, and enact policies that drive innovation. They also oversee the federal ministries of Communications and Mass Media (*Mincomsvyaz*, MCMM), Economic Development (*Mineconomrazvitie*, MED), Education and Science (*Minobrnauki*, MES), Defense

(*Minoborony*, MOD), and Industry and Trade (*Minpromtorg*, MIT), all major components of Russia's S&T (R&D) system. Other important components include members of the President's *Council for Science and Education* (previously the Council for Science, Technology, and Education),[8] the State Duma's *Committee on Science and High Technologies*, and the Federation Council's *Committee on Education and Science*.

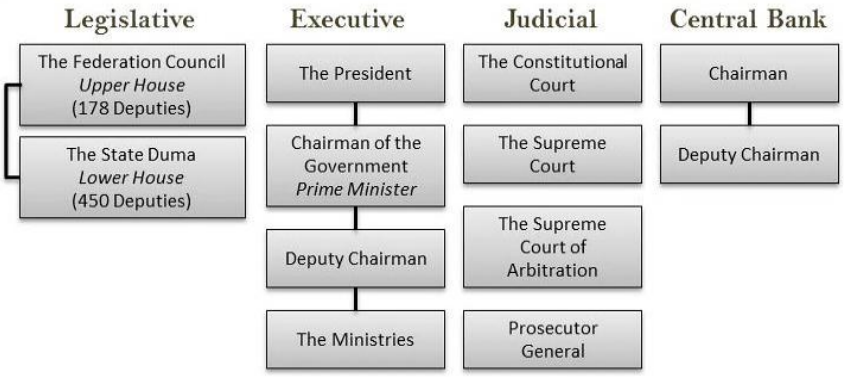

Figure 5. Basic Structure of the Russian Government

Following the Yeltsin presidency from 1991 to 1999, current President Vladimir Putin's first term as president from 2000–2004 saw a period of growth. GDP grew nearly tenfold and a Russian middle class began to emerge. The finance and economic ministers, Alexei Kudrin and German Gref, increased private investment to modernize industry, upgrade infrastructure, and reduce income dependency on raw material exports (Stott 2012). Putin's current presidency began in March 2012 and continues through 2018. The current Prime Minister is Dmitri Medvedev initiated many of the current innovation policies during his presidency from 2008 to 2012.

While neither Putin nor Medvedev openly opposes the other, lack of support for each other's policies has lessened the policies' potency and given the impression of opposition in leadership (Nielsen 2012). Their focus has shifted from supporting one cohesive agenda to addressing individual innovation agendas.[9] Thus, the building of Russia's foundations for innovative growth, such as the creation of public-private partnerships, improved regulatory processes, and increased transparency, are adversely affected by conflicting visions, and gaps in governance remain relatively unchecked. In some cases, legislation has been enacted (such as IPR protections) to address issues and

[8] President of Russia, Executive Order on the Presidential Council for Science and Education Signed, July 30, 2012, http://eng.kremlin.ru/news/4240.

[9] Putin, for example, initiated a Russian DARPA, while Medvedev's policies focused on a broader technology innovation agenda (*RIA Novosti* 2013).

create an environment more conducive to business, but such actions are perceived as being superficial, created only to meet World Trade Organization standards.[10]

The following sections describe the role of governance in innovation-led development in Russia, how the government in recent years has leveraged (or squandered away) the strengths of the legacy systems built up during the Soviet era, and the anticipated impact recent innovation policies and initiatives.

B. Role of the Soviet Legacy Systems

1. Education and Workforce

Russia had one of the best educational systems in the world under the former Soviet Union, and even though the quality of higher education fell in the 1990s, the quality of science and engineering education is still high by OECD standards (OECD 2011). As Figure 6 indicates, Russia today has 28 million people with university degrees (up from 15 million in 1990), compared to 65 million in the United States and 58 million in China (Rollwagen and Renkin 2012). Russia still maintains an advantageous position in university education attainment in the science and engineering fields despite a large-scale emigration of scientists and engineers over the past two decades; it ranks with South Korea, Germany, Sweden, and Finland in the percentage of new degrees granted in these disciplines.

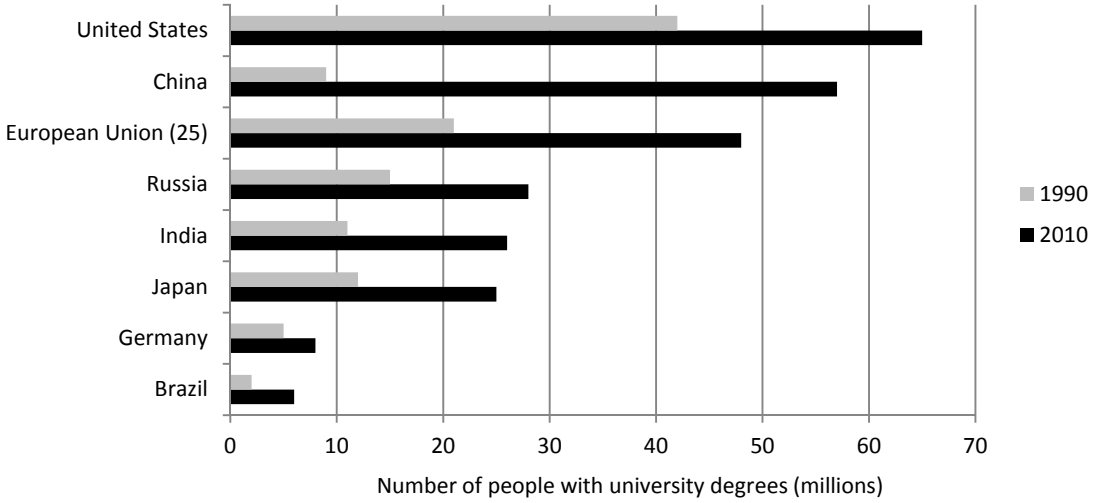

Figure 6. Number of University Degrees Granted in Russia Compared with Other Countries, 1990 and 2010

[10] Discussions with experts. See Appendix A.

Figure 7 shows that Russia appears to be stagnating while China and Brazil are growing fast in terms of numbers of universities ranked in the top 500 of the Academic Ranking of World Universities (ARWU).[11]

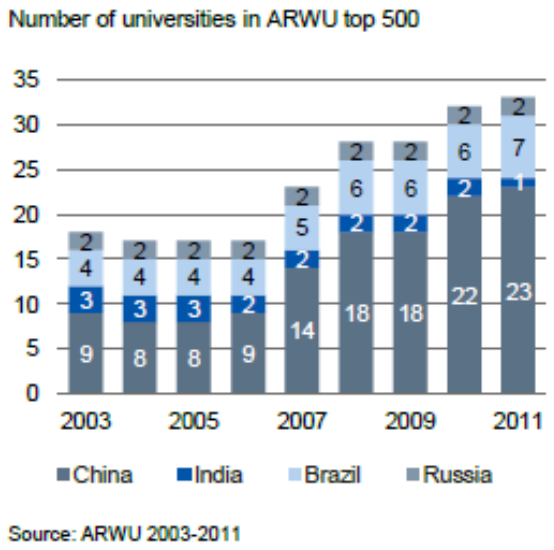

Figure 7. Comparison of Numbers of Top Universities in China, India, Brazil, and Russia Countries

Part of the problem may be that while university enrollments are high, corruption and academic fraud in the system is rampant (Blaney 2010). Reported instances range from plagiarism and violations of doctoral requirements at Moscow's leading universities (Radyuhin 2013) to distribution of fake degrees and diplomas, often with employers complicit (Payne 2010). Universities suffer from corruption and insular research communities. Universities face an aging cohort of researchers who are underpaid—professors make $500 per month compared with $1,800 for military officers (O'Keefe 2012)—and not accustomed to competing for grant money, a direction that the Russian government is trying to move towards.

In addition, the Russian funding model for university education, based in part on student payments, is unsustainable in the face of a decline in the college age cohort and the resultant decline in enrollments (Klein 2011). As a result, some experts view the decline in quality of the education system as being significant. According to Balzer (2011) "there are few more stunning changes in global affairs than the rapid decline in Russia's standing in education, science and technology….Corruption, business climate

[11] Academic Ranking of World Universities (AWRU), http://www.shanghairanking.com. The 2013 Academic Ranking of World Universities (ARWU) is released today by the Center for World-Class Universities at Shanghai Jiao Tong University."

and the transparency and predictability of institutions all play a role. In addition, as global rankings indicate, the education system itself must perform better to meet the needs of an innovation economy."

The Russian Government's goal is to have 5 universities in the top 100 by 2020. (Table 3 lists the top five universities in Russia at present.) Among recent efforts addressing this goal has been Russia's participation in the Bologna process. This series of agreements between European countries designed to ensure comparability in standards for courses will give Russian scholars increasing opportunities to study abroad[12] in areas that include management education (in which Russia currently ranks 115 out of 144 (WEF 2012). In addition, a privately funded School of Management that opened for the fall 2010 semester at the Skolkovo Innovation Center (Thornock and Whitaker 2011).[13]

The lack of employment opportunities makes it difficult for Russia to retain its scientific talent. Further, it is difficult to recruit high-quality engineers under the age of 40 in Russia (Popovskiy 2012), and there is little alignment between higher education and workforce needs (Patton 2012). Most applied science professionals are hired by Russian state corporations, which often increase salaries to retain top talent.[14] This is a significant barrier to the growth and development of small and medium-sized businesses, specially the availability of highly qualified managers (OPORA 2012).

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[12] According to the European Commission (http://ec.europa.eu/education/higher-education/bologna_en.htm):

> The Bologna Process launched the European Higher Education Area in 2010, in which students can choose from a wide and transparent range of high quality courses and benefit from smooth recognition procedures. The Bologna Declaration of June 1999 put in motion a series of reforms needed to make European Higher Education more compatible and comparable, more competitive, and more attractive for Europeans and for students and scholars from other continents. Reform was needed then and reform is still needed today if Europe is to match the performance of the best performing systems in the world.

[13] The Skolkovo Innovation Center is a Russian campus-like development that "concentrates international intellectual capital, thereby stimulating the development of break-through projects and technologies," http://www.sk.ru/en/Model.aspx.

[14] Discussions with experts. See Appendix A.

Table 3. Russia's Top Five Universities

Name	World Ranking	Research Strengths	Industry Collaboration	Notes
Lomonosov Moscow State University, Moscow	100–150	Mathematics, physics, arts, and humanities	—	Largest university in Russia with 40,000 students
Moscow Institute of Physics and Technology, Moscow	Below top 500	Applied mathematics, physics, electrical engineering, and computer science	Yandex, Intel, Acronis, ABBYY	Most competitive admissions in Russia; conducts research only through affiliated research institutes
St. Petersburg State University, St. Petersburg	350–400	Mathematics and physics	Mitsui, Microsoft, Russian Railways	Oldest university in Russia, est. 1724
Novosibirsk State University, Novosibirsk	Below top 500	Natural sciences	Business incubator for nanotechnology and biomedical technologies	Close ties to Siberian branch of Russian Academy of Sciences (RAS)
Moscow State Engineering Physics Institute, Moscow	Below top 500	Nuclear, elemental particle, and condensed matter physics, and electrical engineering	—	Contains a 2.5-MW research reactor and Neutrino Water Detector NEVOD

Source: Universities in Russia by 2013 University Web Ranking, http://www.4icu.org/ru/.

Note: Many of Russia's prestigious universities are ranked low because they conduct research through affiliated research institutions. The Moscow Institute for Physics and Technology, for example, is one of Russia's most prestigious universities. It has the highest threshold for qualification via the Unified State Exam and is the school of choice for the country's top math and science students. However, since it does not have a research program, it is not ranked in the top 500 of such lists as *Times Higher Education* and *US News & World Report*.

2. Funding for Research and Development

Russia's R&D is focused on national security, and is the main driver of innovation. R&D is largely performed by state-owned national academies and institutes, while universities are almost exclusively focused on education. The Russian Government continues to be the largest funder of R&D. A fairly constant 60–66 percent of R&D expenditures each year are from public funds (in the United States, the private sector accounts for two-thirds of R&D funding), and the Russian national budget, not state budgets, overwhelmingly dominates the system of public S&T funding. These numbers, however, are misleading, as state-owned companies and branches of research institutes are classified as business entities but primarily conduct publicly financed research activities. Accounting for this, the International Energy Agency estimates that the state science sector accounts for 98 percent of budgetary funding for science (Gianella and Tompson 2007).

Despite the cutbacks of the 1990s, Russia continues to spend more on R&D than many emerging economies. Scientists at the Russian Academy of Sciences, the largest research-conducting institution, publish only 2.7 percent of the total volume of publications in the world's leading scientific journals, a number that has remained flat since 2005 (NSB 2013). However, this statistic belies the fact that scientific research in Russia is built on a foundation comparable with leading EU countries, and Russian

scientists received Nobel Prizes in 2000, 2003, and 2010 most recently, and about one per decade prior to that.

The rate of patent applications in Russia over the past 15 years, at 30,000 per year and steadily increasing, is ahead of the United Kingdom and France, but below Germany (although it has been surpassed by East Asian countries in the past decade). Patent applications by non-residents in Russia are a small but steadily growing number in the past decade, indicating a growing presence of multinational corporations that are establishing R&D operations in Russia. See Chapter 6 for details.

3. Military Innovation

The defense industry is an important source of innovation in Russia. In 2012, the government funded the Future Research Fund, a multibillion dollar Russian equivalent to the U.S. Defense Advanced Research Projects Agency (DARPA), to develop cutting-edge Russian weapons through 2020. The goal is defense modernization through strategic leapfrogging (i.e., a military Skolkovo). Russia has traditional strengths in nuclear arms, missile technology, avionics, and transport vehicles. New areas of focus will include nanoelectronics, hypersonics, and unmanned aerial vehicles.

