OECD Reviews of Innovation Policy

RUSSIAN FEDERATION

OECD Reviews of Innovation Policy: Russian Federation

2011

OECD

Please cite this publication as:
OECD (2011), *OECD Reviews of Innovation Policy: Russian Federation 2011*, OECD Publishing.
http://dx.doi.org/10.1787/9789264113138-en

ISBN 978-92-64-11312-1 (print)
ISBN 978-92-64-11313-8 (PDF)

Series: OECD Reviews of Innovation Policy
ISSN 1993-4203 (print)
ISSN 1993-4211 (online)

Corrigenda to OECD publications may be found on line at: *www.oecd.org/publishing/corrigenda*.

Foreword

This study is part of a series of OECD country reviews of innovation policy.[1] It was requested by the Russian government, represented by the Ministry of Education and Science of the Russian Federation, and was carried out by the OECD Directorate for Science, Technology and Industry (DSTI) under the auspices of the Committee for Scientific and Technological Policy (CSTP).

This OECD review of Russia's innovation policy draws on a background report prepared by the Ministry of Education and Science of the Russian Federation,[2] and on the results of an extensive series of interviews with major stakeholders of Russia's innovation system that were carried out by the OECD review team during two main fact-finding missions, the first in Moscow and Saint Petersburg, and the second in Tomsk and the Republic of Tatarstan. It also draws on several other Russian sources of publicly available statistics and information.[3]

The review was drafted by Jean Guinet, Head of the Country Studies and Outlook Division (CSO, DSTI),[4] Michael Keenan (CSO, DSTI), Gernot Hutschenreiter (CSO, DSTI) and William Tompson (Regional Development Policy Division, OECD Directorate for Public Governance and Territorial Development), with contributions from Jean-Eric Aubert, Michela Sciurpa and Patrick Dubarle (consultants to the OECD). Luc Soete, Director of UNU-MERIT (the United Nations University-Maastricht Economic and Social Research and Training Centre on Innovation and Technology), helped define the review's scope and objectives by participating in the first fact-finding mission in Russia, and provided subsequent advice on its implementation. Jean Guinet ensured overall project co-ordination and supervision.

The review was made possible by the initiative and support of Andrei Fursenko, Minister of Education and Science of the Russian Federation. It also owes much to officials from the Ministry of Education and Science of the Russian Federation and some affiliated institutions, particularly Serguei Ivanets (Vice-Minister and Head of the Russian delegation to the CSTP) and Vladimir Kiselev (Head of the Section for Research of International Science and Innovation Policy in the Centre for Science Research and Statistics), for providing guidance on the issues to be examined, for organising travel and interviews in Russia, for providing additional information throughout the review process, and for providing feedback on early drafts of the review.

Notes

1. See *www.oecd.org/sti/innovation/reviews*.

2. "National Innovation System and State Innovation Policy of the Russian Federation" (Moscow, 2009). The report was prepared by a consortium of research organisations including: Center for Science Research and Statistics of the Ministry of Education and Science of the Russian Federation; Federal Institute for Education Development of the Ministry of Education and Science of the Russian Federation; Institute of World Economics and International Relations of the Russian Academy of Sciences; Institute for National Economic Forecast of the Russian Academy of Sciences; and the Center for Strategic Development's "North-West" Fund.

3. Especially the Institute for Statistical Studies and Economic of Knowledge (ISSEK) of the National Research University – Higher School of Economics, and OPORA, a Russian Non-Governmental Organization for Small and Medium Entrepreneurship.

4. Up until the end of November 2010; currently independent consultant and Head, International Laboratory for S&T Studies, ISSEK, National Research University-Higher School of Economics, Moscow, Russia.

Table of contents

Tables

Figures

Boxes

OECD Review of Innovation Policy – Russian Federation Overall assessment and recommendations

Introduction

The challenge of diversifying Russia's economic structure and reducing its reliance on natural resource sectors has loomed large on the policy agenda for well over a decade. Even during the boom years before 2008, there was widespread awareness that growth was being driven by transitory factors and that steps were needed to facilitate Russia's transition into self-sustaining, investment- and innovation-led growth. Since late 2008, the global financial and economic crisis has underscored the importance of this challenge. Attention has therefore increasingly focused on modernisation and, in particular, on innovation, as the keys to Russia's successful development over the long term.

Modernisation and innovation are two faces of the same fundamental process through which a country can optimise the accumulation, renewal, allocation and use of the material and immaterial capital in order to increase its sustainable growth potential. The Long Term Social and Economic Development Plan until 2020 of the Russian Federation, adopted in November 2008, recognises that this involves consolidating existing comparative advantages while creating new ones based on the development and creative mobilisation of human resources and intellectual capital.

Considering what government can do to effectively promote such deepening and widening of comparative advantages, a wide array of public policies ought to be mobilised:

- *Monetary policy* must avoid an excessive appreciation of the rouble which could spread a Russian form of "Dutch disease".
- *Budgetary policy* must ensure fiscal sustainability in a way that secures an appropriate amount of public investment in innovation, as well as an innovation-friendly tax treatment of assets and income.
- *Competition and trade policy* should work in tandem to discourage rent-seeking behaviour and help improve the position of Russian businesses in global innovation networks and markets.
- *Financial policy* must promote the development of financial institutions that are able to value properly innovation-related investment and manage efficiently part of the risks inherent to innovation.
- *Education and training policy* should work with labour market policy to help secure the quantity, quality and efficient allocation of human resources required for more knowledge-intensive and market-oriented productive activities.
- *Research policy* must help develop and mobilise, for socially useful purposes, mutually reinforcing research capabilities in the public and private sector.

- *Industrial and regional policy* must provide appropriate infrastructure, frameworks and other support to realise the innovation potential of specific sectors and clusters.
- *Social and health policy* should consider innovation a means, but also a result of, the improvement of quality of life.
- *Environmental policy* should see pro-innovation regulations and incentives as important means to encourage value-creating responses to the need to decouple economic growth and use of natural resources.
- *Judiciary policy* must enforce the rule of law, protecting innovation activities that are already inherently risky against additional unbearable uncertainties.

It is likely to be insufficient to boost investment in research and development (R&D) and innovation through direct public support if too little attention is paid to the necessary improvement of the broader economic context.

The innovation system concept provides a unifying analytical perspective for the whole-of-government policy approach advocated by the OECD Innovation Strategy (Box 0.1). This report takes this perspective in assessing the current strengths and weaknesses of the Russian innovation system with a view to identifying institutions and policies that, with appropriate modifications, could enhance its performance. It does not examine in detail all aspects of relevant institutions and policies; after reviewing briefly those that shape what can be called framework conditions for innovation, it devotes more attention to dedicated science and technology (S&T) and innovation policies, with a special focus on research policy.

Achievements, shortcomings and challenges

An assessment of Russia's innovation system must adopt an evolutionary perspective (Figure 0.1). It must take into account both the enormous changes in the political and economic context since 1992 but also the important constraints imposed by the legacy of the past. This combination of radical transformation and the resilience of some former institutional arrangements and mindsets makes the modernisation trajectory of Russia very different from that of China, where the combination of a gradualist approach to the modification of the overall politico-economic framework has been accompanied, in a context of rapid industrialisation, by faster and more radical microeconomic structural reforms, notably in an admittedly less mature S&T and R&D corporate and public sectors. For example, one finds in Russia today the coexistence of increasingly prevalent market-oriented mechanisms for the allocation of economic resources with others that are more social/political network-based. There is a sharp contrast between progressive territorial, scientific, technological and industrial nodes of excellence and a rather large stagnant pool of firms and organisations with very low productivity and little innovation.

Despite the persistence of some of these problematic features, recent years have seen continuous progress in creating or empowering agents of positive change, whether individuals, productive, research and educational organisations, or public support institutions. This has brought the country closer to what could be a turning point in the development of an efficient national innovation system which, while maintaining distinctively Russian characteristics, would make a decisive contribution to the realisation of an ambitious national socio-economic development agenda.

Box 0.1. The innovation system approach in the Russian context

The innovation system approach emphasises the following ideas which are particularly important to be considered in Russian context:

- Innovation is not a specialised activity carried out by specific institutions that the government can create and direct but the result of more diffused primary forces that the government can mainly empower and influence.

  Russia has not yet entirely overcome the legacy whereby each task strategic for the society was entrusted to dedicated institutions, according to a strict division of labour.

- Innovation results from the interactions between a number of competent market and non-market institutions responding to compatible incentives. Relevant competencies are a mix of capacities inherited from previous phases of economic /historical development and new ones, which permanently develop in response to current and prospective opportunities, as signalled by the incentive structures.

  In Russia this process is still distorted by the strategies pursued by some powerful actors, including those who have inherited capabilities but resist their upgrading and redeployment when this would weaken their institutional position and those who have built economic and political influence through rent-seeking behaviour but have no pressing need to invest in new innovation-related competencies.

- Innovation systems are an evolutionary set of institutions and processes. They never reach a steady, optimal state but constantly co-evolve with surrounding economic and social conditions. As countries grow richer, the determinants of their competitiveness change as do the role and type of required science, technology and innovation capabilities. Initially, they compete primarily on the basis of factor endowments, before moving to an efficiency-driven stage of development, in which the key factors include a country's efficiency of its financial, labour and product markets and the quality of its institutions. The most advanced countries come to depend primarily on their ability to innovate.

  Russia developed substantial scientific and technological capabilities very early on, but these were poorly geared to wealth creation processes. It now faces the challenge of making the transition to an innovation-driven growth model whereas there is still a great deal of unfinished business at the second stage – in terms of institutional quality and market efficiency.

- In the most advanced innovation systems firms that operate on competitive markets are the main locus of innovation activities, *i.e.* the main places where new knowledge or new combinations of existing knowledge is transformed into economic wealth. But public research retains a key role in mission-oriented activities and as a supporting knowledge infrastructure for market-oriented actors.

  The Russian innovation system is not yet firm-centered, despite the high share of the corporate sector in R&D intensive activities, because the majority of technology-oriented enterprises are only to a limited extent driven by market incentives and are insufficiently submitted to market disciplines.

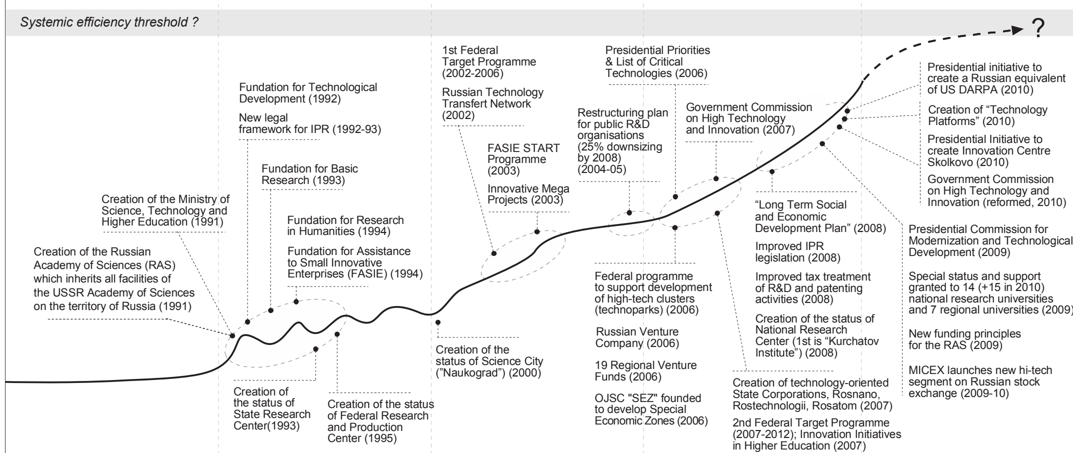
- Throughout their evolution and integration within global networks national innovation systems incorporate lessons from international experience but retain country-specific features which may be sources of competitive advantage or disadvantage.

  For all reasons given above the Russian innovation system exhibits strong distinctive features. Some of them are not imperfections but rather form the basis of knowledge-based competitive advantages which could be better exploited if other, more problematic features were removed through the adoption and adaptation of relevant international good practices.