The Russian defense sector's reliance on contractors is anticipated to see a shift towards opening up military contracts to companies that operate without state support, particularly in the manufacture of electronic components. Vadim Kozyulin, director of the conventional weapons project at the Russian Center for Policy Studies, has said that this results in more competitive products. For example, private companies own most of the innovative designs in the areas of radio electronics and radio electronic warfare device development (Kozubova 2012).

C. Government Innovation Policies

The legacy of the Soviet system, along with continuing corruption and excessive bureaucracy, has created an adverse and uncompetitive business climate. Achieving an innovative economy is a challenging task. In a nation with a history of strong state influence and industrialization by decree, new policies are being written to shift the Russian economic culture toward a Western model of innovation. The government's recent policies to enable S&T-based innovation in the economy have been in the form of:

- Infrastructure to support collaboration between companies through the creation of special economic zones[15] (which may include technology clusters,[16] technoparks, and business incubators) and the Skolkovo Innovation Center;
- High-level strategic plans, such as an overarching mandate for long-term S&T planning, commonly known as Strategy 2020, that was released by then President Dmitri Medvedev in 2011; and
- Selection of focus areas in technology for developing new expertise.

These policies represent the most recent steps in Russia's ambitions toward achieving global competitiveness, and have been described in detail in the following subsections. Additional mechanisms and institutions connecting research organizations to technology commercialization avenues are listed in Appendix D.

1. Special Economic Zones and Technology Transition Centers

Between 2009 and 2012, the Russian government passed a number of laws with the intent of building an infrastructure to (1) support collaborations between companies, especially startups and small firms and universities; (2) establish a legal framework for the innovation centers to encourage R&D by entrepreneurs; and (3) set up special economic zones that allow more of a free market approach to developing business and to allow easier recruitment of foreign talent. A special economic zone may be its own entity or it may include business incubators, technology clusters, and technoparks. A list of recent laws related to these entities follows.

- Federal Law No. 217-FZ (2009), "Law on Small Enterprises near Universities," gave Russian universities control over their intellectual property (IP), allowing for the creation of small companies on campuses.
- Government Regulation 218 (2010), "On Measures of the State Support of the Development of Russian Higher Educational Institutions and Organizations Implementing Complex Projects to Create High-Technology Production,"

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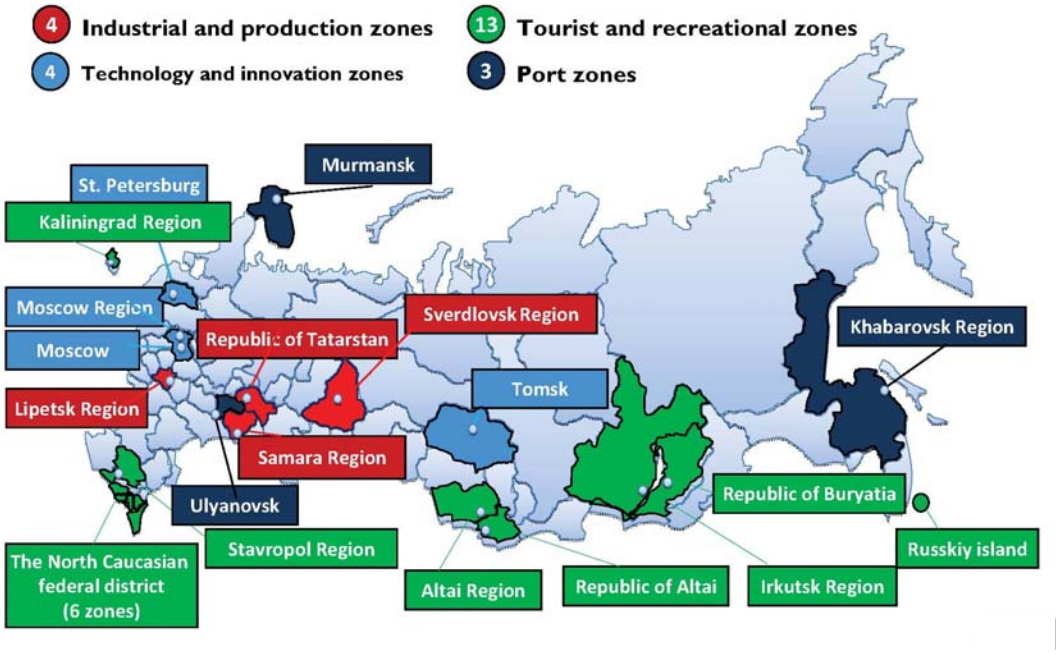
[15] Special economic zones are geographic areas that can include technology clusters and other programs. Firms in these special economic zones generally do not have to follow the restrictive Russian policies. The goals for these areas are to increase foreign investment, with the effects of these investments spilling over to the development of infrastructure and economic growth. See Special Economic Zones in the Russian Federation, http://invest.gov.ru/en/government_support/privileges/sez/.

[16] Technology clusters are defined by the Russian MED in *The Concept of Long-Term Socioeconomic Development of the Russian Federation until 2020*, November 17, 2008 (http://www.innoclusters.ru/en/cluster_policy), and further outlined in MED Letter, No. 20615-AK/D19, December 26, 2008, the title of which roughly translates as *On the guidelines for cluster policy implementation in the constituent entities of the Russian Federation*, http://www.innoclusters.ru/en/cluster_policy_in_the_russian_federation.

provides subsidies and state support for cooperation of higher education institutions and organizations that implement complex high-technology projects.

- Federal Law No. 244-FZ (2010), "Law on the Skolkovo Innovation Center," sets out the legal framework for the establishment and operation of the Skolkovo Innovation Center, and aims to encourage research and development in certain areas. Companies and individual entrepreneurs are granted tax, customs, and other benefits.
- Law on Special Economic Zones (2012), "SEZ Law" (recently amended), sets minimum investment threshold, residency requirements, and permitted business activities and simplifies land acquisition and administration procedures.

Figure 8 shows the locations of Russia's special economic zones.



Source: Ministry of Economic Development of the Russian Federation (2011).

Figure 8. Special Economic Zones in Russia

Special economic zones attract many of the world's leading technology-based companies with special tax privileges, the right to buy land, simplified customs clearing procedures, and cheap access to basic infrastructure (telecommunications, heating, power, etc.) (OECD 2011). They are often based on technology clusters.[17]

[17] Technology clusters are defined by the MED in *The Concept of Long-Term Socioeconomic Development of the Russian Federation until 2020*, November 17, 2008, http://www.innoclusters.ru/en/cluster_policy,

a. Technoparks

The locations of Russia's technoparks are planned so as to concentrate resources in areas where there is a proven technical expertise with the hope of creating local spillovers. Table 4 lists the number of technoparks, business incubators and technology transfer centers in Russia today. Technoparks have been created in Zelenograd, Skolkovo, Dubna, Tomsk, Innopolis, among other places. While there have been mixed results thus far, the potential of these technology parks has been hindered by mismanagement and an inability to attract foreign investment.

Table 4. Technoparks, Incubators, and Technology Transfer Centers

Type of Organization	Number	Per 100,000 Researchers
Technoparks	83 (up from 55 in 2006)	21.3
Business Incubators	89 (up from75 in 2008)	22.9
Technology Transfer Centers	100 (up from 86 in 2008)	25.7

b. Business Incubators

Business incubators in Russia are evolving from supporting small businesses to supporting fast-growing breakthrough startup companies (Ernst & Young 2010). Russia averages one business incubator for every 2.7 million people compared to the United States which has one incubator for every 280,000 people.

The Moscow and St. Petersburg areas have several incubators, including the student-created QD incubator at the St. Petersburg State University of Information Technologies, Mechanics and Optics (ITMO); Digital October in Moscow; and the Russian State University of Trade and Economics (RSUTE) incubator in Krasnodar (Ortmans 2012). The most recent wave of Russian startups (such as Kaspersky Lab, Ozon, Mail.ru) has attracted attention from incubators and accelerators from the Baltic and Nordic region. For example, Finland's 2011 Startup program admitted three Russian companies. One of them is Maxygen, a young company producing inexpensive DNA tests to detect infectious diseases in 15 minutes compared to the industry average of 2–3 hours (Ortmans 2012).

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and further outlined in MED Letter, *No. 20615-AK/D19*, December 26, 2008, which roughly translates as *On the guidelines for cluster policy implementation in the constituent entities of the Russian Federation*, http://www.innoclusters.ru/en/cluster_policy_in_the_russian_federation.

c. Technology Transition Centers

In addition, several mechanisms have been set up in recent years to transition technology into targeted applications; these include Technical Promotion Zones, State Corporations that specialize in transitioning defense and national-security centric technology, and the Russian Technology Transfer Center, a network of over 70 innovation centers related to the defense and aerospace sector.

Examples of Russian Technology Parks

The Zelenograd Technical Center was a closed campus until 2006, when it gained the SEZ status. A third information technology (IT) park at Kazan aims to foster IT-led economic development in the region. Some are fairly recent ventures (Innopolis and Skolkovo are still under construction), so it is difficult to speculate on their impact. However, even for the Zelenograd Technical Center, which has been in existence since 1988 before being accorded SEZ status in 2006, it is difficult to gauge the impact of the R&D and innovation related activities on the larger economy.

The Zelenograd Innovation and Technology Centre (ZITC) was established to host joint ventures with American, French and Italian semiconductor firms. It was initially referred to as Russia's Silicon Valley (Casey 2012) It is the home to Russia's largest chip manufacturers, including Angstrem.

In 2010 a second Russian Silicon Valley was established in Skolkovo. It encompasses the Skolkovo Institute of Science and Technology (SkolTech), which is being developed in collaboration with MIT. Skolkovo Foundation is a technopark with a special intellectual property rights (IPR) court in addition to the other benefits of being a SEZ. It has broad involvement of international expertise through an international advisory council, partnership with the MIT Foundation, and plans to host foreign firms and laboratories (OECD 2011). Nineteen joint R&D centers have been established in partnership with leading global companies: Microsoft, Cisco, SAP, IBM, Intel, Siemens and Nokia (Gokhberg and Roud 2012). The government has earmarked $4.2 billion for investment and pledged millions more in grants and tax privileges. About three quarters of the government funds will be spent developing the 390-hectare site on the fringes of southwest Moscow.

The Kazan IT park, created in 2009, was the first park to be built under a federal IT-Park program. It has a Business Incubator where residents include LCOR, a computer game company, and Avtodroiya, a satellite based system to enforcing speeding regulations on motorways (Ford 2012).

Also in Kazan is Innopolis, the first planned city to be built since the fall of the Soviet Union. Innopolis has been designed with urban, modern infrastructure to support a population of 155,000 the core of which (60,000) will work in the IT sector. The goal is to increase the IT sector share of Tatarstan's Gross Regional Product—currently 3.5 percent—up to at least 6 percent, on par with Brazil, India, and China (Ford 2012).

2. Strategy 2020

In 2011, then-President Dmitri Medvedev (now Prime Minister) published an overarching policy that outlined high-level strategic direction and long-term S&T planning for Russia. This policy was commonly known as Strategy 2020 (Government of the Russian Federation 2011). The new policy targeted many of the missing components in Russia's National Innovation System by setting goals for R&D, education, financing, and operational responsibility. Among some of Strategy 2020's broad mandates are: (1) incentives to students studying engineering and applied sciences; (2) stronger integration of international cooperation on innovation; (3) improvement of the education system,

including entrepreneurship and technology management; and (4) the development of Technology Platforms,[18] aimed at bringing together stakeholders in the most promising technological areas in order to bridge the gap between science and industry.

Since the inception of this plan, a change in leadership at the highest levels has dimmed the prospects for this plan. Moreover, Strategy 2020 is viewed as overly ambitious[19] and unrealistic given the current status of the research enterprise in Russia,[20] and this has reduced its credibility. Many experts posit that specific goals and expectations are well beyond what can reasonably be achieved.[21]

3. Technology Focus Areas

A November 2009 memorandum from President Medvedev on reforming and privatizing state corporations identified five focus areas for Russia's technology innovation (National Academies of Science 2010):

1. Medical technology, medical equipment, and pharmaceuticals
2. Energy efficiency, conservation, generation, and distribution
3. Telecommunications and space technology
4. Applications of nuclear fission and fusion
5. Information and communications technology (ICT)

Russia's science, technology, and innovation policies reflect its strong defense industrial technology push, and an absence of a manufacturing "pull" for large-scale technology commercialization. The government has investments in condensed matter physics for energy transmission technologies, while energy generation technologies (fuel cells, photovoltaics), which require large-scale manufacturing capability to be economically viable, are not being pursued (World Nuclear Association 2013). Plans are also underway to upgrade Russia's communications infrastructure and satellite navigation system (National Academies of Science 2010).

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[18] Technology Platforms are one of the key tools of innovation policy in Russia aimed at bringing together stakeholders in promising technological areas to bridge the gap between science and industry. There are 28 Technology Platforms with more than 2,000 organizations involved (Ministry of Economic Development (MED) 2011). They are targeted at fostering communication and pre-competitive collaboration among leading producers, suppliers, research organizations, universities, and engineering companies (Gokhberg and Roud 2012).

[19] Discussions with experts (Appendix A) as well as news articles and a report from the Center for Strategic International Studies (Kuchins, Beavin, and Bryndza 2008).

[20] Discussions with experts. See Appendix A.

[21] Discussions with experts. See Appendix A.

5. Business and Innovation

The World Bank Development Education Program classifies an economy based on its distribution of agriculture, industry, and services.[22] According to this definition, Russia is a middle income country, a position that has changed little since the 1990s. Table 5 shows the composition of the Russian economy in 2012.

Table 5. Composition of Russian Economy, 2012

	Services	Industry	Agriculture
GDP composition by sector	58.0%	37.6%	4.4%
Labor force composition by occupation	62.7 %	27.5%	9.8%

Source: The CIA World FactBook. https://www.cia.gov/library/publications/the-world-factbook/geos/rs.html.

Most industry in Russia remains in large, state-owned enterprises (SOEs) mostly focused on natural resources. Russia has yet to complete the process of downsizing huge conglomerates inherited from the Soviet Union, including de-monopolizing the "natural monopolies" and privatizing the large SOEs.[23] Even though the number of small and medium-sized companies is growing, the SOEs receive preferential treatment from the government (Ernst & Young 2011), which stifles innovation-inducing competition. Employment in the domestic manufacturing sector, which produces largely low-value-added goods, is declining.

While Russia's product portfolio is dominated by oil and gas products, there are significant strengths in state-supported defense-related sectors such as nuclear arms technology, aerospace and space technology, shipbuilding, electronics, and geology. Recent emphasis has been on IT and communications, energy efficiency technologies,

[22] In low-income economies, agriculture accounts for about 25 percent of the economy, with the industry and service sectors about evenly split between the balance. In middle-income countries, agriculture accounts for about 11–12 percent of the economy, industry 35 percent, and services over 50 percent. In high-income economies, agriculture accounts for 2 percent of the economy, followed by industry at 32 percent, and services at 66 percent. See http://www.worldbank.org/depweb/beyond/wren/wnrbw_09.pdf.

[23] Putin's ambitious plans for selling shares in state companies, set out in his 2012 pre-election program, are now likely to be modified with a smaller list of assets in banking and transportation infrastructure being sold first and energy shares being sold later (Wall 2012).

nanotechnology, and biotechnology. The service sector is dominated by grocery retailing, tourism, gambling, and real estate.

In addition to petroleum products, Russia exports metals, wood and wood products, and a variety of civilian and military manufactured goods. Russia imports machinery, vehicles, pharmaceutical products, plastic, semi-finished metal products, food products, optical and medical instruments, iron, and steel. Table 6 shows Russian imports and exports in 2012.

Table 6. Russian Exports and Imports, 2012

Exports (9)*	$542.5 billion (2012 est.)
Imports (16)*	$358.1 billion (2012 est.)
Exports to	Netherlands 12.2%, China 6.4%, Italy 5.6%, Germany 4.6%, Poland 4.2% (2011)
Imports from	China 15.5%, Germany 10%, Ukraine 6.6%, Italy 4.3%

Source: The CIA World FactBook. https://www.cia.gov/library/publications/the-world-factbook/geos/rs.html.

* Number in parentheses is Russia's ranking compared to other countries.

Manufacturing of high-technology products accounts for only 0.7 percent of GDP—more than seven times less than in China (5.2 percent) and half of the value achieved by Brazil (1.5 percent) (WEF 2011). The number of manufacturing jobs in Russia is declining, while employment in the government sector is growing, "pointing to a move toward a growing role of the state that is built on the redistribution of resources rather than creation of value" (WEF 2011). Young people aspire to work for the government, not private industry.[24]

Russia does not have a tradition of private property ownership or commercialization of innovations. Until the fall of the Soviet Union, it was illegal to own a private company. By almost every measure, the capacity and sophistication of the commercial sector is not conducive to innovation (for example, only about 3 percent of industrial organizations engaged in marketing their innovations in 2007) (Gokhberg et al. 2009). Corruption and the rule of law adversely affect the business climate. Government rules and regulations significantly raise the cost of doing business in Russia compared to countries at similar levels of GDP per capita. For example, Russia ranks 118 out of 185 countries in the World Bank's 2012 Doing Business rankings, versus 50th in GDP per capita (Porter 2007, World Bank 2012).

[24] Discussions with experts. See Appendix A.

Treason is defined so broadly that some Russians are afraid that associating with foreigners could put them at peril.[25] There is little control or enforcement of regulations; corruption and lack of transparency are pervasive issues. The Centre for Strategic Research, a think tank that conducted focus groups in Moscow and regional cities, found that Russians saw little chance of changing their "predatory" ruling elite through the ballot box. Most thought a revolution was possible and even desirable (CSR 2012).[26]

Most of the R&D and innovation-related funding in Russia is public. The private financial system has been unable to accumulate the capital necessary to sustain growth and institutional change, a situation exacerbated by government policies that do not encourage investment.

In this chapter, selected indicators of Russia's business climate are discussed, along with the nature of research-industry interaction, which is a crucial factor in any innovation system. Russia ranks in the bottom half of almost every indicator related to business conditions published by the World Economic Forum **(**WEF), the World Bank, and the World Intellectual Property Organization (WIPO). Russia has a long way to go before achieving conditions in which innovation can flourish, but increasing its global linkages, as it has been attempting to do, may be a step in the right direction.

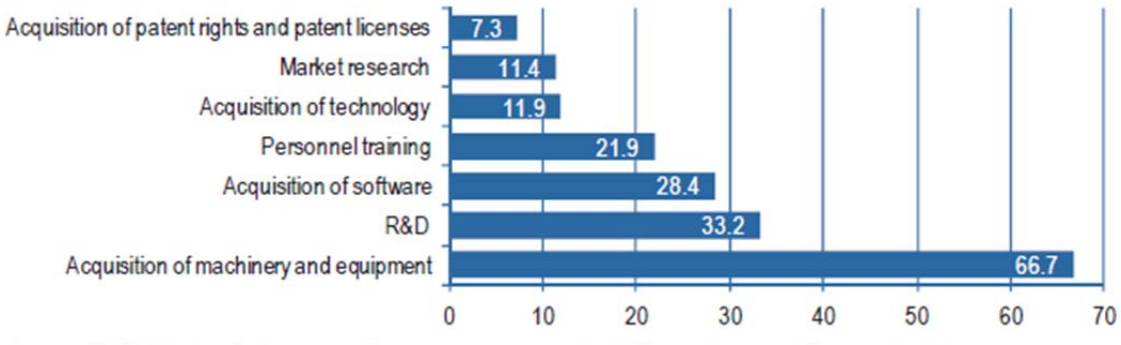
A. Technology Commercialization and Research-Industry Linkages

Since state interests have historically been prioritized over transitioning technology to the commercial market, R&D in Russia has been separate from production, with manufacturers performing limited in-house innovative activities. Researchers, including those at the Russian Academy of Sciences, are disconnected from activities related to commercialization and innovation, and they have little incentive to seek out such opportunities. The net result is that research activity is typically not innovative or geared towards commercial application (Gianella and Tompson 2007).

Lacking the benefits of linkages to the research community, and hampered by bureaucratic inefficiencies, business interest in (and demand for) innovation remains low, especially for technological innovations. Russia's private sector is oriented toward imitation and technology adoption via acquisition of equipment and machinery, rather than innovation based on R&D (NRC 2010) as shown in Figure 9. Less than 10 percent of firms engage in acquisition of technology via patent rights and licenses.

[25] Discussions with experts. See Appendix A.

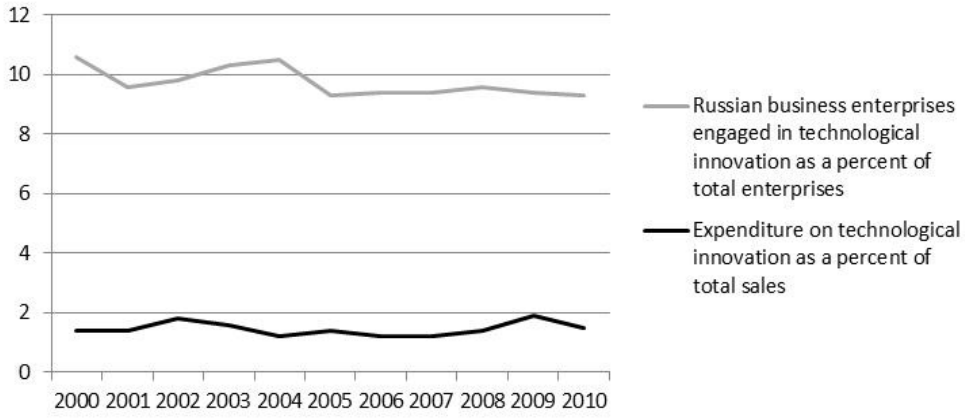
[26] Center for Strategic Research, http://eng.csr.ru/index.php/about-center.



Source: Figure from OECD (2011). Data from *Indicators of Innovation Activity: 2010,* Higher School of Economics, Moscow.

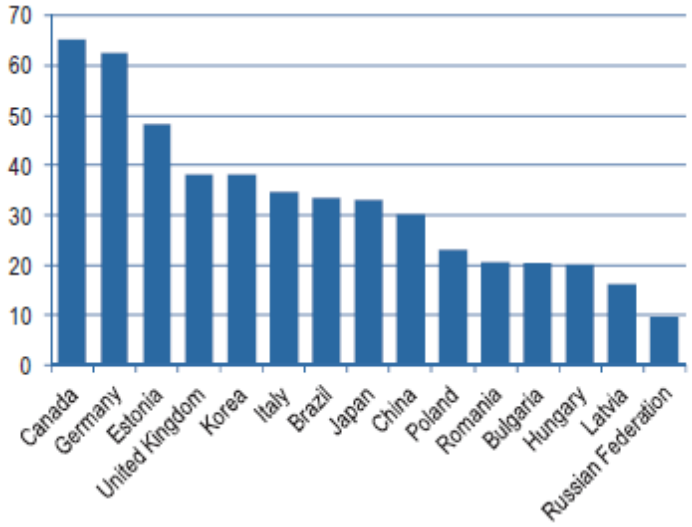
Figure 9. Percentage of Domestic Russian Businesses Engaged in Selected Types of Innovation Supporting Activity

Data on business innovation trends in Russia do not look promising. Sales of innovative products in Russia are less than 10 percent of industrial product sales and have remained so for over a decade. In comparison, innovative products in the European Union accounted for more than 60 percent of industrial product sales (Gokhberg et al. 2009). Figure 10 shows that the percentage of Russian firms engaged in innovation-related activities is around 10 percent, which ranks below the Organisation for Economic Co-operation and Development (OECD) countries, as well as countries with a lower potential for technological innovation, such as Hungary and Latvia, as shown in Figure 11. Figure 10 also shows business expense on technological innovation as a percent of total sales in Russia, which less than 2 percent and has remained consistently so for more than a decade.



Source: Data from *Indicators of Innovation in the Russian Federation 2012,* Higher School of Economics, Moscow, http://www.hse.ru/en/primarydata/innov2012.

Figure 10. Industrial Innovation Activity in Russia, 2000–2010



Source: Figure from OECD (2011). Data from Community Innovation Survey (CIS) 2006 and *Indicators of Innovation Activity: 2010,* Higher School of Economics, Moscow.

Figure 11. Percentage of Industrial Enterprises Engaged in Technological Innovation, by Country (2008 or nearest year)

Recent resolutions have been passed in an attempt to improve industry-research collaboration.[27] Technology platforms[28] launched in 2011 are the latest public-private partnerships intended to bridge the gap between research and industry.

B. Corruption and Rule of Law

Corruption comes close to outweighing all other factors in its impact on the business climate in Russia. Along with lack of judicial independence, corruption adds to the dead weight of the bureaucracy where bribery occurs at every level of authority.[29] Corruption poses political risk to even major corporations and distorts the economic system.

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[27] For example, Resolution 218 (2008), "On development of cooperation between Russian institutions of higher learning and production enterprises," provides the business sector with incentives to collaborate with research groups in universities.

[28] Technology Platforms are one of the key tools of innovation policy in Russia aimed at bringing together stakeholders in promising technological areas to bridge the gap between science and industry. There are 28 Technology Platforms with more than 2,000 organizations involved (MED 2011). They are targeted at fostering communication and pre-competitive collaboration among leading producers, suppliers, research organizations, universities, and engineering companies (Gokhberg and Roud 2012).

[29] The Russian Ministry of Economic Development published that in 2010 Russians paid $581 million in bribes to authorities for security provisions, which represents 13 times more than the total amount estimated for 2005 (Ortmans 2012). The country has moved to 143rd place out of 182 on Transparency International's Corruption Perceptions Index, tied with Nigeria (Stott 2012).

Successful companies often face tax, health, or labor inspections that can lead to "violations." Private ownership and wealth are generally perceived to be the result of political connections, not entrepreneurship (Porter and Ketels 2007).

A high rate of business-related convictions has dampened the entrepreneurial spirit.[30] Investigative journalism has not been successful at curbing corruption and can be a dangerous profession in Russia, especially in the provinces.[31] The recent ouster of the U.S. Agency for International Development (USAID) from Russia is especially troubling because some of the money the agency was spending in Russia was going toward training judges (Herszenhorn 2012). Special economic zones like Skolkovo are supposed to offer protection from the legal system in an attempt to induce foreign direct investment, but this is only being implemented (as of now) for high-technology investments. Russia is likely decades away from reducing corruption.[32]

Linked to the high degree of corruption is the symptom of capital flight. Russia continues to lose funds to overseas entities because of the poor investment climate (Stott 2012). Russia lost $57 billion in 2012 through the transfer of funds overseas, including $35 billion from "dubious operations." Perpetrators include corrupt bankers who create disposable companies, tax authorities who write down the nonpayments, and members of the Federal Security Service, which monitors financial flows. This estimate, if accurate, provides a rare insight into the maturity of organized crime in Russia and the scope of the country's corruption (Baev 2013).

Finally, lack of judicial independence discourages investment in business. People with good ideas leave Russia because they know they cannot succeed there. Small and medium-sized companies are especially vulnerable to the judicial system. Multinational corporations such as Ford, GM, and Proctor & Gamble have developed adaptive strategies to protecting the small and medium-sized companies in their supply chain.[33]

C. Business Climate Measures

As mentioned, Russia ranks low on almost every indicator related to business conditions published by the WEF, the World Bank, and the WIPO. In categories such as IPR protection and intensity of local competition, the country ranks in the bottom 15 percent of 144 countries.