Figure 0.1. Russia's innovation policy: Institutional reforms and learning curve

	Soviet background (till 1990)	Turbulent restructuring, with early experimentation of new innovation policy approaches (1990s)	Stabilisation, with significant additions to the innovation policy framork (2000-2005)	Consolidation and exp ansion of the innovation policy framework (2005-2010)	Towards a mature and efficient national innovation system (2010+)

Russia's innovation policy learning curve



	Soviet background (till 1990)	1990s	2000-2005	2005-2010	2010+
Innovation drive	Government demand dictates technological innovation in large scale engineering projects. Science is largely mobilised for the needs of the defense industry. Little innovation in consumer goods and non-priority capital goods sectors.	Collapse of government demand for innovation and of corresponding supply chains. With a few exceptions, successful firms in the new market environment rely mainly on foreign technologies and business know how.	First success stories of market-led innovation in some areas, e.g. software, advanced materials. Small innovative firms emerge, often as spin-offs of public research.But innovation remains low on the agenda of most large, often state-owned enterprises.	FDI and R&D centres of multinational corporations start to play a significant role. The number of innovative SMEs continues to grow but not enough to compensate the lack of a sufficient demand for innovation from large firms and the government.	
Public research	The Academy of Sciences carrries out most of basic research. A myriad of specialised institutes and other organisations carry out applied research and technological development for civilian and military purposes.	Abrupt downsizing and restructuring. Many organisations involved in applied research or engineering design are abolished or incorporated to the business sector. Foreign financing help survival but pauperisation leads to large scale emigation of scientists and engineers.	Inceased federal spending stops the degradation and lays the ground for renewal of viable organisations. Better working conditions, including salaries, and the development of innovation networks create new motivations and opportunities.	Sustained federal budgetary support allows upgrading of research capabilities through an increasingly selective approach. Reinforcement of university research capabilities. New support programmes and infrastructures facilitate commercialization at national, regional or local levels. But conservative forces continue to resist both market-led and government selection process.	
Innovation infrastructures	Idiosyncratic features with geographical distribution reflecting strategic (military) and political considerations, as well as historical circunstances (especially World War II).	First Technoparks appear in Tomsk, Moscow and Zelenograd (1990-91). First Innovation Technology Center created in Saint Petersburg (1996). Necessity encourages many experimental commercialization strategies in the public research sector.	Constant development of Incubators, Technoparks, Centers of Technology Transfert and Innovation Technology Centers, around both universities and public research institutes. Many bottom-up Initiative at local (e.g. science cities) and regional levels.	In 2008, there were about 120 Business Incubators, 85 Technoparks and 100 Centers of Technology Transfert. New programmes and approaches aims at consolidating these infrastructures around stronger nodes. technology-oriented Special Economic Zones (SEZs) are created in Saint Petersburg, Zelenograd, Dubna and Tomsk. Industrial SEZs are created in Lipetsk region and Republic of Tatarstan.	
Policy governance (Leading ministries and agencies)		Ministry of Science, Technology and Higher Education *(In charge of coordination of civilan R&D budget)* → Ministry of Industry, Science and Technology → Ministry of Education and Science →		*(Federal Agency for Science and Innovation)* →	*(abolished in 2010)*
		Ministry of Economy / Ministry of Trade → Ministry for Economic Development and Trade → Ministry of Economic Development →			
		Ministry of Communications → Ministry of Communications and Informatization → Ministry of Communications and Media →			
		Ministry of Defence →			
		Russian Academy of Sciences →			

The notion of a turning point conveys the idea that a system does not develop as a more or less rapid continuous process, but through phases that usually emerge when certain critical components reach maturity and start to interact fruitfully in the presence of appropriate catalysts. In terms of components, Russia now has a quite complete portfolio of competent actors (small and large firms, research universities, public research institutes) and supporting institutions and measures, although these are still insufficiently co-ordinated, some are still experimental, and others lack critical mass. Some recent additions to the institutional landscape may have catalytic effects. For example, changes at the highest level of policy governance may provide the needed policy catalyst if these are complemented by efforts to break with the top-down tradition in policy implementation and to build more distributed, co-ordinated and adaptive governance structures at lower policy levels.

Over the past few years, the political leadership has made innovation a national priority, and a series of concrete presidential initiatives prove that this is not mere rhetoric. To ensure that, beyond their individual merits, these initiatives can catalyse wider beneficial transformations, it is necessary to examine the current set of policy instruments and frameworks for gaps, weaknesses or inconsistencies. This should be based on a shared diagnosis of the current status of the innovation system, the strengths on which to build to exploit new opportunities in a challenging and highly competitive global environment, and the barriers to be rapidly overcome.

Table 0.1 provides a summary SWOT (strengths, weaknesses, opportunities and threats) analysis of the Russian innovation system. It shows that Russia has some useful legacies on which to build, including relatively high educational capabilities and strong positions in certain S&T fields. The recent high-level commitment to innovation has created the conditions for renovating and building new infrastructures in support of S&T and innovation along strategic lines. This in turn has led to efforts to target spending on priority areas and to introduce greater competition in the allocation of resources.

At the same time, the performance of the innovation system continues to be undermined by several factors, some of which are legacies of the former Soviet system. Among these are the very low levels of R&D and innovation activities in firms, weak framework conditions for innovation (particularly a lack of competition, low levels of trust, and high levels of corruption), and weak infrastructures and regulations. Furthermore, policy efforts at reform are often frustrated by active resistance from established groups and/or institutional inertia.

The current state of the Russian innovation system is represented in the top left-hand side of Figure 0.2. This shows that while firms are placed at the centre of the picture – as the natural loci of innovation activities – they have yet to assume a central role in the innovation system. Instead, in a set of arrangements peculiar to many (former) socialist systems, a large number of branch research institutes and design bureaus continue to play a dominant role in R&D and innovation. Although the number of personnel employed fell sharply in this sector during the 1990s, many institutes adopted preservation strategies and managed to survive, often at a level of basic subsistence. Many have been transformed into joint-stock companies while remaining government-owned. Their funding comes mostly from the public purse in one form or another, *e.g.* as block grants from government ministries or as contract research and design work from other, production-oriented, state-owned enterprises (SOEs).

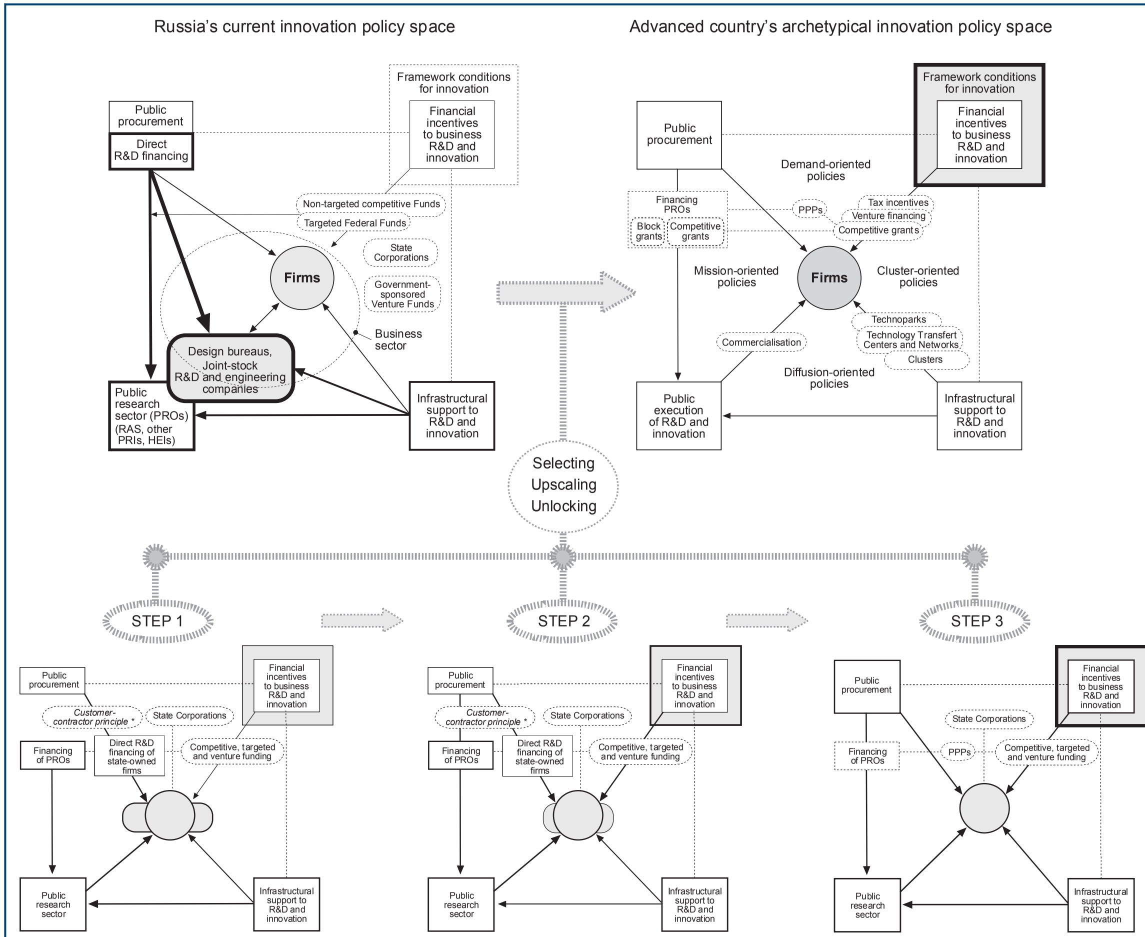
Table 0.1. SWOT analysis of the Russian innovation system

Strengths	Weaknesses
• Generous endowment of natural resources and accumulated intellectual capital. • Geographical proximity to, and historical links with, many advanced and emerging countries. • High general level of education of the population. A well developed and recently reinforced higher education system in science and technology which attracts a large but decreasing share of enrolments. • Long-standing scientific and engineering culture and many centres of world excellence in the modernised part of the public research system. International reputation and even prestige in key S&T fields, such as aerospace, nuclear science and engineering, and advanced software. • An increasing number of firms, including a significant proportion of fast-growing ones, with best practice production and management methods capable of seizing new market opportunities through innovation when incentives are sufficient. A critical mass of new technology-based firms in some sectors and locations. • Rapidly developing diversified innovation infrastructures. Revitalised science cities, such as Dubna and Zhukovski. New multidisciplinary centres of excellence, such as Kurchatov. • Federal government commitment to the modernisation and innovation agenda, and ability to mobilise resources in priority areas. • Accumulated experience in designing and using, at least experimentally, most innovation policy tools. • Improved balance between co-operation and competition among the different components of the public research system. This includes an increased share of competitive funding in the budget of the Russian Academy of Sciences (RAS), as well as new incentives and mechanisms to pool resources in responding to national priorities. • Well-articulated innovation strategies in pioneering regions, such as Tomsk and Tartarstan.	• A low rate of investment has reduced the structural benefits of fast growth in the last decade, restraining knowledge acquisition embodied in capital goods and lowering demand for innovation. • The composition of business investment is distorted to the detriment of innovation owing to disincentives in the business environment, notably the lack of competition. Many large firms with defective governance still survive using outdated capital stock to serve relatively captive markets. Inefficiencies in the state-owned corporate sector compromise Russia's ability to compete on high-technology civil markets. • Some innovation-related infrastructures and institutions are still immature or poorly enforced, such as knowledge networks and clusters or intellectual property rights legislation. • International linkages are strong and balanced in science and large-scale mission-oriented technological undertakings (*e.g.* aerospace) but less so in market-driven ones, partly due to internal and external barriers to high-technology trade and foreign direct investment. • The public research sector still contains many segments that do not satisfy the criteria of excellence and/or relevance. Allocation of resources too often is not performance-based. • The governance system and its practices have so far tended to encourage multiple and partly competing visions, as well as overlapping and too top-down implementation strategies by different federal agencies and state corporations. • The current mix of policy objectives and measures presents several biases, *e.g.* active science, technology and innovation policy is used to substitute rather than complement the improvement of key framework conditions for innovation, which remain weak. It emphasises supply rather than stimulation of demand, and public investment in innovation is channelled through an instrument portfolio which tends to crowd out business investment.

Table 0.1. SWOT analysis of the Russian innovation system (*continued*)

Opportunities	Threats
• Growing worldwide demand for innovation and related knowledge. Better integration into global value chains, facilitated by accession to the World Trade Organization, would help Russia channel its resources to areas in which international competitiveness significantly increases growth potential. • Reinforced research universities, working in closer synergy with the best parts of the RAS and other public research institutes, as well as a new generation of firms, managers and entrepreneurs can be powerful additional engines of innovation. • Rapidly expanding global markets for engineering services present great promise for Russian firms and specialists in aerospace, software, information and communication technologies, etc. • Russia's geography creates great challenges for the development and maintenance of transport and communication infrastructures, many of which are currently sub-scaled and outdated. This can be an opportunity if a modernisation programme emphasises innovative solutions and public procurement becomes more innovation-friendly. The same holds true for the modernisation of the extractive industries and the implementation of the new ambitious public health and environment policy agenda. • More generally, the vintage capital structure in many sectors makes it possible to leapfrog to best productivity levels once the rate of investment picks up. • A vast reservoir of would-be innovative entrepreneurs exists among the younger generations, as revealed by responses to several programmes of the Foundation for the Promotion of Small Enterprises in Science and Technology. • Over the last few years, brain circulation involving the Russian diaspora has significantly increased. This can be amplified and some recent government initiatives will help. • The multiplication of success stories brought about by new commercialisation channels and platforms, such as Rosnano or emerging high-technology clusters, can contribute to a change of mindset in the broader research and business communities. • Growing innovation awareness and initiatives at the level of municipalities and regions.	• Strong competition for grasping new global opportunities from both advanced countries and very dynamic emerging economies. • An ageing society, with an even more rapidly ageing population of engineers and researchers. • Lack of competition aggravates technological backwardness in many sectors and exacerbates the decoupling of profitability and productivity patterns, thus distorting resource allocation to the detriment of investments yielding high long-term social benefits. In response, government accentuates its direct involvement in innovation processes instead of correcting the problem at its roots. • Persistent low leverage of public S&T spending on business investment in innovation makes sustained budgetary effort more problematic from a fiscal perspective. Government is therefore tempted to interfere directly through other, non-market-friendly means. • RAS remains a glorious learned society but uses its well-deserved prestige to resist the need to improve the efficiency of its management. • The state-owned corporate sector remains a black box from the perspective of civil innovation policy; non-transparent processes for the allocation of resources create numerous "black holes" (large resources are used to produce little marketable outcomes). • State corporations do not fulfil their mission and drift towards outdated and inefficient national champion approaches (Rostechnologii) or develop an alternative, entrepreneurial model of national innovation policy loosely co-ordinated with other existing initiatives (Rosnano). • Russia loses out in the intensifying global competition for talent. • Lack of decentralisation prevents national goals and priorities from being translated into actions that fit regional capabilities. In turn, regions develop innovation strategies that do not add up to an optimal national outcome. • *In fine*, the Russian paradox, *i.e.* the low ratio of innovation outcomes to innovation capabilities, is eventually resolved by a decline in capabilities.

Figure 0.2. Advancement of the Russian Federation's innovation system and policy: A stepwise transition path



* The customer-contractor principle disciplines top-down allocation of public money to R&D performing organisations. It implies t hat government purchases research on an arms-length basis from a contractor either on it s own behalf or on behalf of business and society more generally . Its implementationrequires appropriate institutional arrangement s in the form of e.g. performance contracts managed by a dedicated public agency.

In the corners of the same picture, four functions of public policy intervention in support of firms' innovation efforts are highlighted:

1. In the bottom left-hand corner is public research carried out in the academies, higher education institutions (HEIs) and other research institutes. Such activity is intended to provide the innovation system with new codified knowledge and trained human resources. At present, its contribution to firms' innovation is considered weak and in need of strengthening. The dominant branch research institutes occupy an overlapping space with these institutes as they consume the largest share of public spending on R&D.
2. In the bottom right-hand corner is infrastructural support to R&D and innovation. This consists of both tangible, *e.g.* technoparks, and intangible, *e.g.* networks, infrastructures. A lot of policy attention has been given to such infrastructure, particularly as a means for diffusing and commercialising the knowledge produced in public research institutes. However, much of this effort has a knowledge supply-side bias and has remained largely disconnected from limited attempts to encourage (existing) firms to innovate and fund R&D.
3. In the top right-hand corner are the fiscal incentives offered by governments to encourage firms to innovate or fund their own R&D. These have been relatively under-utilised in Russia, but when they are used elsewhere, their uptake and effectiveness depends heavily on the wider framework conditions for innovation, including competition, regulation, the legal framework, etc. This is probably the weakest link in an otherwise increasingly comprehensive innovation policy mix and will need to be tackled if Russia is to fulfil its innovation potential.
4. Finally, in the top left-hand corner are public procurement and direct R&D financing. Although these tend to be distinct functions in most countries, in Russia they are conflated to some extent, within quite opaque arrangements, owing to their strong support for the branch institutes and design bureaus. In effect, R&D is a major procurement item in itself, largely through the direct R&D financing of branch institutes. At the same time, the use of public procurement to drive innovation in other types of firms, whether public or private, remains underdeveloped.

In summary, the current system suffers from a number of serious imbalances. Specifically, firms are not the central players they should be, and this distorts the balance in the public sector's contribution to Russian innovation performance. Publicly owned branch research institutes and design bureaus are still the central players in the current innovation system. The inadequacies of this arrangement were already well documented in the late Soviet period: weak knowledge flows and lack of interaction between technology developers and technology producers/users are a major problem. A range of solutions are available, the most obvious being the full merger of viable former branch institutes with production-oriented enterprises. Under more favourable circumstances, such mergers should already have occurred during the 1990s, but the uncertainty and short-termism of that period would probably have led to even greater asset stripping and layoffs.

The investment climate today is rather different and offers a window of opportunity to transform the innovation system along the lines outlined in the top right-hand side of Figure 0.2. Here, firms fulfil their central innovation-performing role and fund a higher proportion of gross domestic expenditure on R&D (GERD) than the public sector as in most OECD countries. In this scenario, the public sector continues to support firms in their innovation and R&D activities through a well-balanced mix of activities, including public research carried out mostly in the academies and HEIs, and through R&D and innovation infrastructures, financial incentives to conduct own R&D and innovation, and innovation-promoting public procurement. The main change from the current system is the shift away from the public research system, and notably the former branch research institutes, as the central players in the innovation system. Instead, this role is assumed by production-oriented firms, whether public or private, whose innovation and research activities are enabled by much more favourable framework conditions.

The key issue, of course, is how to shift from the current to the more desirable innovation system set out in Figure 0.2. Reorienting the current system towards production-oriented firms as the central players will involve more than simply reorganising the former branch institutes. Crucially, it will depend on firms developing the interests and capabilities to innovate and carry out R&D. More favourable framework conditions for innovation, combined with an appropriate mix of financial incentives and other policy measures, will play an important role.

There are obviously no "silver bullets", and such transformation can take various routes involving different trade-offs and complementarities, over more or less longer time periods. One such route, but not the only one, is outlined in the bottom half of Figure 0.2. Here, after a period of shifting direct funding of the former branch research institutes to a customer-contractor principle, these institutes are merged into production-oriented firms. As previously indicated, the likelihood and success of such a transformation will depend on whether firms are interested in taking on the institutes, which will depend on their research and innovation strategies. These will be shaped by the framework conditions for innovation and by more dedicated science, technology and innovation (STI) policy actions. The condition of the institutes would also be an important consideration for firms. Some of the best have already been acquired, but there are probably questions about many of the others, particularly given the prolonged period of under-investment. In some cases, outright closure might be the most sensible option.

Guiding principles for policy

Redressing the imbalances in the Russian innovation system requires a more balanced innovation policy that covers a broader spectrum of goals and targets. Specifically, framing the orientation of Russian innovation policy in terms of the following "balancing acts" should be a useful guide:

- *Industrial widening and deepening*: Diversification of the Russian economy will mean widening industry beyond strong dependence on natural resources to emerging (high-technology) sectors (including services) and to formerly strong sectors that have been relatively neglected during the transition period (*e.g.* heavy machinery, defence and aerospace, etc.). At the same time, deepening in existing industry sectors – technological upgrading through knowledge assimilation and own innovation efforts, as well as building backward and forward linkages – will be important for their future competitiveness.
- *Large firms and small and medium-sized enterprises*: These are often offered as alternative locomotives for the modernisation and diversification of the Russian economy. Most industrial economies are driven by large firms; they account for around 70% of the R&D performed by business enterprises in OECD countries.

Large firms have the scope and scale to develop and market innovative technologies, but their size also means they are easily locked into particular technological trajectories. This can make it difficult to adjust to disruptive developments. Innovative small and medium-sized enterprises (SMEs), given the right conditions, can overcome some of the rigidities associated with larger firms and become the basis for new areas of growth. Yet, this requires the presence of demand for innovative products and services, which typically comes from larger firms, the government or sometimes final consumers. In Russia, while support to innovative SMEs should be reinforced, more attention should be given to enhancing the innovativeness of large firms, primarily, but not only, through structural reforms of state-owned enterprises. This would yield double benefits for small firms, in the form of increased demand for their innovations and reduced unfair competition from less efficient or creative, but subsidised, large firms.

- *Public and private innovation efforts*: Private-sector enterprises are the main source of innovation in OECD and fast-developing economies, spurred by the need to build market competitiveness. If R&D spending by enterprises is taken as a proxy for enterprise innovativeness, Russian enterprises perform relatively badly. Innovation survey data, which includes non-R&D innovation, also show Russian enterprises to be weak innovators compared to their international counterparts. In principle, government policy can offer the private sector incentives to encourage innovation. In Russia, the most significant policy contribution would be to improve the framework conditions for innovation. Government can also use existing state-owned enterprises to drive technological upgrading, though this is not without significant risks. The public science base cannot, for the most part, be expected to drive the renewal of Russia's industrial fabric, *e.g.* through the creation of high-technology spin-offs, but it can play an important part in collaboration with existing public and private sector enterprises.

- *Low-technology and high-technology innovation*: A conclusion of recent OECD work is that many countries tend to focus too much on developing high-technology sectors and pay insufficient attention to the benefits of promoting innovation in other sectors. The latter often implies more mundane forms of technological upgrading, *e.g.* acquisition of new machinery, but is of critical importance in raising productivity levels across the economy. Some commentators have argued that Russia should focus on this form of innovation, given that it lags behind S&T frontiers in many areas. But this confuses current status and potential and overlooks the fact that Russia has existing and emerging strengths in high-technology fields, *e.g.* defence and aerospace, nuclear, new materials, information and communication technologies (ICTs), etc. Innovation agendas therefore need to take a balanced approach to supporting high-technology and low-technology sectors of the economy and to avoid what can be described as "high-technology myopia".

- *Domestic and foreign sources of knowledge and technology*: Examples of successful catch-up demonstrate the importance of accessing foreign sources of knowledge through a variety of mechanisms, *e.g.* equipment purchase, foreign direct investment (FDI), original equipment manufacturing (OEM), student mobility, international R&D collaboration, etc. In fact, it is nearly impossible today for any country to rely primarily upon indigenous knowledge for sustainable technological upgrading and productivity growth. This is as true for countries at technological frontiers as for fast-followers and laggards. Accordingly, Russian firms should seek to acquire and adapt foreign knowledge and should be supported in (or at least not prevented from) doing so, where appropriate, by government policy. At the same time, it should be widely acknowledged that indigenous scientific and engineering capabilities play an essential role in modernisation, particularly in areas in which Russia is close to scientific and technological frontiers, but also as a source of absorptive capacity in less advanced sectors and as a seed bed for the emergence of new industries.

- *Science-push and demand-pull dynamics*: Developments in science and technology are important drivers of innovation but are insufficient on their own. Demand, mediated mostly through markets, but also through networks and in-house hierarchies, plays a crucial role in promoting and shaping innovation. Users are also now recognised as important sources of knowledge in shaping innovation. Russian policy, which has inherited from the Soviet era a mostly supply-push perspective on innovation, should pay greater attention to demand and the role of users in promoting and shaping innovation.
- *Military and civil technologies*: This is a crucial issue in Russia given the high share of military-related R&D in total public R&D spending and the prominence of the military-industrial complex in the state-owned enterprise sector. The relationships between civil and military applications have changed dramatically, with the reversal of the direction of knowledge exchange flows in many cases in the dominant scientific and technological paradigms, especially in the field of ICTs. The armament industry now depends increasingly on critical technologies developed in an open civil environment. The announced creation of a Russian version of the US DARPA (Defense Advanced Research Projects Agency) responds to the need to better mobilise creative resources for radical innovations with military applications. At the same time, Russian defence policy should view the broader innovation agenda, notably the restructuring of the state-owned technology-oriented enterprise sector, as an important contribution to its own objectives.

Specific policy recommendations

Broadly speaking, policies can be divided into those that are dedicated to STI and those that are concerned with the framework conditions for innovation. While the former have an essential part to play in driving the modernisation agenda, they cannot substitute for the relatively weak framework conditions for innovation that prevail in Russia. STI policies must therefore be accompanied by policies that improve the framework conditions for innovation, particularly in terms of competition, corruption, property rights (including, but not confined to, intellectual property) and the rule of law. While the specific policy recommendations made below are mostly concerned with dedicated STI policies, these other policy issues should also be borne in mind.

Public governance of the innovation system

The OECD Innovation Strategy has identified a number of desirable qualities in innovation policy governance, including legitimacy, coherence, stability, adaptability and ability to steer and give direction. There are both complementarities and trade-offs between these qualities, and the manner in which they are managed differs from country to country. In Russia, legitimacy depends to a large extent on the involvement of the central government, particularly the offices of the president and prime minister. The reinforcement of the governance structure at the highest level, through the creation of the Presidential Commission for Modernisation and Technological Development and the Government Commission on High Technology and Innovation, offers a golden opportunity to achieve a nation-wide consensus on the problems to be solved, to make crucial decisions on high-level policy trade-offs and strategic tasks, and to prioritise and sequence concrete actions on a broad front, notably to remove key blocks that have been left in place in previous generations of reforms. Paradoxically, but most importantly, such high-level initiatives could also open the way for less centralist, top-down policy formulation and, crucially, minimise the risks of implementation failures by empowering the key actors distributed across the innovation system and by drawing upon their extensive knowledge. The newly announced technology platforms could make a useful contribution in this regard.

A major criticism of S&T policy a decade ago was its inability to set and implement spending priorities. Funds were spread thin across research-performing institutes which adopted, more or less successfully, preservation strategies. At the same time, the system had little stability. The situation today is markedly different, at least in terms of new funding. For example, the commissions have set clear, albeit rather broad, priorities; the results of the 2006 critical technologies exercise have formed the centrepiece of a federal targeted programme; and the establishment of the state corporation Rusnano has given a strong boost to the area of nanotechnology. The use of foresight techniques, particularly technology road-mapping, is increasingly popular at many different levels and demonstrates the more strategic and future-oriented perspectives being adopted.

The increasing use of federal targeted programmes (FTPs) is also a significant development, as they allow for targeted actions that transcend traditional administrative boundaries and their fixed duration provides a certain degree of adaptability. There is usually a trade-off between adaptability and stability, however, and this applies to the FTPs given the limited duration of their funding.

Evaluation practices appear to be rudimentary and not well established, in part because of the absence of a strategic approach to S&T planning during the years of transition. The FTPs appear to include *ex ante*, mid-term and *ex post* assessments, and some major new programmes, such as the establishment of national research universities, seem to have incorporated similar arrangements. However, these appear to fall short of full-fledged evaluations. Moreover, their strong reliance on assessments against set quantitative indicators (*e.g.* numbers of registered patents) risks distorting behaviours to fulfil artificial targets. In light of these considerations, the government should:

- Establish stakeholder forums to achieve greater coherence and to draw upon the wide range of knowledge distributed across the innovation system. These should draw together the relevant ministries and agencies, the SOEs and state corporations, the academies and HEIs, and, of course, the private sector, in order to formulate strategic goals and action plans. Without full and meaningful involvement of the main actors from across the distributed landscape of the national innovation system, top-down plans and strategies risk being ignored, even in a relatively centralised governance system like Russia's. In this regard, the recent announcement to launch a number of technology platforms, inspired by European Union experience, would seem to be a move in the right direction.

- Extend the scope of foresight exercises beyond the identification of S&T priorities. They should be designed so as to better catalyse networking across innovation systems and to create advocacy coalitions to champion change.

- Evaluate FTPs for their success in prioritising issues and activities of importance to Russia, for their mobilisation of a mix of innovation system actors, and for their contributions to inter-departmental and industry-academic co-operation.
- Adopt a more nuanced approach to evaluation, with less reliance on quantitative indicators and greater appreciation of evaluation as a tool for learning as much as a tool for accountability.

Framework conditions for innovation

The quality of framework conditions is essential for achieving strong innovation performance. The framework conditions include macroeconomic stability, many aspects of the regulatory regime and the tax system, competitive markets, openness to international trade and foreign direct investment, as well as an intellectual property rights regime that fulfils its function to provide incentives for innovators while not unduly impeding the diffusion of ideas. It is these framework conditions that allow private innovators – individuals and firms – to plan ahead and take risk because they can reap the gains of their innovation efforts that also benefit society at large.

Flaws in framework conditions can also constrain policy makers' action and prevent the use of policy tools that have been proven effective in more favourable circumstances. For instance, pervasive corruption can make governments very reluctant to give direct subsidies to business firms. Countries with a weak and ineffective tax system and administration tend to be reluctant to introduce fiscal incentives for R&D, or do so very cautiously. In this way flawed framework conditions can lead to distorted policy responses.