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[30] In 2003, Mikhail Khodorkovsky, CEO of the private oil company Yukos and an outspoken critic of the Russian government, was arrested on charges of tax evasion, and the government expropriated Yukos. He remains in jail today (Gustafson 2012).

[31] Discussions with experts. See Appendix A.

[32] Discussions with experts. See Appendix A.

[33] Discussions with experts. See Appendix A.

Senior managers in Russian companies spend more than 20 percent of their time dealing with the bureaucracy; obtaining a permit requires more than 60 days of administration time (WEF 2011). As a result, Russian companies, including Kaspersky, Yandex, Qiwi, Dressformer, Cardiowave, mail.ru, and Kernel, incorporate in Delaware to avoid doing business in Russia. Incorporating in Delaware also helps with investor relationships as many investors are reluctant to invest in Russia because of the corrupt judicial system.[34] Finally, declaring bankruptcy is difficult in Russia, increasing the risk for startups and new ventures. (Ortmans 2012).

The Russian Government hopes to spur innovation by actively seeking investments from foreign corporations. Foreign companies will be given access to tax breaks, incentives, and fewer regulations. Russia already boasts a corporate tax rate of 20 percent and an individual tax rate of 13 percent—much lower than the 35–40 percent rates found in the United States (Thornock and Whitaker 2011). However, foreign firms that do invest will face corruption, bureaucracy, nontransparent legislation, and the absence of an independent judiciary system (see Table 7). As one of the experts put it, "The Russians took German bureaucracy and perfected it."[35]

Table 7. Most Problematic Factors for Doing Business in Russia

Factor	Percentage of Responses
Corruption	20.5
Inefficient government bureaucracy	11.9
Access to financing	10.0
Tax rates	9.3
Inadequately educated workforce	7.1
Insufficient capacity to innovate	6.5
Tax regulations	6.0
Crime and theft	5.9
Policy instability	4.5
Inadequate supply of infrastructure	4.3
Inflation	4.1
Poor work ethic in national labor force	3.1
Restrictive labor regulations	2.3
Poor public health	1.7
Government instability/ coups	1.6
Foreign currency regulations	1.1

Source: WEF (2012). The WEF report shows results of a survey in which respondents were asked to select the five most problematic factors for doing business in their country from a list of 14, and to rank them between 1 (most problematic) and 5 (least problematic).

[34] Discussions with experts. See Appendix A.

[35] Discussions with experts. See Appendix A.

D. Multinational and Transnational Corporations

Russia's business economy is heavily dependent on foreign corporations.[36] Several large multinationals (Boeing, IBM, Motorola, Cisco, and Microsoft) have R&D centers in Russia. In addition, many of the foreign companies are investing in local production facilities to make their penetration into the local market more cost-effective and to overcome legal restrictions on imports. The broad trend is to keep the company's R&D and manufacturing base in Russia but move marketing and sales to the United States.[37] Some of the high-technology multinational companies use the scientific expertise of Russian research institutions by establishing R&D centers and contracting with them on a long-term basis (Sokolov 2010).

The transnational corporations are important to the Russian national innovation system given the volume of their direct investment into the Russian economy during the last 10 years. Between 2007 and 2010 the number of foreign-owned companies engaged in R&D remained at about 60 or approximately 1.5 percent of the total number of all organizations performing R&D. The greatest innovation activity comes from the companies Russia jointly owns with other countries, which play a positive role in the Russian innovation economy (Sokolov 2010). Examples of these transnational corporations are in Appendix E.

Outward flow of foreign direct investment (FDI) from Russia has also steadily increased over the past decade. Some of the investments are acquisition related, with the goal of accessing particular technologies or capital goods, which is reported to be the most important source of innovation as shown in Figure 9 (OECD 2011). Others have focused on strengthening the supply chain of Russia's large companies. Overall, the trend is towards increasing internationalization of the Russian economy.

E. Venture Funding and Access to Capital

The private financial system In Russia has been unable to accumulate the capital necessary to sustain growth and institutional change. This causes private banks and financial institutions in Russia to remain less competitive than large international banks. This situation is exacerbated by government policies that do not encourage investment[38]

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[36] A multinational corporation has a parent country and a centralized decision-making process but adopts a selling strategy that is unique to every other country where it has investments. A transnational company is borderless; it does not consider any particular country as its base, home, or headquarters.

[37] Discussions with experts. See Appendix A.

[38] All funding awarded by the government must be approved by the relevant ministry and is closely supervised by public prosecutors or the Tax Administration. Soon after beginning their work, research ventures must begin paying taxes regardless of whether or not they had the time to come up with a product that is earning revenues (USRBC 2012).

and result in capital flight. Recent changes to Russia's banking and strategic sector laws are aimed at improving its rankings in the World Bank's "ease of doing business" index.[39]

The venture capital sector is not highly developed in Russia compared to other Eastern Block economies or even other former Soviet republics. The source of most venture capital funding in Russia is the government, not private capital,[40] although the growth of the IT sector is gradually leading to the emergence of private venture communities such as the Digital October Center[41] and Startuppoint,[42] an online start-up community.

In the area of public venture funding, the earliest stage of funding is provided by the Skolkovo Innovation Ecosystem, the Russian Venture Company (RVC) provides middle stage funding, and Rusnano (a joint-stock company created and owned by the government of Russia and aimed at commercializing developments in nanotechnology) has a $10 billion budget for later stage funding (RUSNIC 2008). RVC is wholly owned by the government in partnership with private capital and invests in finance, ICT, telecommunications, nanotechnology, and biotechnology. Its aim is to encourage a system of innovation development and economic modernization by creating venture funds that in turn will finance around 200 Russian start-ups (RUSNIC 2008). Table 8 summarizes these funding sources.

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[39] See http://data.worldbank.org/indicator/IC.BUS.EASE.XQ.

[40] Discussions with experts. See Appendix A.

[41] The Russian Venture Club is a professional community of venture investors, created by and with the support of the Russian Venture Company. The operator of the club is the Digital October Center for New Technologies and Technological Entrepreneurship. The club holds regular meetings aimed at strengthening cooperation in the industry and the exchange of opinions among experts (http://digitaloctober.com/venture_club).

[42] Startuppoint is the largest online community of Russian start-ups with over 14,000 participants, 3,000 projects, and 300 private investors and venture funds. Its main activities involve connecting investors with innovative projects, attracting mentors to start-ups, and organizing events connecting entrepreneurs with investors (http://startuppoint.ru/home/).

Table 8. Innovation Funding Sources

Stage of Funding	Description
Early Stage Funding: Skolkovo	• Established in 2010, Skolkovo is an innovation ecosystem that has an Institute of Science and Technology, corporate R&D centers, business incubators and accelerators, private seed and venture funds, and start-up companies, as well as residential space and social infrastructure. • Skolkovo is governed by a special law, which gives its resident companies special economic conditions for running their businesses. • More than 200 companies have received the status of Skolkovo resident.[a]
Middle Stage Funding Russian Venture Company (RVC)	• Mission: to encourage the development of a VC industry and boost capital of VC funds. • Established in 2006, RVC was established by Russian Government on June 7, 2006 (Order No. 838-r). • RVC is a government venture capital fund to transfer capital to high-technology investments.[b]
Late Stage Funding: Rusnano	• Mission: to build a competitive nanotechnology industry based on the advances of Russian scientists and the transfer of cutting-edge technologies from other countries. • The Fund for Infrastructure and Educational Programs supports development of infrastructure to enable nanotechnology innovation in the country.[c] • Rusnano, USA, is located in Menlo Park, USA.[d]

[a] From http://web.mit.edu/newsoffice/2011/skolkovo-agreement-1026.html.

[b] From http://www.rusventure.ru/en/company/brief/.

[c] From http://en.rusnano.com/about.

[d] From http://en.rusnano.com/about/subsidiary/rusnano-usa.

RVC USA, a subsidiary of the Russian Venture Company, presents itself as a "visionary and strategic investor that melds the innovation of U.S. startups with the resources of Russia." While it has offices in Boston and Menlo Park, it directly invests in Russian companies that are incorporated in the United States, in particular those who would like to host R&D in Russia while keeping marketing and sales in the United States. The Russian fund focuses on making investments in the $1 million to $3 million range in IT, life sciences, semiconductors, and clean technology (East-West Digital News 2012). By most accounts it is too soon to judge whether the efforts have been successful.

An annual review of the Russian private equity and venture capital market in 2010 noted that the number of private equity funds and mixed investment funds formed in 2010 was many times higher than the number of new highly risky (VC) investment funds. Examples of emerging innovative companies are described in Appendix F.

While business innovation in Russia is a long way from success, Russia's accession to the World Trade Organization and improved intellectual property rights protection (described in the next chapter) could encourage increasing transparency in business regulation and increase prospects for innovation, but it is too early to gauge their effectiveness.

6. Impact of Policies on Innovation Indicators

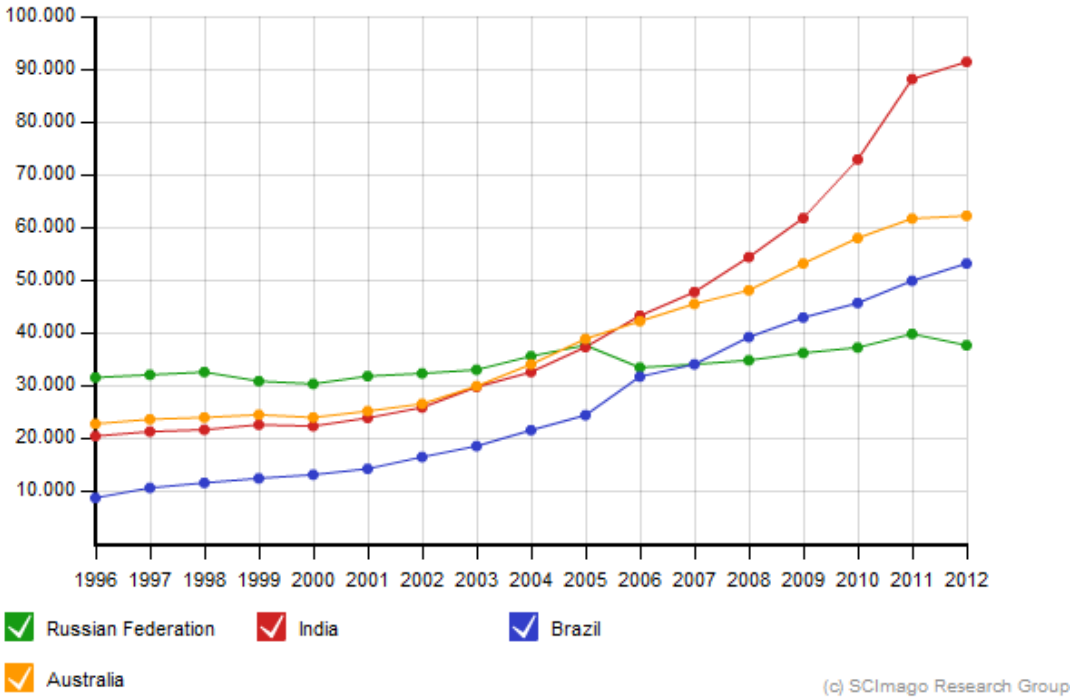
Russia has seen many changes in culture and governance over the past few decades; in some areas, the legacy of the Soviet Union inhibits the conditions required for innovation; in others, strengths of the Soviet era (such as a world class science and engineering workforce) have diminished to a large extent, creating a need for outward engagement to rebuild capacity. There is an imbalance between the innovation inputs and outputs in Russia, and recent government innovation policies aim to narrow this gap by

- Improving research-industry linkages and increase commercialization of R&D outputs through the establishment of technology parks and business incubators,
- Making research grants competitive and increasing research collaborations with the global scientific community, and
- Increasing private sector participation in, and funding of R&D and innovation-supporting activities.

This chapter presents data on the trends shown by innovation-related outputs for Russia.

A. Publications and International Co-Authorship

Russia been fallen behind peer countries (such as India and Brazil) in its rate of scientific publications as shown in Figure 12. Russia's worldwide ranking in number of citable scientific publications has dropped from ninth to sixteenth place in the past decade. The quality of Russian scientific publications has likewise fallen. Ranked by H-index, a measure of publication quality based on citations, Russia is in twenty-first place worldwide, ahead of India and Brazil. International co-authorship in scientific publication by Russian scientists have gradually declined over the past 3 to 4 years, after a decade of increase in the years 1996–2006.



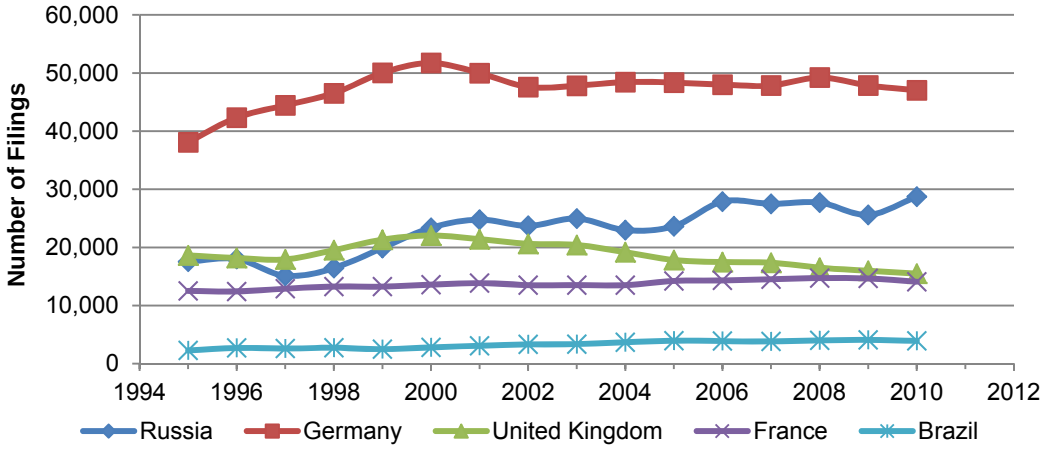
Source: Chart created using SCImago, http://www.scimagojr.com/index.php.