In the past two decades, Russia has made significant progress in many respects. Most importantly, it has succeeded in moving towards a market economy and has taken important steps to manage and stabilise the macro economy. Yet, there remain noteworthy shortcomings. These have been extensively analysed in recent years and need to be addressed effectively if Russia wants to embark on a more innovation-driven growth trajectory. They include exceptions to the rule of law, overly restrictive regulations, corruption, a lack of competition in many parts of the economy, underdeveloped supporting institutions, *e.g.* for financing innovation and intellectual property rights protection.

Taken together, these adverse conditions exert a stifling impact on value-creating entrepreneurial activity, including innovation. They create an environment in which incentive structures work against complex, long-term, inherently risky productive activities such as innovation. Rather, they tend to favour legal or illegal activities aimed at redistributing value. The expected result would be a low level of business investment in innovation and thus a shortfall in innovation output. A bias of incentives towards redistribution is a heavy burden on future development, including the realisation of an innovation-based development scenario.

Rule of law, corruption and administrative burden. Progress in reducing corruption, strengthening the rule of law, reducing the "bureaucratic burden" on business and reforming public administration will be vital elements of any policy aimed at fostering innovation. Russia's basic institutional environment still leaves much to be desired. Policy makers from the president on down have repeatedly expressed dissatisfaction with the performance of the public administration, law-enforcement agencies and the courts, in terms of efficiency, effectiveness and probity.

Competition in product markets. There is clear evidence of a positive correlation between innovation and competition. Most Russian firms appear to be in a situation in which innovation activity increases with competition. This is supported by survey data showing that Russian firms in more competitive environments spend significantly more on R&D and innovate more than firms facing less competitive pressure. Firms with greater market power innovate less, and monopolistic firms innovate least of all. There is also evidence that similar conclusions can be drawn about the outcomes of innovation activity in terms of total factor productivity growth. Overall, product markets in Russia are insufficiently competitive and unusually concentrated, particularly at regional level. On various measures, large firms loom larger in the Russian economy than in many OECD and other countries. In markets characterised by a small number of large firms, the challenge of ensuring effective competition and preventing cartels is all the greater. In many regional markets, a few incumbent firms operate in close co-operation with regional or local officials. While this often reflects corruption and rent-seeking behaviour, such arrangements also arise as a result of the limited fiscal autonomy of sub-national authorities which often pursue their social objectives through more or less informal arrangements with large incumbent enterprises operating in their territory. This typically translates into effective barriers to entry from outside competitors. At the same time, it must be acknowledged that there appears to have been real reduction in the bureaucratic burden on small firms over the last decade.

Financial markets. A well-developed financial system, which reduces the cost of external financing and is able to manage risks, is an important catalyst of innovation. Russia's financial system, despite rapid expansion in recent years, is still relatively underdeveloped, leaving considerable scope for financial deepening to contribute to long-term growth. A large majority of Russian firms rely on retained earnings to finance investment and innovation, and enterprise surveys almost always report the shortage of own funds and the cost of borrowing as the principal barriers to investment. This points to the importance of strengthening the banking sector and non-bank financial institutions. Funds for innovation and risk financing are scarce in Russia, partly owing to the dearth of venture capital. The development of risk capital markets is still impeded by the overall underdevelopment of financial markets.

Intellectual property rights. The new IPR code, which entered into force on 1 January 2008, is basically in line with IPR protection legislation of most developed countries. However, problems of enforcement remain, *e.g.* lack of transparency in court decisions and in administration bodies, especially concerning copyright.

To cut through a maze of unfavourable framework conditions and the opportunistic and rent-seeking behaviour that has evolved through attempts to derive private benefits from them is a gargantuan task. One approach is to create "special zones" (enclaves that could take various forms, *e.g.* selected regions, technoparks, business entities, projects, etc.) that would be shielded from the influence of the prevailing, non-conducive environment, and to provide them with special privileges, such as access to the highest levels of power to cut through red tape, readier access to resources, etc. This approach has some merits. It was widely applied in the Soviet Union and produced a number of impressive results in mission-oriented research and technology development (*e.g.* in the aerospace or nuclear industries). However, the experience of the Soviet Union also provides compelling evidence of the inherent limitations of that approach; these were due precisely to the insular character of these efforts. To achieve a sustainable, innovation-driven growth trajectory, it is necessary to get the framework conditions right on a broad basis.

To summarise, despite progress made, there is urgent need for further improvements in the framework conditions for innovation, and the potential gains from such improvements are higher than in most OECD countries. To this end and to prepare a solid ground for innovation and to create an environment in which other, more dedicated, instruments to boost innovation can be effectively applied, the government should screen the current situation with the following main objectives:

- Maintain sound macroeconomic conditions, including the sustainability of public finances, one of the most important conditions for sufficient and dynamic evolution of both private and public investment in innovation. Better performance in innovation can, in turn, help to attain healthy macroeconomic and fiscal conditions.
- Move towards a more pro-competition stance to strengthen market incentives that reward innovative behaviour and continue efforts to improve the business environment and reduce administrative burden, including on business start-ups. This could be achieved, for example, by introducing an overarching competition policy to support free and fair market competition by providing for more vigorous and uniform implementation of competition law and strengthening the powers of relevant institutions; by further reforming the public administration and reducing red tape; by increasing the transparency and accountability of public administration; and by minimising uncertainty and the need for subjective decision making by the government administration.
- Continue to address aspects of the financial system and related regulation that could constrain the financing of innovative projects in the business sector, notably for SMEs.
- Continue to improve the practice of intellectual property rights enforcement.

Education and skills

The Russian Federation produces one of the highest proportions of science and engineering graduates in the world, well above the OECD average. It also has very high rates of university admission, which has led to concerns about quality in a system designed for much smaller numbers. Furthermore, like other areas, higher education was not immune from the austerity of the transition years and has suffered some degradation in facilities and services, particularly in the regions. Curricula in many departments are also in need of updating to better reflect the labour market's demand for skills. This includes innovation management skills and initiatives that will nurture an entrepreneurial spirit among graduates.

Russia inherited a relatively strong system of vocational colleges from the Soviet Union, but this has been somewhat neglected over the last 20 years and is now in a state of serious decline. Indeed, with demographic changes, many colleges may be forced to close in the next few years, particularly in the regions. Demographic change is, however, not the only factor in the decline in admissions. As in most parts of the world, Russia's university student population has grown enormously, partly at the expense of vocational colleges. In fact, it is rather common for students to use vocational colleges as a means to gain access to universities. Russian policy makers should therefore seek to:

- Encourage universities and colleges to update their curricula to better respond to the skills needs of an increasingly innovation-driven market economy. In this regard, the business sector's involvement in advising on curriculum design and in offering placements, particularly to graduate students, should be actively encouraged.
- Explore ways of enhancing the standing of vocational training and improving the facilities at vocational colleges. The problems facing Russian vocational colleges are similar to those in many other countries and experiences and lessons should be shared for mutual benefit.

Promotion of business innovation

Corporate governance

It is widely recognised that SMEs, especially innovative start-ups, play an important role as innovators and in rejuvenating the economy. However, it would be a mistake to neglect the contribution of large firms to innovation. It is hard see how Russia can become an innovation-driven economy without boosting innovation in large firms, many of which hold valuable assets and could become backbones for larger-scale innovation. In practice, many of Russia's large firms are far from as strongly engaged in innovation activity as might be expected. Therefore, the discussion of framework conditions for innovation and corporate governance has to take due account of the (dis)incentives they provide for large firms to engage in innovation.

The Russian Federation's corporate sector has emerged from the legacy of the Soviet system, followed by privatisations, shake-outs and restructuring, starting in the years of transition, and given a new direction in more recent efforts to consolidate and re-establish state influence in what is perceived as strategic areas. Russia's corporate sector has a number of specific features –in terms of structure and corporate governance – which may have important implications for the future development of Russia's innovation capabilities. Today, state control in the Russian economy is extensive, via direct state ownership and control over economic activity. State-owned enterprises are found across a wide range of sectors and often occupy a dominant position in their industry. Furthermore, there is a pervasive blurring of the line between the public and private sectors; this is due to the extensive role of state-owned enterprises. Recent industrial consolidation into ever-larger holdings has been accomplished by merger and acquisition activities of some major public and private firms (particularly in resource-based industries) and by government policy to establish "national champions" capable of competing in international markets.

While consolidation holds the promise of increased economies of scale and scope, and can overcome, in part, the lack of external financing for high-risk innovation, it risks being economically harmful if powerful incumbents stifle competition and effectively deter innovative entrants. This can eventually lead to a decline in national competitiveness in the long run. This danger is a real one and is heightened by the fact that for state-owned enterprises the effectiveness of corporate governance is weakened by a number of factors, including diminished likelihood of bankruptcy and very little risk of takeover. Both of these reduce the discipline markets would otherwise exert on management, by threatening to penalise inefficiency. In view of these arguments, the government should consider the following:

- Improve standards of transparency and disclosure in SOEs. This can be aided by accelerating the appointment of independent and accountable directors on SOE boards and by increasing the independence of government representatives. The non-commercial activities of SOEs should also be moved to relevant government departments where they can be consolidated.
- Ensure that "national champions" put innovation at the heart of their business strategies through a mix of incentives and regulatory moves, *e.g.* by reducing barriers that shield them from international competition. At the same time, monitor closely the activities of state corporations to ensure they remain on track to deliver on their ambitious objectives.
- Carry through and extend plans to part-privatise SOEs and state corporations, as this should provide greater access to foreign know-how and accelerate the modernisation agenda.

Business sector R&D

The state-owned technology-oriented business sector comprises business enterprises in the true sense and related incorporated research organisations. However, some aspects of the research part of this sector are striking. In the Russian Federation – as in many high-performing countries within and outside the OECD – business enterprise expenditure for R&D (BERD) performed in the business sector accounts for nearly two-thirds of total GERD. However, the funding pattern is radically different. In Russia, the R&D expenditure of the business enterprise sector is largely funded by government, not – as is the practice in high-performing economies – by the business sector itself. This highlights the continuing dominance of the mostly publicly owned former branch institutes and design bureaus in performing business R&D. While they perform more than 80% of business enterprise R&D, these institutes, perhaps half of which operate in the defence sector, remain separated organisationally from production enterprises, which tends to weaken their contribution to technological innovation. Any substantial improvement of the overall performance of the Russian innovation system requires a clarification of the roles these institutes actually play in industrial innovation and the ways in which their activities are steered.

For their part, production enterprises performed less than 9% of business expenditure on R&D in 2008 while providing 36% of the funds. This indicates that production enterprises – many of which are state-owned – outsource much of their R&D to branch institutes and design bureaus. They perform relatively little in-house R&D and are not especially encouraged to do so by the government's research policy. For instance, very few research policy measures involve direct financial transfers to production enterprises, and tax incentives and public procurement are underdeveloped. Therefore, the government should:

- Clarify the role of research institutes and design bureaus within the state-owned technology-oriented business sector, their missions in selected areas such as defence or energy, and the whole Russian innovation system. Further transparency is needed regarding the operations, funding, governance and performance of these organisations.
- Explore options for privatising research institutes and design bureaus and/or merging them into production enterprises. Their organisational separation diminishes their contribution to production in many instances.
- Encourage production enterprises to conduct more in-house R&D. A critical first step involves getting such enterprises to put innovation at the heart of their business strategies, thereby creating a stronger requirement for in-house R&D. The recent government instruction to SOEs and state corporations to elaborate "R&D and technological performance contracts", while an unusually directive move, is an attempt to do just that. Ultimately, however, a mix of policy measures will be required to further encourage enterprises to conduct in-house R&D, including direct funding of R&D, indirect fiscal measures, regulation, public-private partnerships, and public procurement.

Supporting innovative SMEs

The contribution of SMEs to the Russian economy is relatively small when compared to OECD economies, accounting for around 12% of GDP and a similar proportion of employment. In contrast to some other transition economies, the growth of a vibrant SME sector in Russia has been stunted by the dominance of large firms, particularly in the resource-based industries that dominate the economy, and by unfavourable framework conditions for operating small businesses. The number of innovative SMEs, defined as high-potential enterprises in the science and technology field, make up less than 2% of the overall SME sector. This figure is particularly low when compared with EU countries.

Recent legislative changes have sought to promote the SME sector. These include the reduction of inspections, and, specifically for innovative SMEs, the law on the organisation of small innovative enterprises with universities, research institutions and microfinance (Federal Law No. 217-FZ), which focuses on standardising the creation of start-up and spin-off companies by federally funded scientific and educational institutions. The hope is that such laws will contribute to the creation of the necessary legal framework for promoting the efficient development of innovative SMEs and will significantly simplify their creation.

Since 1994, a dedicated public non-profit organisation, the (Bortnik) Foundation for the Promotion of Small Enterprises in Science and Technology (FASIE), has been successfully promoting science-based entrepreneurship. Its resources amount to 1.5% of the total civil R&D budget, which it uses to provide a wide array of support measures, ranging from direct financial support to start-ups to the provision of information and other support services to small innovative enterprises. The most significant measure is "Start", targeted at start-ups, and modelled to a certain extent on the US National Science Foundation's Small Business Innovation Research (SBIR) programme. It provides two-stage support, with seed money followed by development grants. FASIE has funded about 10 000 projects. In recent years, it has increasingly moved towards nurturing "innovation seeds" and young scientists (more from HEIs than from the RAS).

For financing, the federal government founded the Russian Venture Company in 2006 with the aim of stimulating the creation of a venture capital industry in Russia. It has also encouraged the creation of regional venture funds, and 23 of these have been created in 21 regions. The number of companies that have benefited from both the national and regional funds seems rather small – fewer than 50 companies by mid-2009. One problem seems to be too few opportunities for funding; another seems to be that the venture funds show insufficient interest in investing in early stages of project development.