Figure 12. Trends in Number of Citable Documents Published in Scientific Journals for Russia and Selected Countries, 1996–2012

B. International Cooperation in Patenting Activity

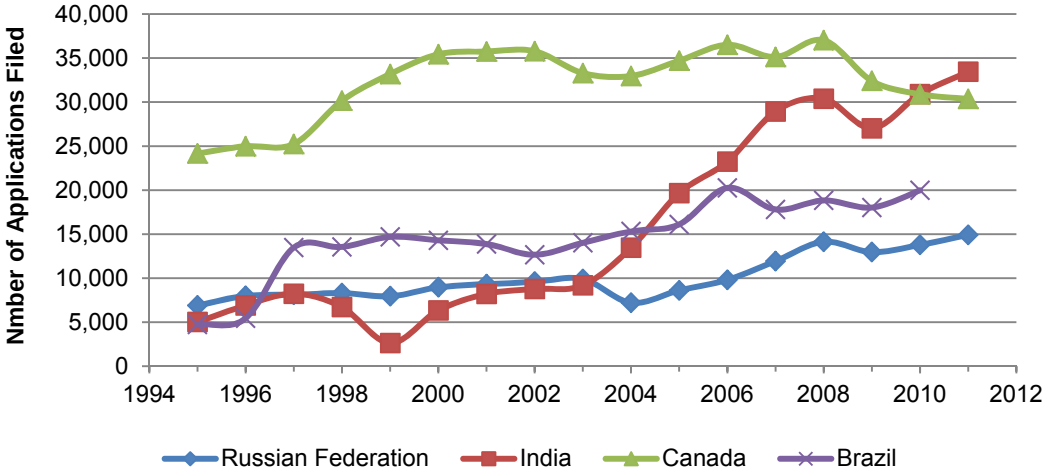
A comparison of patent applications by Russian residents versus nonresidents shows Russia's output characteristics are reversed relative to India and Brazil. In patent applications by residents, Russia is above the OECD average (on par with the UK and France) and significantly higher than Brazil and India, although it has lost ground to East Asian countries. The rate of patenting activity by residents in Russia, shown in Figure 13, speaks to a high potential for R&D-based innovative activity and new product development.

On the other hand, in the area of patent applications by nonresidents, India and Brazil have surged past Russia in the past 10 years, as Figure 14 shows. This reflects a comparatively high level of foreign investment in R&D in Brazil and India. Patents granted to nonresidents in Russia, on the other hand, while fewer, are growing. *Increase in nonresident patent activity despite weak IPR protection and bureaucratic challenges indicate that foreign investors are slowly tapping into Russia's strengths in science and engineering, undeterred by a risky investment climate and a low domestic capacity for commercialization.*



Source: World Bank Data, http://data.worldbank.org/indicator/IP.PAT.RESD/countries/KR-JP?display=default.

Figure 13. Number of Patent Applications Filed by Country Residents in Russia and Selected Countries, 1995–2010



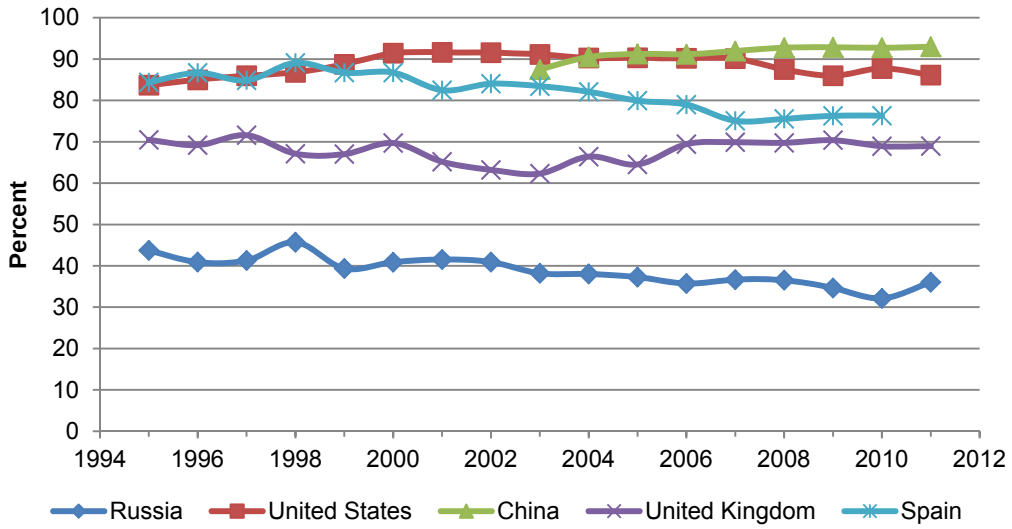
Source: World Bank Data, http://data.worldbank.org/indicator/IP.PAT.RESD/countries/KR-JP?display=default.

Figure 14. Growth in Patent Applications Filed in a Country (Domestic Patent Office or under the PCT) by Non-residents in Russia and Selected Countries, 1995–2011

Additionally, patents jointly filed with non-Russian co-inventors increased as a percentage of the total for patents filed at the USPTO, but declined for patents filed under the PCT and at the European Patent Office over the past decade. The same holds true for Brazil and India; researchers from these countries preferentially co-patent with US-based collaborators.

C. Business Expenditure on Innovation-Related Activities

The overall business expenditure on R&D in Russia as a percentage of GDP is at 0.66 percent, comparable to Spain and Italy (with the United States and Germany close to 1.9 percent and China at 1.4 percent). It is predominantly focused on services (over 85 percent) with high-technology manufacturing at less than 8 percent. However, when considering the fraction of business R&D that is financed by industry (excluding government and other sources), Russia ranks lower than all OECD countries indicating poor (and declining) industry participation in R&D related activities, as shown in Figure 15. This is in partly driven by weak enforcement of intellectual property rights. *Current innovation policies have not stimulated industry financing of R&D and innovation activities sufficiently to reverse this trend.*



Source: OECD.StatExtracts, http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB.

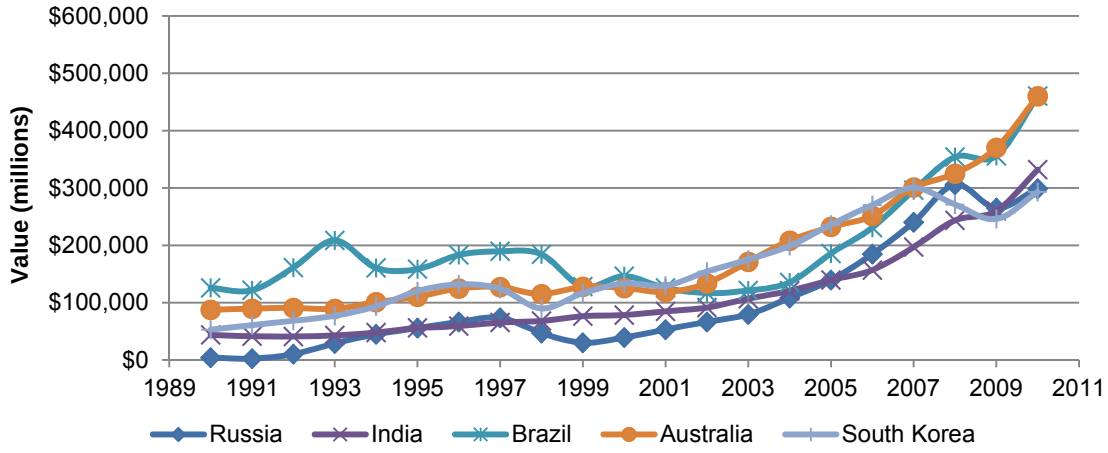
Figure 15. Percentage of Business Expenditure on R&D Financed by Industry for Russia and Selected Countries, 1995–2011

D. Value Added of Knowledge-Intensive Services and Manufacturing

In value added of knowledge and technology-intensive industries, Russia has grown steadily over the past 15 years, keeping pace with India, Brazil and Australia as shown in Figure 16. However, Figure 17 shows that the bulk of this increase comes from services such as business, financial, health and education; the share of high-technology manufacturing in value addition has actually fallen during this period.

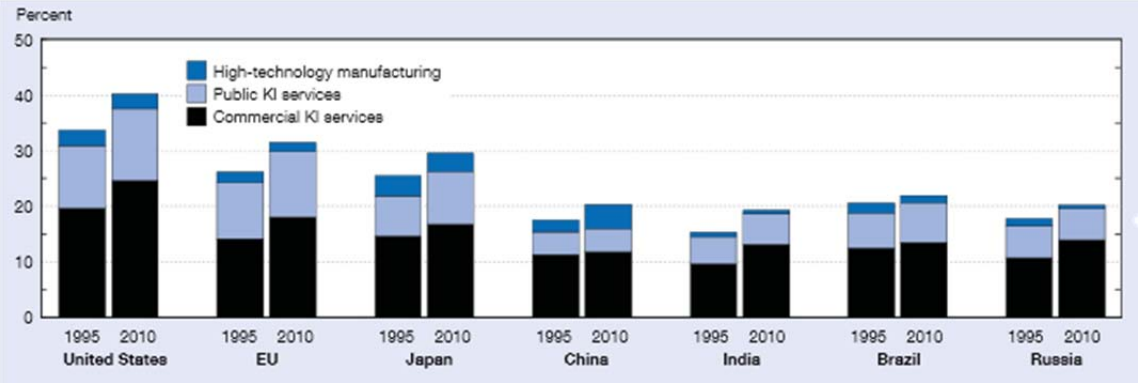
As a share of GDP, Russia's knowledge intensive services have grown on par with Brazil, India and China. As Russian firms increasingly participate in global value chains

of knowledge-based service and manufacturing industries, competition can serve as a driver for innovation. This can be seen in the IT and IT-dependent sectors.



Source: NSB (2013).

Figure 16. Value Added of Knowledge- and Technology-Intensive Industries for Russia and Selected Countries, 1990–2010



Source: From NSB (2013).

Figure 17. Change in Output of Knowledge- and Technology-Intensive Industries as a Share of GDP for Russia and Selected Countries, 1995 and 2010

E. Specific Outcomes of Recent Innovation Policies

Some of the more recent innovation-related policies and their impact are described in Table 9. For most of the innovation related policies discussed here, it is too early to estimate the impact on output indicators. *However, in some areas, notably human capital development, steps have been taken toward attracting foreign S&T talent and enhancing linkages between research institutions.*

Table 9. Impact of Recent Russian Innovation Policies

2012
Policy: Law on Special Economic Zones (2012)—"SEZ Law" (recently amended) sets minimum investment threshold, residency requirements, permitted business activities, and simplifies land acquisition and administration procedures. **Impact:** Too early to tell about the recent amendments that went into effect early January 2012, but as of January 2012, 307 projects are being implemented in 25 special economic zones, and the overall private investment is USD 12 billion. At the same time, Russia has spent about USD 1 billion to develop special economic zones.
Policy: Decision of the Government of the Russian Federation No. 93 of February 6, 2012 "On the Endorsement of the List of Scientific and Innovation Organizations Permitted to Invite to the Russian Federation Foreign Citizens As Research Workers and Teachers for Scientific or Teaching Activities Beyond the Permission for Attraction and Use of Foreign Workforce" **Impact:** Too early to tell.
2010
Policy: Resolution 219 Open grant competition initiated on April 9, 2010. Designed to build a network of élite research universities across the Russian Federation, while promoting regional economic development, world-class teaching and scientific research, successful technology transfer and commercialization programs, and entrepreneurship. NRUs are expected to enter the rankings of world-class universities by 2015-2020. Resolution 219 provides a total of USD 1.6 billion to support NRU development through 2014, with USD 1 billion approximately allocated through 2013. NRU funding is expected to be steady through 2019 (EURECA 2012). **Impact:** Too early to tell. In 2010, 197 eligible applications were received, and 56 awards made. Among the winners were 20 research universities and 5 federal universities (ACIE 2012)
Policy: Federal Law #86-FZ "On Making Changes to the Federal Law on the Legal Status of Foreign Citizens in the Russian Federation"—This new law to attract foreign scientists came into effect in 2010. Work permits for foreigners recognized as highly qualified specialists will be issued for 3 years with the possibility of multiple renewals. Their income tax rate will be 13 percent. **Impact:** Although the new law does not satisfy all the desires of international companies doing business in Russia with regard to lowering costs and increasing competitiveness, it is now significantly easier to bring assignees to Russia and formalize their status once in the country (Borisova and Gerebtsov 2010)
Policy: In April 2010, through Resolution 220, "Measures to Attract Leading Scientists to Russian Educational Institutions," the Russian government began implementing an initiative to attract leading world scientists to Russian universities in order to develop world-class laboratories. **Impact**: Three-year grants of 150 million rubles each (about USD 5.3 million) were awarded to 40 projects in 2010 and another 39 in 2011. This initiative rapidly expands the circle of global scientists involved with Russia, and nurtures a new generation of Russian scientists open to the world and familiar with global approaches that can be applied to Russia's interests and Priorities. The initiative is also expected to help bring Russian science to the global market, advancing brain circulation rather than "brain drain." (EURECA 2012) The winners in 2010 include world-class researchers such as Ferid Murad, a Nobel Prize laureate in physiology and medicine, who will be visiting Moscow State University of Medicine and Dentistry; mathematician Stanislav Smirnov, a Fields Medal awardee, arriving at St. Petersburg State University; the bioinformatics guru Pavel Pevzner; top-rated physicist Yuri Kivshar; and leading polar researcher Jorn Thiede (AccessRU 2010).