A variety of technoparks, business centres, and business incubators have also been created across Russia, some of which have been rather successful in developing innovative businesses (*e.g.* Tomsk Innovation Technology Centre "Technopark"), others less so. A federal programme targeting the creation of a network of technoparks was initiated in 2006 and has seen their number grow in recent years. In light of these developments, the government should consider the following:

- Expand the FASIE programmes given their success and popularity. At the same time, it should acknowledge that the vast majority of start-ups from the science base, even the most successful, are likely to have only marginal effects on the industrial landscape of the Russian economy in the near future.
- Acknowledge that the limited growth potential of innovative SMEs in Russia is due to the relative lack of interest of larger firms in innovation. If this situation changed, markets would begin to open up for innovative products and services offered by SMEs.
- Improve the framework conditions for innovative SMEs. Small firms tend to be more sensitive to the framework conditions for innovation than their larger counterparts. As long as framework conditions remain relatively unfavourable, the scope for SME-led growth will be limited.
- Better facilitate access to finance, for example by increasing competitive pressures in financial markets, reducing risks and transaction costs, strengthening financial institutions' capacity to serve small clients, etc. The Russian Venture Company has a role to play here, though it will tend to be more niche than mainstream. The recent introduction by Vnesheconombank (Bank of Development and Foreign Economic Relations) of a programme for supporting innovative SMEs is perhaps more promising. Generally speaking, more needs to be done by the government to promote the financing of SMEs' innovation efforts, *e.g.* through the use of reimbursable subsidies and state guarantees for bank credits.

Linking education with research

R&D carried out in HEIs has several benefits, the most prominent being the close connection to training and the knowledge diffusion to other parts of society and the economy that graduate mobility brings. Like some other countries with a strong mission-oriented focus (*e.g.* China, Korea, France), Russia has a relatively weak HEI research system. The institutes of the various academies of science are the traditional location for conducting the sorts of fundamental research carried out in HEIs in many OECD countries.

Since 2000, the government has sought to strengthen research in HEIs through a number of targeted initiatives. These investments have seen the number of researchers in HEIs rise slowly in absolute and relative terms, although as a proportion of the total number of researchers in Russia – at 8.8% in 2008 – this remains very low by international standards. Furthermore, the proportion of GERD performed in the HEI sector in 2008 was even lower, at 6.7%. More recently, the government has launched new flagship initiatives, notably the FTP Research and Academic Teaching Potential of an Innovative Russia (2009-13) and Federal Targeted Support to Leading High Schools (2010-12). These initiatives have significant budgets – around USD 3 billion each for their duration – and seek to address a range of challenges related to promoting and diffusing/using research carried out in HEIs. Much of the new investment is targeted at establishing an elite cadre of research-led HEIs, similar to that found in many OECD countries. It covers several measures, including: large blocks of funding awarded to Russia's two elite institutes, Moscow State University (MSU) and Saint Petersburg State University (SPbSU); the establishment of federal universities and national research universities (NRUs); promotion of R&D co-operation with high-technology industrial corporations; development of a university innovation infrastructure for the creation of small firms; and promotion of inward academic mobility, by attracting the Russian scientific diaspora and other leading foreign scientists to Russian universities.

These significant investments indicate a strong and welcome commitment to strengthening education and research links, but they are just a start and much remains to be done over the medium term. In this regard, the government should:

- Institutionalise some of these new funding lines so that they become an established feature of the HEI research landscape. This is important given the generally low levels of investment in public science since Soviet times. Furthermore, institutionalisation will remove uncertainties around the government's intentions, thereby aiding HEIs' planning and long-term strategies.
- Maintain the competitive element in such funding initiatives, as they can catalyse useful reform and the reorientation of HEIs if appropriate selection criteria are used. Ultimately, the competition for funds in a well-funded system should be based on fully transparent arrangements for performance measurement, based, for example, on comparable publication, teaching quality and commercialisation indicators.
- Evaluate the appropriateness and effectiveness of the increasingly sophisticated portfolio of policy measures now in place, both at the level of individual instruments and at the levels of the wider portfolio. The novelty of many of these initiatives in the Russian context makes them somewhat experimental in nature and they will need to be viewed as such by monitoring and evaluation activities. Ultimately, some should be superseded by alternative instruments as the HEI sector evolves.
- Accelerate the transition towards a more research-intensive HEI sector through a more radical organisational transformation. In some instances, action beyond R&D collaboration with RAS institutes and the like may be warranted, to include the full amalgamation of existing research institutes with HEIs, perhaps along the lines of the French CNRS-HEI model.
- Acknowledge that the budgetary focus on creating an elite cadre of research-led HEIs will result in an implicit stratification of the HEI sector, determined largely by research performance. At the same time, policy should recognise that a broad innovation agenda also needs to pay attention to other layers in the sector – which,

after all, means the majority of HEIs – and seek to identify and build upon their strengths and address their weaknesses.

- Incorporate or align HEI upgrading measures with regional development agendas. Since less research-intensive institutes are more likely to be found in the regions outside of Moscow and Saint Petersburg, their strengthening along strategic lines is important for balanced regional development. In this regard, HEIs should serve as regional growth poles, for example through active cluster policies that require the development of close working relationships with businesses and local research institutes. At the same time, measures to enhance the contribution of HEIs to regional competitiveness should be designed so as to acknowledge that the main contributions of HEIs to regional growth are likely to be through the training of graduates and their subsequent mobility through the local economy.

Public research organisations

Various types of public research organisations, aside from HEIs, account for the largest share of GERD in Russia. In this review, although the vast majority of former branch institutes are still publicly owned, they are dealt with under the section devoted to business innovation.[1] This section is confined to the various academies of science and the National Research Centre programme, piloted at the Kurchatov Institute.

The purpose of the academies of science has been questioned for some time, often on the presumption that Russia, a middle-income country, can ill afford the luxury of funding hundreds of institutes largely, though not exclusively, dedicated to fundamental research. This view tends to miss the considerable contribution that the academies make to training and industrial innovation, although these contributions could certainly be enhanced. It also fails to acknowledge the importance of fundamental research for Russia's long-term development. Furthermore, the academies account for just 15% of GERD, levels that are considerably lower than those spent in applied research institutes, although this is around twice the amount spent in the HEI sector.

The academies are not without their problems. They have been repeatedly criticised for their preservation strategies and have been under considerable pressure in the last five years to cut the number of staff and institutes in return for extra resources. Accordingly, the number of R&D personnel in the Russian Academy of Sciences declined by around 12% in the period 2002-08, although the number of institutes has remained relatively stable. In return, salaries have increased markedly, but remain uncompetitive in large cities and have yet to prevent the long-term ageing of the workforce. Buildings and equipment are in need of major renovation and renewal in most institutes. Some progress has been made on this front in the last few years, but the academies have not benefited to the same extent as selected HEIs from major cash injections, owing to the government's priority to develop a stronger research-intensive HEI sector.

While these resource factors have hindered the productivity of the academies, critics argue that a major weakness is the dominance of block grant financing and an inadequate regime of monitoring and rewards/sanctions for good/poor performance. The RAS, for its part, intends to increase competitive funding to 25% of its allocation (it currently stands

1. This is also in line with the statistical treatment of these institutes by the Russian authorities, which includes them in the BERD figures.

at around 15%). This is a move in the right direction, but is still a low proportion by international standards, probably because a higher proportion would threaten the continuing existence of institutes that are unsuccessful in any competitive bidding process. Policy makers have attempted to bypass these funding arrangements in the academies by introducing parallel funding streams that allocate funding through competitive calls, mainly by the Russian Foundation for Basic Research (RFBR) and the FTPs. In this regard, a larger proportion of the federal budget for basic research could be allocated through the RFBR.

Beyond the academies, the aim of the new programme National Research Centres (NRC) is to provide platforms for the development of breakthrough advances in key technologies in which Russia would like to develop or maintain world leadership, such as nanotechnologies or neurosciences. The programme is being piloted through the Kurchatov Institute, the first of a possible eight institutes to be set up in the next few years. Special funding procedures provide a greater degree of flexibility and set out to minimise bureaucracy. For example, the institutes are free to award R&D contracts, and their researchers are free to invest in commercialisation of their research and in technology-based firms and start ups.

In the area of public research organisations, the government should:

- Enhance the contributions of the academies to training (especially PhD students) and to industrial innovation in strategic industries. The challenge for the academy institutes is to identify and exploit channels of knowledge diffusion beyond academic publications to enhance their contribution to the national innovation system.
- Ensure that the principle of research excellence lies at the heart of the academies' activities. With this in mind, the proportions of block grant and competitive funding allocated to institutes should be further rebalanced in favour of the latter and greater use should be made of performance-based assessments. Increased participation in international funding programmes (see the section below on internationalisation) will also provide additional information on research quality.
- Reform the governance structure of the RAS to allow for a more strategic approach to managing its large portfolio of institutes and to increase its agility in responding to new research opportunities.
- Monitor and evaluate stringently the NRC programme, given the large investments involved. Extension of the programme should perhaps progress in stages to allow time for drawing lessons. Furthermore, every effort should be made to explore opportunities for extending good practices, *e.g.* around research commercialisation, to other parts of the public research system.
- Take further steps to reduce the dependence of all Russian research institutes on block grants. Although Russia has made some progress in moving towards a more competitive funding allocation system, too much funding is still funnelled as block grants to established institutes. On the other hand, it should be borne in mind that block grants are important for providing a modicum of financial stability and direction to institutes and should not be eliminated entirely. Instead, performance-assessment regimes should be established that allow for transparent periodic (intervals of five to ten years) assessment, the results of which should determine the size of block grants received.

Internationalisation

There are many channels available for Russia to source foreign knowledge and technology and to export its own. Foreign direct investment is often touted as one good way, and Russia is increasingly host to many of the world's leading technology-based companies, *e.g.* in aerospace and ICTs, which are looking to exploit high skills at an internationally competitive price.

In common with many other countries, Russia has sought to attract FDI through the establishment of various types of special economic zones (SEZ). For the purposes of this review, the four technology-oriented SEZ in Saint Petersburg, Zelenograd, Dubna and Tomsk are relevant. As these were established quite recently it is difficult to assess their effectiveness. Nevertheless, they appear not to have been particularly successful so far in attracting FDI. More recently, the government has announced plans to establish an innovation city at Skolkovo, a greenfield site just outside Moscow. Much has been made of Skolkovo's reference to Silicon Valley in California as a source of inspiration. The latter is, of course, a largely self-organising phenomenon that many have tried to reproduce in other parts of the world without much success. The proposals for Skolkovo do not appear to fall into such a trap and seek to address failures that are specific to the Russian context. A few large high-technology firms, notably Cisco and Nokia, have already signalled their intention to invest in Skolkovo, and the hope is that many more will follow suit.

FDI can of course work in both directions, and many large Russian firms have become increasingly active in acquiring overseas companies, transforming themselves into multinational enterprises with operations in multiple locations. Some of these acquisitions have been directed at accessing particular technologies or technological capabilities. Joint ventures with foreign companies are also a popular means for accessing technologies and sharing risks. A recent example is the collaboration between Sukhoi and Finmeccanica of Italy on development of the Superjet 100 airliner.

More generally, technology balance of payments (TBP) data, which register the international flow of industrial property and know-how (*e.g.* through patent purchase and licensing, trademarks, technical services, etc.), show a rapid increase in payments and receipts in recent years, an indication of the growing internationalisation of Russian industry. Payments in 2008 were around 2.5 times larger than receipts, with Russia running a TBP deficit of around USD 1.4 billion. Perhaps the most utilised channel for sourcing foreign technical knowledge is the acquisition of foreign capital goods. Indeed, innovation survey data show purchasing of equipment to be the most important source of innovation, though the levels are still very low compared to other countries.

Progress in and, finally, the successful conclusion of Russia's WTO accession process is important for the success of an "innovation scenario" as envisaged in President Medvedev's "Russia, Forward" declaration. In one sense, WTO accession can be seen as safeguarding against the adoption of an overly inward-looking approach to Russia's economic development that could eventually stifle innovation. In another sense, it would help innovation by removing barriers Russian companies currently face in international markets, including in high-technology areas. WTO membership would exercise some leverage for making more progress with competition-enhancing reforms.

On the science side, Russia is in negotiations with the European Union to acquire associate membership in the Framework Programme. This would allow Russian researchers to participate in the Framework Programme on an equal footing with their

European counterparts and could have potentially large benefits. For example, it would better integrate Russian research teams into highly competitive European R&D associations which should lead to a rise in their competitiveness and the quality of their scientific and technological results. A further science-related issue concerns nurturing links with the very extensive Russian scientific diaspora. Government policy has awoken to the potential of a more structured engagement with the diaspora, for example through lab twinning initiatives, mobility grants and a new scheme to facilitate the recruitment from abroad of highly qualified staff. In pursuing and broadening these efforts, government policy should:

- Embrace technology acquisition from overseas as part of a wider strategy to upgrade the technological capabilities of Russian industry. Several channels are relevant, including inward and outward FDI, joint ventures with foreign firms and equipment purchases. These should be exploited as fully as possible to foster technological learning.
- Use the Skolkovo innovation city initiative as an experimental space for testing and demonstrating arrangements that could be extended to the wider economy. It is mainly in this way that Skolkovo can contribute to Russia's modernisation. At the same time, other useful references, besides Silicon Valley, should be found to guide thinking and to frame realistic objectives for Skolkovo, *e.g.* Beijing's Zhongguancun science city.
- Ensure that investments in support of Skolkovo do not crowd out other essential investments that are vital for upgrading Russia's innovation performance and for increasing the presence of Russian actors within global innovation networks.
- Conclude negotiations with the EU on associate membership in its Framework Programme. Policy makers should recognise, however, that successful participation will require further learning and perhaps even some adaptation by Russian research teams, which will naturally take time.

Regional aspects

The Russian Federation is divided into 83 constituent units or federal subjects, 21 of which are republics, of very different sizes and economic specialisation. Outside Moscow and Saint Petersburg a small group concentrates most of the remaining science-based and technology-intensive activities and high-quality higher education institutions. The best mix of federal and regional policies to enhance their innovation potential is recognised as an important, but as yet unresolved, issue. In contrast, the role of innovation in regions that are less well endowed in S&T resources, with a view to avoiding a widening of regional development gaps, is less debated.

Regarding the first issue, Russia can do more to empower regional innovation-led growth engines more fully to the benefit of national performance. Awareness and political will has built up and encouraging initiatives have emerged in regions. A centralisation trend in Russian fiscal federalism has in fact encouraged some regions rich in oil and gas, such as Tomsk and Tatarstan, to bet more on knowledge-based development. One problem is that regions have become even more dependent on federal financial support to fund their initiatives in this new direction. This leads to two types of inefficiencies. First, it pushes regions to compete even when they should co-operate. Second, national priorities and the criteria determining access to federal support seldom fit regional needs and capabilities perfectly. This reduces their impact both on local development and on the overall efficiency of federal spending on innovation. Another problem is that even when they have sufficient resources to act on their own, regions face legal restrictions in some important areas, such as investment in universities to ensure that their research and education programmes are better attuned to local demand.

Regarding the second issue, the widespread lack of attention to non-technological innovation has contributed to benign neglect by federal authorities and rather passive attitudes of local authorities. Too little is known about the real innovation potential of regions with economies that are less R&D-intensive than the national average. The role of all forms of innovation in their modernisation should receive much greater attention.

There have been interesting developments at the sub-regional of governance, whereby cities originally created as closed military research-industrial complexes have, over time, developed a social identity. This is the case for science cities such as Dubna and Zhukovski in the Moscow Region. Populations and municipalities are willing to contribute to local development, most importantly by improving attractiveness for investors, including through enhancing the quality of life. Therefore, the government should:

- Help establish a platform for inter-regional innovation policy learning. To feed this learning process and reinforce its own ability to monitor and assess regional trends, the Federation could promote the harmonised development of statistics and other benchmarking instruments by the regions. International benchmarking should be part of this process, with the selection of a panel from foreign regions corresponding to the main types of Russian regions (large/small, diversified/highly specialised, knowledge-intensive/more traditional industries, etc.). The regionally self-organised Association of Innovative Regions, newly established in 2010, could be a candidate for providing such a platform.
- Acknowledge that many successful initiatives result from a combined and concerted approach by federal and local/regional authorities. This co-ordination is essential for the funding and deployment of any significant project.
- Encourage development of self-organisation capabilities at the regional and local levels. In parallel, review existing restrictions on regional action to boost innovation, with a view to relaxing those that might have little justification in the new economic policy paradigm.
- Concentrate federal funding on areas of regional comparative advantage to avoid spreading resources too thin. This should discourage wasteful inter-regional imitation and competition, notably the proliferation of sub-scale, ill-designed innovation infrastructures, and instead reinforce support to region-led promising cluster initiatives associating public and corporate actors.
- Avoid "high-technology myopia" and embrace the potential of innovation in low-technology manufacturing and services sectors, as well as non-technological innovation, for creating jobs and wealth.
- Connect efforts to promote innovation in large enterprises to regional development agendas. Currently in many regions, there are major hurdles for linking education and research structures, as well as small business, to established industries, on account of the lack of interest in innovation among large incumbents.

Examen de l'OCDE de la politique d'innovation de la Fédération de Russie - évaluation globale et recommandations

Introduction

Depuis plus d'une dizaine d'années, l'un des majeurs défis qui se posent aux dirigeants russes est de diversifier la structure de l'économie afin de réduire sa dépendance à l'égard du secteur des matières premières. Même pendant les années d'expansion, précédant 2008, beaucoup avaient conscience que la croissance était tirée par des forces transitoires et qu'il était donc nécessaire d'œuvrer pour une transition rapide de la Russie vers une croissance autoalimentée, fondée sur l'investissement et l'innovation. Depuis la fin 2008, la crise financière et économique mondiale a souligné le caractère impérieux de ce défi. La modernisation, et en particulier l'innovation apparaissent plus que jamais comme les clés du développement à long terme souhaitable de la Russie.

La modernisation et l'innovation sont deux facettes d'un même processus fondamental par lequel un pays peut optimiser les conditions dans lesquelles ses ressources matérielles et immatérielles sont accumulées, renouvelées, allouées et utilisées, de sorte à accroître son potentiel de croissance soutenable. Le Plan de développement social et économique à long terme de la Fédération de Russie à l'horizon 2020, adopté en novembre 2008, reconnaît que cela nécessite non seulement de consolider les avantages comparatifs existants mais aussi d'en créer de nouveaux par le développement et la mobilisation créative des ressources humaines et du capital intellectuel du pays.

Pour promouvoir effectivement cet approfondissement et cet élargissement des avantages comparatifs la puissance publique doit faire appel à un large éventail de politiques.

- *La politique monétaire* doit faire en sorte de prévenir une appréciation excessive du rouble, qui pourrait déclencher une variante russe du « syndrome hollandais ».
- *La politique budgétaire* doit assurer la viabilité des finances publiques tout en assurant un financement suffisant de l'investissement public dans l'innovation, et en appliquant au patrimoine et aux revenus une fiscalité favorable à l'innovation.
- *Les politiques de la concurrence et des échanges* doivent agir de concert pour décourager les stratégies de recherche de rente, et aider les entreprises russes à mieux se positionner au sein des réseaux et des marchés mondiaux d'innovation.
- *La politique financière* doit promouvoir le développement d'établissements et de mécanismes financiers capables de faire une bonne évaluation les investissements liés à l'innovation et de bien gérer les risques inhérents.
- *La politique d'éducation et de formation* doit être coordonnée avec celle du marché du travail afin d'assurer la quantité, la qualité, et l'allocation efficiente des ressources humaines nécessaires pour renforcer les activités productives à forte intensité de savoir orientées par les marchés.

- *La politique de la recherche* doit contribuer à développer et à mobiliser, à des fins socialement utiles, des capacités de recherche des secteurs public et privé qui se renforcent mutuellement.
- *Les politiques industrielle et régionale* doivent fournir les infrastructures, les cadres institutionnels et les infrastructures nécessaires pour qu'un certain nombre de secteurs et de pôles d'activité particuliers puissent réaliser leur potentiel d'innovation.
- *Les politiques sociale et de santé* doivent envisager l'innovation non seulement comme un moyen d'améliorer la qualité de la vie mais aussi comme une conséquence de cette amélioration.
- *La politique de l'environnement* doit recourir à la réglementation et à l'incitation comme des outils essentiels pour favoriser des solutions créatrices de valeur au problème du nécessaire découplage de la croissance économique avec l'utilisation des ressources naturelles.
- *La politique judiciaire* doit veiller à l'application de la règle de droit et donc protéger les activités innovantes, déjà intrinsèquement risquées, contre des sources d'incertitudes supplémentaires insoutenables.

Les aides publiques directes de soutien de l'investissement en recherche-développement (R-D) et en innovation ne sauraient probablement suffire si on ne s'attèle pas de manière suffisamment volontariste à la nécessaire amélioration du contexte économique d'ensemble.

Le concept de système d'innovation offre une perspective analytique globale bien adaptée à l'approche « pangouvernementale » préconisée par la Stratégie de l'OCDE pour l'innovation (Encadré 0.1). Le présent rapport adopte cette perspective pour mettre en évidence les atouts et les faiblesses du système d'innovation actuel en Russie, dans le but d'identifier les institutions et les politiques qui, moyennant certains changements, pourraient permettre d'améliorer son fonctionnement. Il ne dresse pas un inventaire détaillé de tous les aspects des institutions et des politiques pertinentes ; après avoir brièvement recensé celles qui modèlent ce que l'on peut appeler les conditions-cadres de l'innovation, il analyse plus attentivement les politiques spécifiques de la science et de la technologie (S&T) et de l'innovation, en se concentrant particulièrement sur la politique de la recherche.

Encadré 0.1. L'approche systémique de l'innovation dans le contexte de la Russie

Le concept de système d'innovation met l'accent sur les idées suivantes, qui apportent un éclairage important sur la manière d'aborder tout débat sur la promotion de l'innovation dans le contexte de la Russie :

- L'innovation n'est pas une activité spécialisée confiée à des institutions spécifiques que le gouvernement peut créer et diriger ; c'est plutôt la résultante de dynamiques premières plus diffuses, que les pouvoirs publics peuvent surtout libérer et influencer.

  La Russie reste tributaire d'un passé dans lequel chaque fonction revêtant une importance stratégique pour la société était déléguée à des institutions dédiées, selon une stricte répartition des tâches.
- L'innovation est la résultante d'interactions entre de nombreuse institutions dont certaines obéissent à une logique de marché et d'autres non, dont l'action est donc orientée par des structures d'incitation différentes mais compatibles. Elles détiennent des compétences qui sont une combinaison de capacités héritées des phases antérieures du développement économico-historique du pays et de capacités nouvelles, qui se développent au fil du temps en réponse aux opportunités actuelles et futures qui sont signalées par les structures d'incitation.

  En Russie, ce processus est encore perturbé par les stratégies de certains puissants acteurs, notamment ceux qui disposent de capacités héritées du passé, mais qui craignent que la modernisation et le redéploiement de ces capacités ne fragilisent leur position institutionnelle, et ceux qui ont bâti leur pouvoir d'influence économique et politique grâce à des stratégies de rente mais qui n'ont pas un besoin pressant d'investir dans de nouvelles compétences liées à l'innovation.

- Les systèmes d'innovation sont constitués par un ensemble d'institutions et de processus en évolution permanente. Jamais ils n'atteignent un état stationnaire et optimal, mais ils ne cessent de se modifier en symbiose avec l'évolution du milieu économique et social ambiant. Quand les pays s'enrichissent, les facteurs de leur compétitivité changent à mesure qu'évoluent le rôle et les formes de capacités requises dans les domaines de la science, la technologie et l'innovation. Dans un premier temps, leur position concurrentielle est déterminée essentiellement par leurs dotations en ressources, mais à l'étape suivante, la poursuite de leur développement dépend de plus en plus de l'efficience avec laquelle ces ressources sont exploitées, et les facteurs de réussite prépondérants deviennent alors l'efficience des marchés du capital, du travail et des produits ainsi que la qualité des autres institutions. Au stade ultime, le succès des pays les plus avancés en vient à dépendre essentiellement de leur capacité à innover.

  La Russie s'est dotée, très tôt, d'importances capacités scientifiques et technologiques, mais qui étaient mal adaptées aux processus de création de richesse. Le pays doit maintenant évoluer vers un modèle de croissance tirée par l'innovation, alors qu'il lui reste beaucoup à faire pour satisfaire pleinement aux exigences de la deuxième étape de développement, à savoir améliorer la qualité des institutions et l'efficience des marchés.
- Dans les systèmes d'innovation les plus performants, ce sont les entreprises opérant sur des marchés concurrentiels qui constituent les principaux acteurs de l'innovation, car elles sont les lieux privilégiés dans lesquels les savoirs nouveaux, ou les combinaisons nouvelles de savoirs antérieurs, sont transformés en richesse économique. Mais la recherche publique conserve un rôle clé, non seulement pour l'accomplissement de missions spécifiques d'intérêt publique, mais aussi comme infrastructure d'appui intellectuel pour les acteurs du marché.

  L'entreprise ne constitue pas encore le cœur du système d'innovation russe, en dépit de ce que semblerait indiquer la part élevée du secteur commercial dans les activités à forte intensité de R-D, car la majorité des firmes de ce secteur ne sont que partiellement guidées et insuffisamment disciplinées par des signaux et des mécanismes de marché.
- Tout au long de leur évolution et de leur intégration au sein des réseaux mondiaux, les systèmes d'innovation nationaux tirent des leçons de l'expérience internationale, mais conservent quelques caractéristiques propres qui peuvent être sources d'avantages ou de désavantages concurrentiels.

  Pour toutes les raisons indiquées aux points précédents, le système d'innovation russe présente une personnalité très marquée. Certaines de ces particularités ne sont pas des imperfections mais constituent au contraire le germe d'avantages concurrentiels liés au savoir qui seraient mieux exploités si d'autres traits, plus préjudiciables, étaient corrigés par l'adoption et l'adaptation de bonnes pratiques internationales.

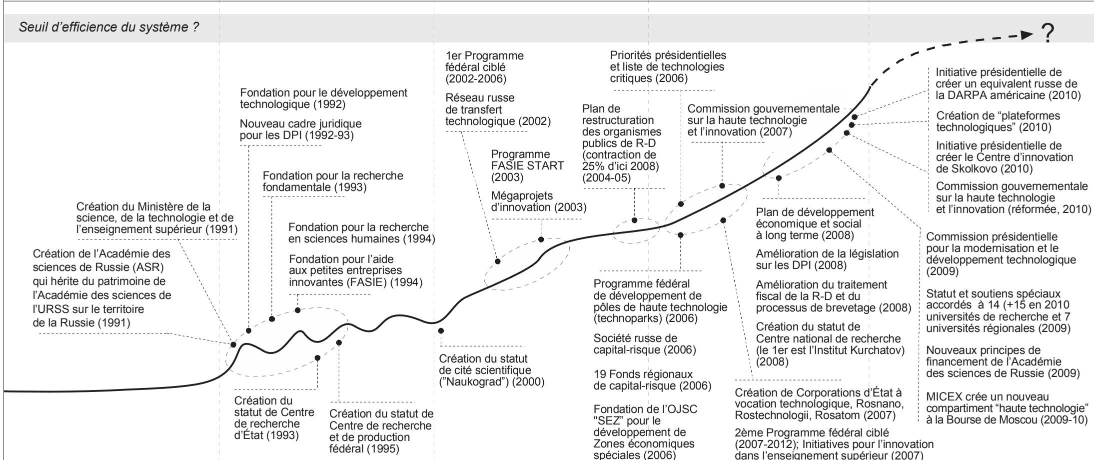
Réussites, insuffisances et défis

Toute évaluation du système d'innovation russe doit se faire dans une optique dynamique (Figure 0.1). Il faut prendre en considération non seulement les changements gigantesques qui ont bouleversé le paysage politique et économique du pays depuis 1992, mais aussi les fortes contraintes imposées par l'héritage du passé. Cette conjonction entre, d'une part le changement radical, et de l'autre la survivance de certains dispositifs institutionnels et de certaines mentalités de la période antérieure, fait que la trajectoire de modernisation de la Russie diffère beaucoup de celle de la Chine, où une approche graduelle du changement du cadre politico-économique général a été combinée, dans un contexte d'industrialisation rapide, à des réformes structurelles microéconomiques plus rapides et plus radicales, notamment dans les secteurs public et privé de S&T et de R-D, certes moins matures au départ que leurs homologues russes. Ainsi, en Russie, pour l'allocation des ressources économiques, coexistent des mécanismes de marché de plus en plus prévalents, avec d'autres mécanismes sous-tendus par des réseaux sociaux et politiques. On observe un fort contraste entre un certain nombre de pôles d'excellence territoriaux, scientifiques, technologiques et industriels très dynamiques, et la masse stagnante des entreprises et des organisations caractérisée par des niveaux très faibles de productivité et d'innovation.