2009
Policy: FZ Federal Law 217 FZ (2009)—"Law on Small Enterprises near Universities;" gave Russian universities control over their intellectual property, allowing for the creation of small companies on campuses enables federally educational institutions to engage in commercialization of intellectual property and start-ups. **Impact:** According to the Gaidar Institute (http://www.iep.ru/en), by the end of 2009, 116 business entities had been established by 44 HEIs (OECD 2011). In January 2012, Yevgeny Primakov the president of the Russian Federation Chamber of Commerce and Industry (RF CCI) proclaimed this long-awaited law to be nonworking in practice and requires additional normative acts (EUREKA 2012)
2008
Policy: Federal Law No 57-FZ "On the Procedure of Making Foreign Investments in Companies of Strategic Importance for National and State Security" of 29 April 2008. **Impact**: Despite amendments introduced in 2011, uncertainties remain. In practice it remains difficult for foreign investors to determine the exact scope of application. In addition, many investors have complained of onerous approval process and the significant delays it causes (Sybre 2012). On November 28, 2012, PM Medvedev chaired a session of the Commission on Foreign Investment which drafted new SSL amendments. It is expected that they will be introduced into the Duma within the next few weeks, and adopted and signed into law within the next six months.

7. Factors that Can Affect Innovation in Russia and Challenges Therein

Russia's top-down, state-driven innovation policies and mechanisms are not likely to be successful by 2020, as projected. This innovation by decree or fiat is contrary to the way that innovation succeeds elsewhere. Moreover, the Russian national innovation system efforts are fragmented and not well coordinated. They represent a zero-sum game, shifting resources from one to another. Unlike Medvedev's championing of high-technology industries and innovation, President Putin's priority has been to invest in military innovation.

To foster innovation in business, the Russian Government has initiated a variety of policies across all geographic and industrial regions, including improving research-industry collaborations and instituting a confusing array of technology platforms, technoparks, business incubators, and global collaborations. Many of these directives create top-down isolated environments that are not conducive to innovation. However, adaptive strategies such as creating special economic zones to shield companies from the rampant corruption are a step in the positive direction. Meanwhile, businesses and talented entrepreneurs are using technology to adapt to (and circumvent) the political environment, and marketplace mechanisms are beginning to emerge that could potentially advance innovation in certain fields.

A. Intellectual Property Rights Protection

In 2008, Russia incorporated the WIPO Copyright Treaty on intellectual property rights (IPR) into Part IV of the Russian Civil Code. Although this was an important step in the right direction, the document failed to address many key issues, including those involving compensation, and many view this legislation as composed solely for the purpose of meeting World Trade Organization eligibility requirements. Currently, IPR regulation is the responsibility of one organization, the Russian Federal Service for Intellectual Property, Patents, and Trademarks. Russian judges and prosecutors unfamiliar with IPR often travel to the United States for training supported by the U.S. Patent and Trademark Office. Special economic zones will have IPR courts onsite. While

progress in IPR protection has been slow, the legislation is beginning to pave the way for collaborations in higher technology content industries.[43]

B. Entry into World Trade Organization

After 19 years of negotiations, the World Trade Organization admitted Russia on August 23, 2012. Russia has committed to revised intellectual property rights, reduced import duties (on average from 9.5 percent to 6 percent within 3 years of entry), and negotiated a number of special provisions relating to foreign investment in the banking, insurance, and telecommunications sectors.

The hope is that membership in the World Trade Organization will encourage economic modernization and facilitate efforts to improve the business environment. Russia's industrial and retail sectors are expected to benefit from lower import duties on equipment; on the other hand, local industries will face increasing foreign competition. Protectionist tactics are already being used by the government to counter the lowering of tariffs, such as imposing fees and fines on imported cars, in an attempt to encourage companies to invest in local manufacturing plants.[44]

C. Global Collaborations

Rusnano and the Russian Venture Company now have offices in the United States and there are several collaborations between Russia and Israel. New opportunities for Russian students to study abroad and for foreign researchers to work in Russia are emerging. Launched in 2009, the foreign researcher program provides 79 grants of up to USD 5 million each to integrate internationally acknowledged scientists into Russian

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[43] IBM signed an agreement to provide designs for chipset production to domestic chipmaker Angstrem, a step by the global electronics giant to gain a bigger footprint in Russia. Until this and another partnership for microelectronics development were signed this year, IBM "did not have any good collaborations" in Russia's microelectronics industry, said Michael Wirth, a business development executive with IBM Russia & the Commonwealth of Independent States (CIS). (IBM and CIS are working together "to capture regional business growth and increase its presence in the fastest growing markets in the world.") Under the agreement, U.S.-based IBM will share intellectual property related to the manufacturing process of its 90-nanometer chipset. It also will assist Angstrem in setting up production. Based in Zelenograd, Angstrem began as a state scientific organization in 1963 and became a shareholder-owned company in 1993, according to its website. It is owned by Leonid Reiman, the communications and IT minister from 1999–2008 (Nielsen 2012). At the St. Petersburg International Economic Forum in June 2012, IBM signed an agreement with technology firm ITFY and Rusnano, Russian Venture Company, Rostelecomand, and the Skolkovo Foundation. Under the agreement, a microelectronics center will be created at the Skolkovo innovation hub outside Moscow and have access to IBM's intellectual property for chip design (Nielsen 2012).

[44] Despite Russia's entry into the World Trade Organization this year which should ostensibly lower tariffs, the government has continued to nudge companies to invest in local production by imposing a $700 fee on imported cars, ostensibly for recycling the vehicle when it breaks down (Kramer 2012)

university research laboratories (Gokhberg and Roud 2012).[45] In 2010, forty leading Western scientists, some with Russian backgrounds, were awarded these grants to support their partnerships with local institutions of higher education in both applied and fundamental fields of knowledge (AccessRU 2010).

Russia has been open to Western advice in the energy sector where it relies on Western technology to find and extract oil and natural gas. In the 1990s Russia had Production Sharing Agreements with Western companies. Shell, for example, made investments, and once it recouped its investment, it shared the profits with its Russian partner. However, in recent years, business agreements with Russian oil companies have not been conducive to collaborative production activity because foreign companies had to keep increasing the investment amount, thereby forestalling profit sharing. Western companies are now limited to the role of minority partners using advanced extraction technology to discover new oil and gas deposits. As minority shareholders, they have limited power and little visibility into the workings of Russian companies. In 2012, Rosneft provided an opportunity for BP to leave a joint venture between BP and AAR, a Russian oil consortium.[46]

D. Innovation in the IT Sector—A Growing Entrepreneurship Ecosystem

Entrepreneurship capabilities in Russia are nascent, stemming from a history of state control accompanied by a lack of acceptance of failure. Forty-seven percent of foreign investors do not perceive Russia as having an environment attractive for entrepreneurship.

The ICT sector in Russia stands out as one where bottom-up, grassroots entrepreneurship is a growing force, buoyed by its access to the largest Internet market in Europe. In 2010, 42 percent of private equity and venture capital investment was in the ICT sector (Russian Venture Capital Association 2010). Russians have established

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[45] Federal Law #86-FZ allows work permits to be issued to foreigners recognized as highly qualified specialists for a period of 3 years with the possibility of multiple renewals. Although the new law does not satisfy all the desires of international companies doing business in Russia with regard to lowering costs and increasing competitiveness, it is now significantly easier to bring employees to Russia and formalize their status once in the country (Borisova and Gerebtsov 2010).

[46] TNK-BP is a joint venture between BP and AAR, a group of oligarchs. In recent years, the relationship between BP and AAR has been deteriorating. On October 17, 2012, AAR agreed to sell its half of TNK-BP to Rosneft for $28 billion. The next day, Rosneft offered BP the same amount for its half of the joint venture. The offer would be paid partly in cash and the rest in shares, giving BP a 10 percent stake in Rosneft (*Economist* 2012). Russia watchers, however, have little doubt that the takeover was scripted inside the Kremlin. Rosneft is run by Igor Sechin, a long-time Putin ally and Kremlin hard-liner who has always favored extending state control over key assets (Stott 2012).

themselves in the global ICT market without any government assistance, or as is commonly described, despite government intervention. Many successful IT entrepreneurs have turned into investors themselves, slowly spurring an entrepreneurship ecosystem. For example, Igor Matsanyuk, who merged his online gaming company Astrum Online Entertainment into Mail.ru, subsequently founded the investment company IMI.VC.

Russian innovation tends to be incremental and imitative, adapting to conditions on the ground rather than being cutting edge. As a result, innovation is sometimes seen in unexpected places, such as part of an informal service economy where there is a high degree of mistrust in formal institutions. Two such ideas that have been successful are.

- QIWI, a reverse ATM machine that adds cash to a prepaid card. This innovation has potential throughout the world where people are reluctant to use banks.
- Ozono (the Russian Amazon) accepts cash only on delivery, motivated by a lack of retail stores and the consumer's mistrust of the banking system. Further, Russian consumers want to see the product before they purchase. This requires a sophisticated product delivery system, which could prove to be an innovative model for other developing countries, such as those in Africa.

Shortly after his inauguration in 2008, President Medvedev signed a decree on urgent measures to eliminate administrative barriers to entrepreneurship and achieve speedy development of relevant legislation (OECD 2011). These and other efforts to encourage and nurture entrepreneurship have been implemented, but their impact is unclear.

Russia's Information Technology Sector—A Growing Strength

Russia's software market is dominated by small and medium-sized enterprises (SMEs) with higher average wages than India or China. Exports have grown sharply, reaching USD 3 billion in 2009. Russian companies have established brand recognition as developers of complex software solutions involving sophisticated algorithms and are globally competitive in anti-virus software and games for the mobile platform.

Perhaps the most famous entrepreneur in Russia is Eugene Kaspersky (a former KGB official and Putin associate), co-founder of Kaspersky Lab, which makes antivirus products. Yandex, the "Google of Russia" is now a public company, and similar ventures such as the London-listed Mail.ru Group, for example, reported a year-over-year revenue growth of 50 percent for the first quarter of 2012. Russia has its own Facebook (vKontakte), Google (Yandex), Amazon (Ozono), and Groupon (BigLion).

E. Globalization of the Younger Generation and a Rising Middle Class

There is a "western minded, new generation, that doesn't know the Soviet-lifestyle indoctrination" (Dubograev 2012). This younger generation (30 and under) is seeking more academic opportunities abroad and some have returned to Russia to begin their careers. The increased effort to retain Russians with foreign degrees has been reflected in new educational policies, government initiatives, and financial incentives from state-corporations; however, some experts are not convinced these policies are working.

Overall consumer spending is on the rise in the Russian middle class, encouraging foreign investment and creation of startups (Kramer 2013). Recent increases in foreign direct investment to Russia have spurred manufacturing activity (52 percent of total foreign direct investment, which also includes manufacturing related to resource extraction) in sectors such as automotive, food production, and machinery and equipment (Ernst & Young 2011). Russia is projected to surpass Germany and become the largest automotive market in Europe in 2014. In August 2012, Russians bought more cars than Germans did, before sales tapered off in the fall. Four big automotive manufacturers—Ford, Renault, General Motors and Volkswagen—have signed agreements with the Ministry of Economy to each increase local production to 350,000 cars a year, build engine factories, and invest in R&D. These foreign carmakers are choosing to manufacture in Russia instead of importing vehicles manufactured elsewhere in part because of Russia's onerous rules on imported cars.[47]

[47] Despite Russia's entry into the World Trade Organization this year (which should ostensibly lower tariffs), the government has continued to nudge companies to invest in local production by imposing a $700 fee on each imported car, ostensibly for recycling the vehicle when it breaks down (Kramer 2012).

8. Summary and Conclusions

A. Legacy of Soviet-Era Institutions

Innovation is typically believed to thrive in an environment of openness, competition, access to information, and risk taking, all of which were discouraged or penalized in the Soviet era. Russia does not have a tradition of private property ownership or commercialization of innovations. Consequently, by most commonly accepted indicators, Russia has traditionally lacked the drivers for innovation (sophistication of the commercial sector, competition, customer demand), mechanisms for innovation (research-industry linkages, avenues for commercialization of R&D outputs) and the framework conditions that can enable and foster innovation (effective governance and rule of law, support for business and entrepreneurship, trade and intellectual property laws), where Russia most lags behind other countries.

On the other hand, a strong education system, particularly in science and engineering, and a tradition of defense-focused R&D and innovation—the legacy of the Soviet era—create potential opportunities for Russians in knowledge-intensive industries and have made Russia an attractive target for multi-nationals seeking R&D talent.

Today, success in business and innovation in Russia are usually achieved by either adapting to and functioning within the prevailing conditions or circumventing the reach of authority. A fear of failure still prevails, discouraging entrepreneurship in the culture. For innovation policies to succeed, Russia needs a transparent and effective regulatory framework, and this is where Russia lags behind comparable economies.

B. Weak Participation by Domestic Firms

By most measures, the capacity and sophistication of the commercial sector is not conducive to innovation. Outside the state-supported sectors, R&D and technology development are weakly linked to production. Weak enforcement of IPR and poor research-industry linkages have left the bulk of Russian firms geared towards innovation by imitation rather than commercialization of new products, and the current innovation policies have had little impact on this. Recent policies that facilitate knowledge absorption and diffusion of knowledge (critical for imitative strategies) are geared towards technoparks and business incubators, and have not benefitted the economy as a whole. As a result, the domestic sector’s involvement in innovative activities is far below the EU average and has remained flat over the past decade. Only one in ten businesses invests in R&D and innovation.

An exception is the information technology sector which stands out as an example of a growing innovative sector despite the ground conditions, engendering venture capital networks and allowing innovation to occur outside the control of the government.

Of all the innovation related indices, those associated with the way domestic companies compete are the weakest and most lacking in improvement (for example, Russia's ranking in innovation indicators related to technological advantage and business conditions is much lower than those which are weighted towards R&D-related inputs).

C. Non-Competitive Natural Resource Sector

Russia has plentiful natural resources widely distributed throughout the country. One of the world's biggest suppliers of oil, Russia's economy is highly dependent on its natural resources. This "resource curse" is believed to have inhibited the creation of knowledge-based sectors, unlike in other countries such as Australia, Norway, and Canada that have done so despite a heavy dependence on natural resource income. Studies of countries that have escaped the resource curse suggest strength of institutional structures, high levels of transparency and long-term planning as factors that predispose a nation to invest the wealth generated by the natural resources in a way that brings long-term benefits to society (Humphreys, Sachs, and Stiglitz 2007). These factors are missing in Russia.

A more worrying aspect is that Russian state-run oil companies—not innovative by any standards—may not be competitive in the long run, given the development of new energy technologies (such as fracking and shale-oil) as well as competition from China, which gives the European Union and other customers of Russia's oil companies more options from which to choose.

D. Culture of Corruption and Bureaucracy

The legacy of the Soviet Union and a state-controlled economy has resulted in pervasive corruption and excessive bureaucracy, which outweigh other factors in the extent to which they deter business and innovation. Research and academic institutions also suffer mismanagement of funds and lack of transparency, which has resulted in a large-scale decline of their quality. Lack of judicial independence and a high rate of business related convictions effectively discourage investment and dampen the entrepreneurial spirit.

Much of the private sector in Russia, including multinational corporations, has developed adaptive strategies to grow and succeed despite the corruption and bureaucracy entrenched in the culture. International automobile companies invest in Russian car manufacturing facilities that are going out of business as a way to avoid stiff

tariffs while quickly gaining a foothold in a country that has one of the fastest growing global automotive markets.

E. Growing Foreign Investment

An increasing inflow of foreign domestic investment into the manufacturing and ICT sectors provides reason for limited optimism. Driven by rising demand as well as access to a skilled workforce, collaborations with Boeing, General Electric, IBM, General Motors, and others are improving the overall investment climate and creating new market-driven mechanisms to grow the economy. Multinational corporations are increasingly setting up joint manufacturing operations with Russian companies, so it is likely that Russia's production in sectors such as automotive, materials, and aerospace will increase. Russia's recent entry into the World Trade Organization opens up new opportunities for trading and IP-driven collaboration, of which companies like IBM are already taking advantage.

F. Ambitious Innovation Policies Hindered by State Control

The Russian Government has implemented several policies aimed towards developing the conditions and infrastructure needed for innovation. One example is the creation of special economic zones, enclosed campuses where companies receive legal and physical protection, and in theory would be isolated from corruption and bribery. Despite the best of intentions, bureaucratic challenges and the overall environment of top-down control lead to a pessimistic outlook. Recent alleged corruption problems at Skolkovo are already creating concern with global partners. Strategy 2020, an overarching mandate for strategic S&T planning developed in 2011 is viewed as overly ambitious and unrealistic.

G. Summary

In summary, while there are glimmers of innovation emerging, Russia's ability to implement its innovation strategy is hampered by the country's top-down central planning approach and a near-absence of a regulatory framework conducive to innovation. Corruption and lack of transparency thwart the intent of government action and make it difficult to gauge the true impact of planned policies.

Recent government policies to support innovation have attempted to create a business-friendly environment by mandating special economic zones around technoparks and business incubators; however, without linkages to the production economy the impact of these policies may be minimal. Emerging areas such as nanotechnology and biotechnology, where the Russian government has made large investments may suffer from the absence of links to the private sector.

An underdeveloped financial sector and limited access to capital also hinders industrial innovation, however, improving regulations and the presence of foreign companies have contributed to the recent growth of the banking industry. With the exception of the information technology sector, venture funding in Russia is largely public and still nascent, despite some growth in areas such as nanotechnology, biotechnology, IT, and telecom. There is a steady growth of private venture capital inside and outside Russia seeking to invest in Russian companies and incorporating in the United States (particularly Delaware) to circumvent bureaucracy. While the effect is small at the moment, it gives investors a chance to seek out talent in Russian small and medium-sized companies.

Russia is growing in importance as a destination for multi-national corporations. Aerospace, automotive, and other technology-intensive sectors are leveraging existing technical expertise by setting up research centers and other collaborative ventures; this is substantiated by a steady increase in patent filings by nonresidents in the past decade. A fast-growing middle class is expected to bring increasing competition and growth in the consumer driven economy.

Our analysis shows that commercialization of R&D outputs in the civilian sector is one of the weakest aspects of Russia's national innovation system; Russia's rate of patent applications by residents is above the OECD average (on par with the UK and France), while industry participation in R&D-intensive innovation activities (as opposed to innovation by technology adoption or imitation) is lower than all OECD economies, suggesting that the country's substantial R&D investments are not being realized to the benefit of the civilian economy. A major barrier is weak enforcement of IPR. Recent innovation policies have had little to no impact on closing this gap.

On the other hand, a knowledge-intensive and nonproduction driven sector like information technology is able to draw upon the technological expertise of the Russian workforce and thrive at the margins of the bureaucracy. IT has grown rapidly into an innovative sector in Russia with increasing share in the global market, despite the ground conditions that inhibit other areas of the economy. For future sectors that are built on an underlying IT platform, Russia might be well poised for successful participation.

Underlying both successes and nonsuccesses in innovation is the role of governance and culture. Where firms are hindered by excessive bureaucracy, corruption and weak framework conditions, innovation is marginalized. A slow but increasing influx of FDI in knowledge-intensive industries may succeed in capitalizing on Russia's S&T strengths and increase Russia's capacity for innovation, if they are able to adapt to the conditions on the ground.

The strengths, weaknesses, opportunities, and threats of Russia's innovation system are summarized in Table 10.

Table 10. Strengths, Weaknesses, Opportunities, and Threats of Russia's Innovation System

Strengths	Weaknesses
• Plentiful natural resources widely distributed through country • Highly educated population with strong education system for science and technology • Balanced national budget with funds available for innovation projects • Federal government commitment to innovation and strong federal investment in innovation budgeted • Strong presence in select innovation sectors such as space and energy technology • Increasing number of multinational firms establishing R&D and other facilities	• Corruption and excessive bureaucracy pervasive • Lack of political and judicial transparency deters business and investment climate • Weak enforcement of intellectual property rights • Business sector lacks capacity and sophistication needed for technological innovation • Economy suffers from "resource curse" (excessive reliance on natural resources at the expense of developing the nonresource economy) • Inefficient state-owned enterprises dominate economy and hinder innovation • Economy dominated by oil and natural gas exports • Low levels of private investment in R&D and marketing; low demand for innovation products; lack of entrepreneurial culture in business and education; lack of domestic competition
Opportunities	**Threats**
• Expanding global need for science and engineering services offer growth markets for R&D firms • Strong institutions in technology research and education offer good candidates for collaboration with domestic and foreign firms • Collaborations with Russian and foreign organizations offer the transfer of more knowledge into the country • Participation in the digital economy presents opportunities for innovation-driven economic growth	• Outside opportunities for highly skilled Russians causing high emigration for the best workers • Decreasing oil prices and alternative sources of energy impact national revenues • An ageing population will drain the economy and limit technical skills of engineers and scientists • Those with control of R&D, including the national academies, are reluctant to give up power and embrace needed reforms • Lack of competition and state control of R&D drives innovation in wrong directions • Growing competition in global marketing of innovations from foreign countries

Appendix A.
Discussions with Experts

Table A-1. List of Experts by Sector

Sector	Expert Name	Affiliation	Date of Discussion
Academic	Lisa Cook	Assistant Professor, James Madison College, Department of Economics, Michigan State University	9/18/2012
Academic	Anna Fokina	Legal Intern at RVC USA	10/16/2012
Academic	Jean Guinet	Head of the Research Laboratory for Science and Technology Studies, Higher School of Economics (HSE), Moscow, Russia	10/1/2012
Government	Dmitry Akhanov	CEO of Rusnano, USA	10/16/2012
Government	Axel Tillman	Chief Executive Officer, RVC USA, Inc.	10/9/2012
Government	Israfil Raug-ogly Ali-Zade	Member, Trade Representation of the Russian Federation to the United States	11/19/2012
Stefan Dobrev	Nestle	Corporate R&D Portfolio Manager, Corporate Innovation, Technology and R&D	3/6/2013
Industry	Dmitri Dubograev	Founder and Managing Partner, femida.us	11/19/2012
Industry	C. Ellis Vaughn	G2 International Marketing	11/19/2012
Non-profit	Will Pomeranz	Deputy Director, Kennan Institute, Woodrow Wilson International Center for Scholars	9/6/2012
Non-profit	Edward Verona	President and CEO of the U.S.-Russia Business Council (USRBC)	9/19/2012
Non-profit	Kate Watters	Executive Director of Crude Accountability	10/11/2012

Appendix B.
Russia's Historical Timeline and Governance Structure

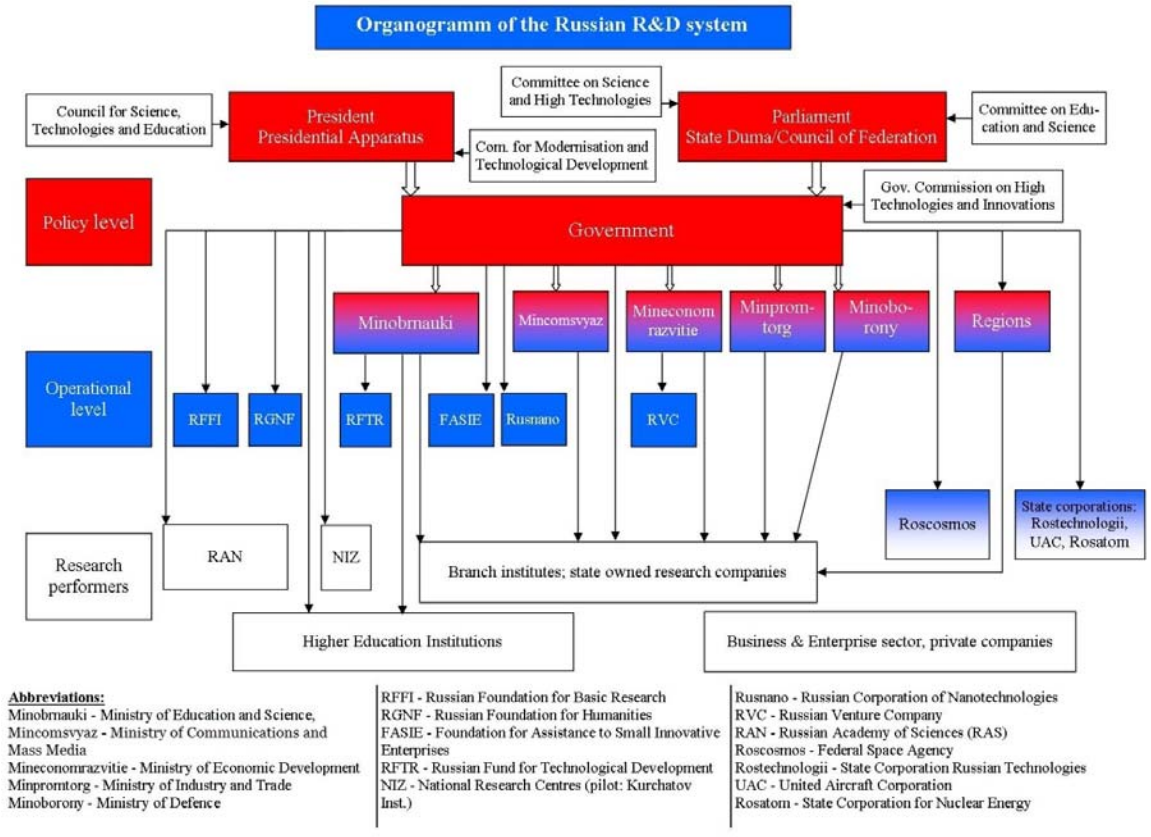
Table B-1. Timeline

1682−1725	Peter I the Great establishes Russia as a world power and introduces European cultural influences
1724	Peter the Great founds what is now the *Russian Academy of Sciences* (RAS) in St. Petersburg
1755	*Lomonosov Moscow State University* founded
1861	Emancipation Reform of 1861 freed serfs and gave them the right to own property and businesses
1917	Russian Revolution overthrows Tsarist government
1922	Creation of the Union of Soviet Socialist Republics (USSR, aka Soviet Union)
	Universities, where scientists carried out both training and research, now became exclusively training centers with little R&D activity
	R&D was now concentrated in research institutes of the RAS and of the industrial federal ministries
1929	Stalin proposes the first Five-Year Plan giving government control of the country's agriculture and manufacturing
1922−1940	Employment in *Science and Scientific Services* sector increased more than ten times and its share of total employment increased from 0.6% to 1.1%
1941	Soviet Union and the United States engage in the Cold War
1950	*Science and Scientific Services* sector were 82% higher than in 1940
1957–1975	Space Race between the USSR and the USA accelerated scientific advancement, led to many spin-off technologies and establishes technological leadership in the two nations
1985	Gorbachev comes to power and institutes the new liberal reform policies of *glasnost* and *perestroika*
	Democratization of the Communist Party through these more open and untraditional policies eventually leads to the collapse of the USSR
1989	President George H.W. Bush and Ronald Reagan declare the Cold War over
1990	R&D expands with investments mainly for personnel, rather than equipment and facilities.
	Personnel exceed 2.8 million, while applied R&D organizations remained separated from production and half of R&D was for military purposes
1991	USSR dissolves into 15 independent republics; 50% decline in GDP from 1990-1995
	Birth rate plummets, while death rate increases in Russia

	Ministry of Science, Technology, and Higher Education established and took over responsibility of the State Committee for S&T
1993	Constitutional crisis results in civil strife and near civil war
	The victory of Boris Yeltsin shifts power from the parliament to the president
	Beginning of a downsizing in R&D and a fall in the prestige of R&D and education careers
1998	The Russian financial crisis of 1998, also known as the "Ruble" crisis, reduces the value of the ruble, reducing spending and raising social tensions
1999	Transfer of power from Yeltsin to Putin; beginning of the Putin era
2002	Human capital flight (aka. "brain drain") epidemic tops 500,000*

* "Russian brain drain tops half a million," *British Broadcasting Company News*, June 20, 2002, accessed November 15, 2012, http://news.bbc.co.uk/2/hi/europe/2055571.stm.