Malgré la persistance de certaines de ces caractéristiques handicapantes, on a assisté ces dernières années à des progrès continus dans la création ou la potentialisation d' « agents du changement positif » – individus, organismes de production, de recherche ou d'enseignement, ou institutions publiques de soutien. Ceci a rapproché le pays de ce qui pourrait être un tournant dans l'avènement d'un système d'innovation national performant qui, tout en conservant certains traits propres à la Russie, apporterait une contribution décisive à la réalisation des objectifs socio-économiques ambitieux du pays.

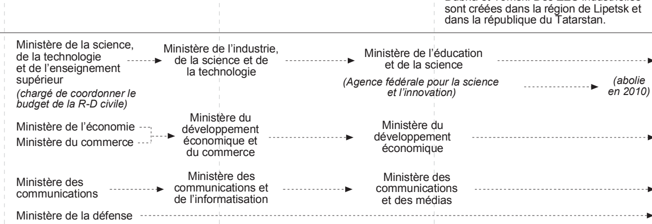
Figure 0.1. La politique d'innovation de la Russie : Réformes institutionnelles et courbe d'apprentissage

Courbe d'apprentissage de la politique d'innovation russe



	Héritage soviétique (jusqu'en 1990)	Restructuration turbulente, avec l'expérimentation précoce de nouvelles approches de la politique d'innovation (1990s)	Stabilisation, avec des apports significatifs au cadre de la politique d'innovation (2000-2005)	Consolidation et expansion du cadre de la politique d'innovation (2005-2010)	Vers un système d'innovation parvenu à maturité et efficient (2010+)
Moteur de l'innovation	La demande gouvernementale dicte l'innovation technologique dans les grands projets techniques. La science est dans une large mesure mobilisée pour les besoins de l'industrie de la défense. Peu d'innovation dans les secteurs des biens de consommation et des biens d'équipement non prioritaires.	Effondrement de la demande gouvernementale d'innovation et des chaînes d'approvisionnement correspondantes. A de rares exceptions près, les entreprises qui réussissent dans le nouvel environnement de marché s'appuient surtout sur des technologies et du savoir-faire commercial étrangers.	Premiers succès d'innovations appelées par le marché dans certains domaines comme le logiciel ou les matériaux de pointe. Apparition de nouvelles entreprises innovantes, souvent issues de la recherche publique. Mais l'innovation demeure une faible priorité pour la plupart des grandes entreprises, souvent détenues par l'État.	L'investissement direct étranger et les centres de R-D des multinationales commencent à jouer un rôle significatif. Le nombre de PME innovantes continue d'augmenter, mais pas assez pour compenser l'absence d'une demande suffisante d'innovation de la part des grandes entreprises et des pouvoirs publics.	
Recherche publique	L'Académie des sciences réalise l'essentiel de la recherche fondamentale. Une foule d'instituts spécialisés et d'autres organisations font de la recherche appliquée et du développement technologique à des fins civiles et militaires.	Contraction et restructuration de grande ampleur. Beaucoup d'organismes de recherche appliquée ou d'ingénierie disparaissent ou sont absorbées par le secteur commercial. Le financement étranger aide à la survie mais la paupérisation conduit à une émigration importante de chercheurs et ingénieurs.	L'augmentation des dépenses fédérales stabilise la situation et jette les bases de la rénovation des organisations viables. De meilleures conditions de travail, notamment salariales et le développement de réseaux d'innovation créent de nouvelles motivations et opportunités.	Un soutien budgétaire constant permet une modernisation des moyens de recherche fondée sur une approche de plus en plus sélective. Renforcement des capacités de recherche des universités. De nouveaux programmes de soutien et de nouvelles infrastructures facilitent la commercialisation aux niveaux national, régional ou local. Mais des forces conservatrices continuent d'opposer une résistance aux processus de sélection dictés par le gouvernement ou le marché.	
Infrastructures d'innovation	Caractère indiosyncratique, avec une distribution géographique due à des considérations stratégiques (militaires) et politiques, ainsi qu'aux circonstances historiques (notamment la 2ème Guerre Mondiale).	Les premiers technoparks apparaissent à Tomsk, Moscou et Zelenograd (1990-91). Création du 1er Centre pour l'innovation et la technologie à Saint-Pétersbourg (1996). Dans le cadre de stratégies de survie, les expérimentations en matière de commercialisation se multiplient dans le secteur de la recherche publique.	Développement constant d'incubateurs, de technoparks, de centres de transfert de technologies et de centres pour l'innovation et la technologie autour à la fois des universités et des instituts de recherche publics. De nombreuses initiatives issues de la base aux niveaux local (p.ex. au sein des cités scientifiques) et régional.	En 2008, on comptait environ 120 Incubateurs d'entreprises, 85 Technoparks et 100 Centres de transfert de technologie. Les nouveaux programmes et les nouvelles approches visent à regrouper ces infrastructures autour de pôles plus solides. Les premières Zones économiques spéciales (ZES) à vocation technologique sont créées à Saint-Pétersbourg, Zelenograd, Dubna et Tomsk. Des ZES industrielles sont créées dans la région de Lipetsk et dans la république du Tatarstan.	

Gouvernance de l'action publique (principaux ministères et agences)



La notion de tournant contient l'idée qu'un système ne se développe pas suivant un processus continu, plus ou moins rapide, mais en passant par des « changements de phase » qui surviennent quand certaines composantes critiques arrivent à leur point de maturité et commencent d'entrer dans des interactions fructueuses, pour peu que de bons catalyseurs soient présents. En termes de composantes, la Russie dispose maintenant d'un portefeuille assez complet d'acteurs (petites et grandes entreprises, universités de recherche, établissements publics de recherche), ainsi que d'une gamme d'institutions et de mesures de soutien assez complète, même si l'ensemble n'est pas parfaitement orchestré et si certaines actions en sont encore au stade expérimental et d'autres n'ont pas atteint la masse critique suffisante. On peut espérer que certains ajouts récents au paysage institutionnel auront un effet catalyseur en améliorant la coordination et en assurant la masse critique dans tous les domaines d'action. Par exemple, les changements intervenus au niveau le plus élevé de la gouvernance des politiques publiques pourraient provoquer la mutation plus profonde nécessaire s'ils sont accompagnés d'efforts pour rompre avec la tradition de pilotage par le haut dans la mise en œuvre des politiques, par la mise en place de structures de gouvernance plus distribuées, plus coordonnées et plus adaptables aux niveaux inférieurs de décision.

Ces dernières années, le gouvernement a fait de l'innovation une priorité nationale ; une série d'initiatives concrètes de la présidence attestent de la réalité de cet engagement. Pour faire en sorte que, au-delà de leurs avantages intrinsèques, ces initiatives puissent déclencher des changements positifs de plus grande ampleur, il faut examiner l'ensemble des instruments et des cadres institutionnels de politique en place afin d'en identifier les manques, les faiblesses ou les incohérences. Cette évaluation doit s'appuyer sur un diagnostic partagé de la situation actuelle du système d'innovation, concernant notamment les points forts sur lesquels s'appuyer pour exploiter de nouvelles opportunités dans un environnement mondial exigeant et particulièrement compétitif, et aussi les obstacles à l'adaptation qu'il convient de lever d'urgence.

Le tableau 0.1 présente une analyse AFOM (Atouts-Faiblesses-Opportunités-Menaces) résumée du système d'innovation de la Russie. Il montre que le pays possède de considérables atouts hérités du passé qu'il faut faire fructifier : des capacités éducatives relativement élevées et un niveau enviable dans de nombreux domaines de la science et la technologie. L'engagement pris récemment à haut niveau en faveur de l'innovation a créé les conditions de la rénovation et du renforcement des infrastructures de soutien à la science, la technologie et l'innovation en fonction d'objectifs stratégiques. Cette volonté politique s'est aussi traduite par des efforts pour cibler l'effort financier sur des domaines prioritaires et pour faire une plus grande place à la concurrence dans l'allocation des ressources.

En même temps, la performance du système d'innovation demeure compromise par plusieurs facteurs, dont certains trouvent leur origine dans l'ancien système soviétique. Citons : un très faible niveau d'activité de R-D et d'innovation dans les entreprises, des conditions-cadres peu propices à l'innovation (particulièrement le manque de concurrence, le manque de confiance, et la prévalence de la corruption), et la faiblesse des infrastructures et de la réglementation. De plus, les initiatives de réforme se heurtent souvent à la résistance active de groupes d'intérêts bien établis ou à l'inertie institutionnelle.

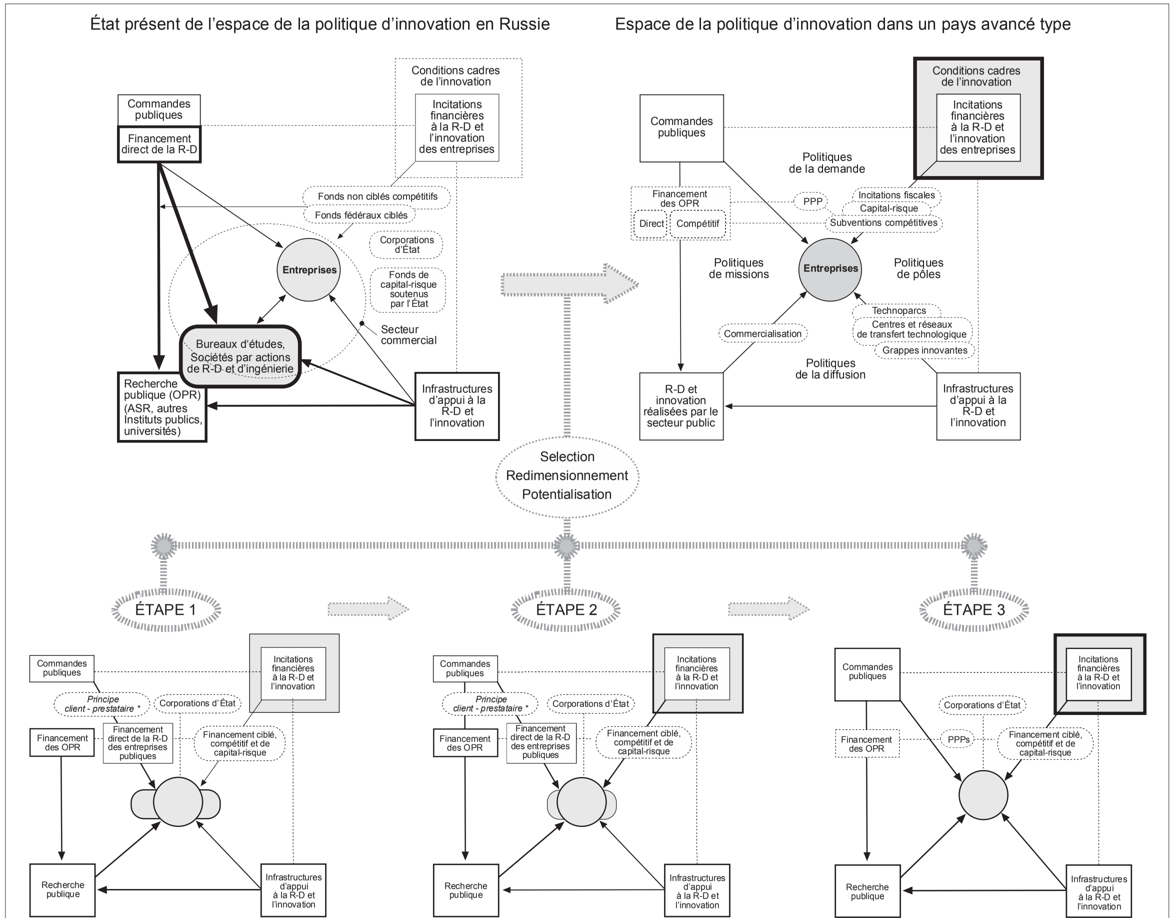
Tableau 0.1. Analyse AFOM (atouts-faiblesses-opportunités-menaces) du système d'innovation de la Russie