The Russian R&D system shown in Figure B-1 is divided into two parts: the higher education system and the business system. Councils and committees provide a coordinating role across the ministries that focus on research and interactions with industry.



Source: ERAWATCH, "Russian Federation: Structure of the Research System," http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/ru/country?section=Overview&subsection=StrResearchSystem.

Figure B-1. Russian S&T (R&D) System

Appendix C.
Innovation-Related Policies and Mechanisms

Table C-1. Laws and Resolutions to Improve Research—Industry Collaborations

Resolution 218 (2008)	"On development of cooperation between Russian institutions of higher learning and production enterprises." It provides the business sector with incentives to collaborate with research groups in universities.
Federal Law No. 217-FZ (2009)	"Law on Small Enterprises near Universities;" gave Russian universities control over their intellectual property, allowing for the creation of small companies on campuses
Resolution 219 (2010)	"Grant Competition." The leading Russian universities have been invited to submit their proposals that should include a program of creation and development of infrastructure facilities in universities: business-incubators, technological parks, centers for technology transfer, etc. One important component of university's program on development of innovation infrastructure should be advanced training of university's staff in the fields of innovation entrepreneurship and technology transfer abroad and invitation of foreign experts for knowledge transfer and consulting.
Resolution 220 (2010)	"On measures designed to attract leading scientists to Russian institutions of higher learning."

Table C-2. Mechanisms and Institutions that Connect Research Organizations to Avenues for Commercialization in Russia

Mechanism	Description and Examples
Technical-Promotion Zones	Technical-promotion zones (Asia-Pacific Economic Cooperation (APEC) 2008) are designed to conduct research and develop the technologies into targeted applications. Four technical promotion zones: • Saint Petersburg—IT sphere • Moscow—Zelenograd—microelectronics • Moscow region—Dubna city—nuclear technologies • Tomsk—new materials sphere
Russian Union of Innovative Technological Centers (RUITC)	Created in 2000, RUITC has grown from 21 to 27 innovation technological centers in 8 regions of the Russian Federation with more than 1,500 companies participating. Their goals are to help companies be innovative, to promote the integration of Russian innovation centers in European innovation networks; to establish connections between regional and federal authorities, and to create an informational environment for an effective innovation centers interaction (http://eng.unitc.ru/aboutitc.html).
State Corporations	State Corporations work with universities and academic research institutes to build business incubators and start companies. These organizations are given status which allows them to pursue public missions but operate with more flexibility than typical government entities These organizations are: • **Rostechnologii**, which operates the military-industrial complex • **Rusnano**, a state-owned and –funded venture capital fund with a budget of $5.5 billion to facilitate growth in nanotechnology innovation • **Rosatom**, which leads the federal program on the development of the nuclear energy industrial complex • **Vnesheconombank**, which leads the building of a financing infrastructure, including special economic zones and supporting development or small and medium-sized companies. • **Roscosmos**, created in 1992, is in charge of the Russian civil and military space program • **Rosavtodor** is responsible for managing state property, specifically motor transport and road facilities, including management of federal motor roads • **Olympstroy**, the State Corporation for Construction of Olympic Venues, such as the development of Sochi Development as an Alpine Resort
Russian Technology Transfer Center	A network of over 70 innovation centers dedicated to coordinating marketing activities for the Russian aerospace and other high-technology companies

Mechanism	Description and Examples
Enhancing University Research and Entrepreneurial Capacity (EURECA)	The U.S.-Russia Foundation (USRF), in cooperation with a consortium of three organizations, New Eurasia Foundation (NEF), American Councils for International Education, and the National Council for Eurasian and East European Research (NCEEER), began implementation of the pilot stage of the program. During this pilot stage, sustainable partnerships between Russian and American research universities will be established, focusing on improving • research management and technology transfer • innovative infrastructure • international networking • seeking of public and private institutions into the program activities (EURECA 2012)
Russian Technology Transfer Network (RTTN)	The network is an association of 68 Russian Innovation Centers with the purpose to disseminate technological information and facilitate the search for partners to implement innovation projects
State Research Centers (SRCs)	50 SRCs associated with the defense complex

Table C-3. Efforts to Foster Entrepreneurship
(Some of Which Were Instituted Under President Medvedev)

Foundation for the Promotion of Small Enterprises in Science and Technology (FASIE)

Since 1994, a dedicated public nonprofit organization, FASIE has been successfully promoting science-based entrepreneurship. It uses 1.5% of the total civil R&D budget to support services to small innovative enterprises. The most significant program is "Start," which is targeted at start-ups and modeled on the SBIR program in the United States (EURCA 2011).

Center for Entrepreneurship (CFE)

Since 2002, the CFE has been offering programming and innovative training with a mission to accelerate entrepreneurship in Russia. It is an initiative of the U.S.-Russia Investment Fund, initially capitalized by USAID. CFE conducts policy forums aimed at improving the climate for startups and innovation and works to build a culture of entrepreneurship (Ortmans 2012).

The Center for Entrepreneurship and Executive Development (CEED)

CEED fosters contact and partnerships between Russia and South East European entrepreneurs in accelerating growth of the businesses through practical know-how and networking opportunities (http://www.ceed-global.org/web/Pages/AboutUs/default.aspx).

Digital October Center for New Technologies and Technological Entrepreneurship

Located in the center of Moscow, Digital October brings together engineers and software developers, entrepreneurs and venture investors, executives and analysts from global technology companies, designers and art professionals to create an ecosystem of technology entrepreneurship. The guiding principle of Digital October is meritocracy in which professionalism, accomplishments and innovation are valued (http://digitaloctober.com/about).

Business Start

Last December Sberbank launched a beta project to support business franchises and startups, known as "Business Start" (Russia Business Watch 2012) Sberbank offers the following (http://www.sbrf.ru/en/smallbusiness/loans/bs/):

- startup capital of up to 70% of project financing
- loans of up to 3 million rubles to launch a business 'from scratch'
- loans for a long term of up to 3.5 years
- loans without having to provide additional security
- franchise opportunities
- consultation support on business matters
- a free course on Basics of Business Operations

Appendix D.
Russian Transnational Corporations

Table D-1. Examples of Transnational Corporations

Ural Boeing Manufacturing
Boeing and the State Corporation Russian Technologies (Rostech), a majority shareholder in the joint stock company VSMPO-AVISMA Corporation, are working on an agreement to expand collaboration in titanium procurement and technology development. In July 2009, Boeing and VSMPO-AVISMA opened Ural Boeing Manufacturing (UBM) as a 50/50 equity joint venture based in Verkhnyaya Salda, Russia. UBM is a state-of-the-art facility that machines titanium forgings for the world's most technologically advanced airplane—the 787. Boeing forecasts that over the next 30 years it will spend as much as $27 billion on Russian titanium, aerospace design-engineering services and a variety of other services and materials (Boeing 2012).
Titanium Innovation Center
Boeing and VSMPO-AVISMA jointly support of the Titanium Innovation Center which has developed three new technologies that are being used in production of the 787 Dreamliner and Next-Generation 737 and may also be used by the Russian aerospace industry. Among these technologies are a new high-strength titanium alloy and a technology for fabrication of titanium sheets for super-plastic forming. The companies will continue developing technologies and alloys to further reduce the cost of titanium parts in commercial airplane manufacturing. (Boeing 2012)
Commercial Aviation Services
In commercial aviation services, Boeing and Rostech are seeking to work together to develop a component management service to support Russian airline customers. This could reduce investment costs, simplify logistics and reduce delivery time of critical spare parts to Russian airlines. The companies also are exploring ways for Boeing to assist Rostech in further development of in-country repair and overhaul capability for Western aircraft components, in order to grow aviation parts repair and overhaul organizations within Russia. Going forward, this expertise can support Rostech's ability to build an efficient and reliable support infrastructure for Russian-made jets such as the Sukhoi Superjet 100. (Boeing 2012)

Appendix E.
Russia's 10 Most Innovative Companies

A growing middle class and investments in innovation are producing some innovative companies in Russia. As one example, Fast Company identified the companies in Table E-1 as the 10 most innovative companies in Russia in 2011.

Table E-1. Russia's 10 Most Innovative Companies

Company	Primary Sector
Yandex. The internet search company Yandex is three times more popular than Google in Russia and this year, it made its move onto Google's international markets with the launch of an English-language search engine. One of Yandex's key advantages has always been the complexity of the Russian language, which has forced it to be a step ahead in the nuance of its algorithms. That pushed the Firefox browser to drop Google in 2009 as its default search engine in Russia, succeeding it with Yandex.	Internet Service Provider
Kaspersky Lab. Russia's leading computer security company has lured Russian geeks away from hacking (their usual forte) and into its virus analysis team. With the help of these whiz kids, Kaspersky Lab has become the fourth largest antivirus-program provider in the world.	Computer Security
ABBYY. Its products for converting paper documents into searchable electronic files are playing a critical role as all text goes digital. It also has an office in Milpitas, California, in the heart of Silicon Valley.	Digital Conversion
Rosnano. Hundreds of innovative nanotechnology project proposals have been submitted to this state-owned venture, ranging from to motor oil to high-tech medicines. The hope is that one of them will develop into a revolutionary invention that will make nanotechnology--and the Russian tech sector--a driver of global innovation.	Nanotechnology
Rosatom. By expanding from nuclear power plants and warheads into medicine, Rosatom spent more than $20 million on a new nuclear medicine complex that will encompass the entire production chain, from the production of isotopes to the manufacturing of the machines that then beam them into cancerous tissues.	Nuclear Medicine
M2M Telematics. By positioning itself to dominate the chip market for Glonass, M2M is Russia's competition to the U.S. Global Positioning System. Many companies are eager to leverage its technology including Nokia, Motorola, and Qualcomm.	Integrated Circuits
Optogan. The company has built a full-scale manufacturing facility in St. Petersburg that will be able to produce 360 million of its patented high-brightness light emitting diodes (LEDs) every year.	Optical Components

Company	Primary Sector
Mikron. A subsidiary of state-controlled Sitronics, Mikron makes the scannable chips used in everything from passports to subway tickets. It has developed the full production chain of these cards in Russia, delivering them to most of the former Soviet states, China, and parts of Southeast Asia.	Integrated Circuits
NPO Saturn. The Russian jet engine-maker developed the engines for Russia's fifth-generation fighter jet, the T-50, which is designed to compete with some of Lockheed Martin's latest warplanes. The T-5, which has made nearly two dozen test flights, is scheduled to be introduced in 2015.	Jet Engines
Lukoil. As Russia's biggest privately owned oil company, its efforts have mainly been focused on state-of-the-art technologies in oil refining and petrochemicals, as well as investments in clean energy and carbon-capture techniques.	Oil

Source: 10 Most Innovative Companies in Russia. April 22, 2011, http://www.fastcompany.com/1738950/10-most-innovative-companies-russia

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Abbreviations

ARWU	Academic Ranking of World Universities
CIA	Central Intelligence Agency
DARPA	Defense Advanced Research Projects Agency
EURECA	Enhancing University Research and Entrepreneurial Capacity
FDI	foreign direct investment
ICT	information and communications technology
IDA	Institute for Defense Analyses
IEA	International Energy Agency
IP	intellectual property
IPR	intellectual property rights
IT	information technology
MCMM	Ministry of Communications and Mass Media
MED	Ministry of Economic Development
MES	Ministry of Education and Science
MOD	Ministry of Defense
MIT	Ministry of Industry and Trade
NRC	National Research Council
NSB	National Science Board
OECD	Organisation for Economic Co-operation and Development
R&D	research and development
RUITC	Russian Union of Innovative Technological Centers
RSUTE	Russian State University of Trade and Economics
RTTN	Russian Technology Transfer Network
RVC	Russian Venture Company
S&T	science and technology
SRC	State Research Center
TNC	transnational corporation
UBM	Ural Boeing Manufacturing
USAID	U.S. Agency for International Development
USRBC	U.S.-Russia Business Council
WEF	World Economic Forum
WIPO	World Intellectual Property Organization

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14. ABSTRACT

This report examines the political, economic, demographic, and other factors that are brought to bear on Russia's industrial and innovation policies. The analysis explores Russia's strengths, weaknesses, opportunities, and threats to show that both governance and socio-economic factors play an important role in determining how well a country is able to use its endowments to create a strong national innovation system. By most commonly accepted indicators, Russia is lacking in drivers for innovation, mechanisms for innovation, and the framework conditions that can enable and foster innovation. Corruption and lack of transparency thwart the intent of government action, and an underdeveloped financial sector and limited access to capital hinders industrial innovation. The role of governance and culture underlies both successes and failures in innovation policies. A slow but increasing influx of foreign direct investment in knowledge-intensive industries may help Russia capitalize on its scientific and technological and therefore increase its capacity for innovation.

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