Forces	Faiblesses
• Richesse en ressources naturelles et en patrimoine intellectuel accumulé. • Proximité géographique et liens historiques avec des pays avancés et des pays émergents. • Bon niveau général d'éducation de la population. Système d'enseignement supérieur bien développé et récemment renforcé dans les filières scientifiques et technologiques, qui attirent une part importante, quoiqu'en déclin, d'étudiants. • Culture scientifique et d'ingénierie bien ancrée, grand nombre de centres d'excellence de niveau international dans la partie modernisée du système de recherche publique. Renommée mondiale, voire prestige dans des domaines scientifiques et techniques clé, comme l'aérospatiale, la science et l'ingénierie nucléaire et la programmation avancée. • De plus en plus d'entreprises, dont un bon nombre à forte croissance, appliquent des méthodes de production et de management conformes aux meilleures pratiques, et sont capables de saisir les nouvelles opportunités de marché liées à l'innovation lorsque les incitations sont adaptées. Une masse critique de nouvelles entreprises de technologies dans certains secteurs et certains sites géographiques. • Des infrastructures d'innovation en développement rapide et diversifiées. Des villes dédiées à la recherche qui ont été revitalisées, comme Dubna et Zhukovski. De nouveaux centres d'excellence multidisciplinaires comme Kurchatov. • L'engagement du gouvernement fédéral en faveur de la modernisation et de l'innovation, et sa capacité de mobiliser des ressources dans les domaines prioritaires. • Une expérience cumulée dans la conception et l'utilisation, au moins à titre expérimental, de la plupart des instruments de la politique de l'innovation. • Un meilleur équilibre entre coopération et concurrence entre les différentes composantes du système de recherche publique. Par exemple : une part plus importante du budget de l'Académie des Sciences de Russie est affectée de manière compétitive ; des mécanismes nouveaux encouragent la mutualisation des ressources en réponse aux priorités nationales. • Des stratégies d'innovation bien articulées dans des régions pionnières comme Tomsk et le Tartarstan.	• Depuis dix ans, la faiblesse de l'investissement a atténué les bienfaits structurels d'une croissance rapide, freinant l'acquisition de connaissances incorporées dans les biens d'équipement, et affaiblissant la demande d'innovation. • La composition de l'investissement des entreprises est déséquilibrée au détriment de l'innovation car l'environnement économique a un effet désincitatif, notamment à cause du manque de concurrence. Beaucoup de grandes entreprises à la gouvernance défectueuse survivent avec des équipements obsolètes en opérant sur des marchés relativement captifs. La capacité de la Russie à remporter des marchés civils dans les domaines de hautes technologies est compromise par l'inefficience du secteur des entreprises publiques. • Certaines infrastructures et institutions essentielles pour l'innovation sont encore insuffisamment matures ou opérantes, comme par exemple les réseaux ou les pôles (« clusters ») de savoir, le droit de la propriété intellectuelle. • Dans les domaines où les projets scientifiques et technologiques de grande échelle sont liés à des missions étatiques (comme l'aérospatiale), les liens internationaux sont forts et équilibrés, mais ils le sont moins dans les domaines où domine la logique de marché. C'est en partie la conséquence d'obstacles internes et externes aux échanges de hautes technologies et à l'investissement direct étranger. • De nombreux segments du secteur de la recherche publique ne remplissent pas le critère de l'excellence et / ou de la pertinence. Trop souvent, l'allocation des ressources s'y fait indépendamment des performances. • Jusqu'à présent, le système et les pratiques de gouvernance encouragent la pluralité de visions stratégiques en partie concurrentes, et une mise en œuvre trop centralisée, mais non exempte de redondances, des politiques par les différentes agences fédérales et corporations d'État. • Le mix actuel d'objectifs et de mesures d'action publique présente plusieurs biais : une politique active de la science, de la technologie et de l'innovation menée en remplacement plutôt qu'en complément d'une amélioration des principales conditions-cadres de l'innovation, lesquelles demeurent insuffisantes. Un accent mis trop exclusivement sur l'offre au détriment de la stimulation de la demande, et un investissement public dans l'innovation orienté via un éventail d'instruments qui tend à évincer l'investissement privé.

Tableau 0.1. Analyse AFOM (atouts-faiblesses-opportunités-menaces) du système d'innovation de la Russie (*suite*)

Opportunités	Menaces
• La demande mondiale d'innovation et de savoirs ayant trait à l'innovation est en expansion. Une meilleure intégration aux chaînes de valeur mondiales, facilitée par l'accession à l'OMC, aiderait la Russie à orienter ses ressources vers des domaines où sa compétitivité internationale augmenterait considérablement son potentiel de croissance. • Des universités de recherche, travaillant en synergie plus étroite avec l'Académie des Sciences de Russie (ASR) et les autres instituts publics de recherche, ainsi qu'une nouvelle génération d'entreprises, de managers et d'entrepreneurs pourraient constituer de moteurs puissants d'innovation. • L'expansion rapide des marchés de services d'ingénierie est prometteuse pour les entreprises et les individus relevant des domaines de l'aérospatiale, des technologies de l'information et de la communication, etc. • La géographie de la Russie pose d'immenses difficultés pour le développement et la maintenance d'infrastructures de transport et de communication ; la plupart sont sous-dimensionnées ou obsolètes. Transformer cette contrainte en opportunité exige un programme de modernisation qui mette l'accent sur des solutions innovantes et des marchés publics plus ouverts à l'innovation. Il en va de même de la modernisation des industries extractives et de la mise en œuvre de la nouvelle et ambitieuse politique de la santé publique et de l'environnement. • Plus généralement, la composition du stock de capital dans beaucoup de secteurs permet d'espérer passer rapidement aux niveaux optimums de productivité si le taux d'investissement se redresse. • Les jeunes générations recèlent un énorme réservoir de candidats-entrepreneurs innovants. C'est ce qui ressort des réponses reçues à plusieurs programmes de la Fondation pour la promotion des petites entreprises scientifiques et technologiques. • Ces dernières années, la « circulation des cerveaux » de la diaspora russe s'est considérablement intensifiée. Ce mouvement pourrait être encore amplifié, et certaines initiatives récentes des pouvoirs publics sont de nature à y contribuer. • La multiplication des exemples de réussites permises par les nouveaux canaux et les nouvelles plateformes de commercialisation, comme Rosnano ou les autres pôles de hautes technologies, peuvent contribuer à faire évoluer les mentalités chez les chercheurs et dans les entreprises. • La sensibilisation croissante à l'importance de l'innovation et un plus grand activisme au niveau des municipalités et des régions.	• Forte concurrence de la part des pays avancés et des économies émergentes les plus dynamiques pour l'exploitation des nouvelles opportunités apparaissant sur la scène mondiale. • Société vieillissante, phénomène particulièrement marqué chez les ingénieurs et les chercheurs. • Le manque de concurrence aggrave le retard technologique dans beaucoup de secteurs et accroît le découplage entre rentabilité et productivité, d'où une distorsion dans l'allocation des ressources, au détriment des investissements porteurs des plus grands bénéfices sociaux à long terme. En réaction, le gouvernement accentue son implication directe dans les processus d'innovation au lieu de s'attaquer aux racines du problème. • Le faible impact des dépenses publiques en S-T sur l'investissement des entreprises en innovation rend l'effort budgétaire de plus en plus difficile à justifier. Les pouvoirs publics sont donc tentés d'intervenir plus directement par d'autres moyens, peu compatibles avec la dynamique des marchés. • L'Académie des sciences de Russie demeure une respectable société savante, mais elle use de son prestige mérité pour résister aux réformes nécessaires pour améliorer l'efficacité de sa gestion. • Le secteur des entreprises publiques reste une « boîte noire » du point de vue de la politique d'innovation civile : l'opacité des processus d'allocation des ressources crée un grand nombre de « trous noirs » (des ressources considérables consacrées à des projets dénués de perspectives commerciales). • Les corporations d'État ne remplissent pas leur rôle et penchent pour des approches de « champion national » peu efficaces (Rostechnologii), ou développent un modèle entrepreneurial alternatif peu coordonné avec les autres initiatives gouvernementales (Rosnano). • La Russie perd du terrain dans une course mondiale aux talents de plus en plus intense. • Faute d'une décentralisation suffisante, les objectifs et les priorités nationales ne se traduisent pas par des mesures adaptées aux capacités existantes au niveau régional. Les régions, quant à elles, élaborent des stratégies d'innovation qui ne vont pas dans le sens de l'intérêt national. • *In fine*, le paradoxe russe, c'est-à-dire la faiblesse du taux d'innovation par rapport aux capacités d'innovation, se traduit à terme par un déclin de ces capacités.

Figure 0.2. Optimiser la politique et le système d'innovation de la Russie : Un itinéraire de transition par étapes



* Le principe client-prestataire permet d'imposer une discipline à l'allocation de fonds publics à des organismes de recherche. Il suppose que l'État achète de manière contractuelle des services de recherche à un prestataire, soit pour son compte propre, soit au profit de l'économie et de la société dans son ensemble. La mise en oeuvre de ce principe nécessite des mécanismes institutionnels adaptés, par exemple des contrats de performance gérés par une agence publique dédiée.

Dans la figure 0.2, est représenté en haut à gauche l'état actuel du système d'innovation de la Russie. On constate que les entreprises, bien que placées au centre de la figure – puisqu'elles sont le siège naturel des activités d'innovation – n'assument pas encore un rôle central dans le système d'innovation. On observe en revanche une configuration que l'on retrouve fréquemment dans les (anciens) systèmes d'économie planifiée, caractérisée par une multitude d'instituts de branche et de bureaux d'étude qui continuent de jouer un rôle dominant dans la R-D et l'innovation. Bien que leurs effectifs aient considérablement baissé dans ce secteur depuis les années 90, beaucoup de ces instituts ont réussi à se maintenir grâce à des stratégies défensives, mais il ne s'agit bien souvent que de survie. Beaucoup sont devenus des sociétés par actions tout en demeurant propriété de l'État. Leur financement provient essentiellement de fonds publics, sous une forme ou sous une autre – dotations forfaitaires des ministères, contrats de recherche et d'étude avec d'autres entreprises, elles aussi publiques, mais tournées vers la production.

Aux quatre angles de cette même figure sont représentées quatre axes de l'action publique pour soutenir faveur de l'innovation dans les entreprises :

1. A l'angle inférieur gauche figure la recherche publique menée au sein des académies, des établissements d'enseignement supérieur, et des autres établissements de recherche. Ces activités ont pour but de fournir au système d'innovation de nouvelles connaissances codifiées et du personnel formé. Actuellement, cette contribution est jugée trop faible et on estime qu'elle devrait être renforcée. Les instituts de branche dominants font en partie double-emploi avec ces instituts et accaparent l'essentiel de la dépense publique en R-D.
2. A l'angle inférieur droit, on trouve les infrastructures de soutien à la R-D et à l'innovation. Elles englobent à la fois les infrastructures matérielles (p.ex. technoparcs) et immatérielles (p.ex. réseaux). Les pouvoirs publics attachent beaucoup d'importance à ces infrastructures, en particulier comme moyen de diffusion et de commercialisation des connaissances produites dans les instituts publics de recherche. Malheureusement, ce type d'action se résume essentiellement à une politique de l'offre, qui reste trop déconnectée des quelques modestes initiatives visant à encourager les entreprises (existantes) à innover et à financer la R-D.
3. A l'angle supérieur droit se trouvent les incitations financières (aides fiscales, subventions conditionnelles ou prêts à des conditions préférentielles) offertes par les pouvoirs publics pour encourager les entreprises à innover ou à financer leur propre R-D. Ces incitations sont relativement sous-utilisées en Russie, mais il faut noter que dans d'autres pays, lorsque les pouvoirs publics y recourent, leur succès et leur efficacité dépendent en grande partie de l'environnement général de l'innovation, à savoir l'état de la concurrence, la réglementation, le cadre juridique, etc. C'est probablement le maillon le plus faible d'une panoplie de mesures pour l'innovation de plus en plus riche par ailleurs, et la Russie devra s'atteler à ce problème pour que son potentiel d'innovation puisse s'exprimer.
4. A l'angle supérieur gauche, les commandes publiques et le financement direct de la R-D. Dans de nombreux pays il s'agit de deux fonctions distinctes, mais en Russie elles se rejoignent dans une certaine mesure, dans le cadre de dispositifs plutôt opaques en raison d'un soutien marqué aux instituts de branche et aux bureaux d'étude. En fait, le soutien à la R-D est un important chapitre de la commande publique, en grande partie par l'intermédiaire du financement direct de la R-D des instituts de branche. Dans le même temps, l'utilisation des commandes publiques pour stimuler l'innovation d'autres types d'entreprises, qu'elles soient publiques ou privées, demeure peu développée.

Pour résumer, le système actuel souffre d'un certain nombre de déséquilibres graves. Les entreprises n'occupent pas le rôle central qui devrait être le leur, ce qui déséquilibre et amoindrit la contribution du secteur public à la performance d'innovation de la Russie. Les instituts de branche et les bureaux d'étude publics restent au cœur du système d'innovation. Les inconvénients de cette configuration avaient déjà été abondamment décrits à la fin de la période soviétique : la mauvaise circulation des savoirs et le manque d'interactions entre les concepteurs, les producteurs et les utilisateurs des technologies constituent de lourds handicaps. Plusieurs solutions existent, la plus évidente étant de fusionner pleinement les anciens instituts de branches viables avec des entreprises de production. Ces rapprochements auraient dû être opérés dans les années 1990 si les circonstances avaient été meilleures, mais l'incertitude et le court-termisme qui prévalaient à l'époque auraient probablement abouti à des dépeçages et des licenciements trop dommageables.

Aujourd'hui, le climat d'investissement est assez différent et il offre une fenêtre d'opportunité pour rapprocher la structure du système d'innovation du modèle représenté en haut à droite de la figure 0.2. Là, les entreprises remplissent leur rôle d'acteurs de l'innovation et financent une plus grande part de la dépense intérieure brute de R-D (DIRD) que le secteur public, comme c'est le cas dans la plupart des pays de l'OCDE. Dans ce schéma, le secteur public continue de soutenir les entreprises dans leurs activités d'innovation et de R-D grâce à un recours équilibré à plusieurs instruments d'action : à travers la recherche publique réalisée essentiellement dans les académies des sciences et les établissements d'enseignement supérieur, par le biais des infrastructures de R-D et d'innovation, par des incitations financières aux entreprises à réaliser elles-mêmes leur R-D et leurs activités d'innovation, et par le biais de commandes publiques destinées à soutenir l'innovation. La différence par rapport au système actuel est essentiellement le décentrement du système public de recherche, et notamment des anciens instituts de branche, qui cessent d'être les acteurs principaux du système d'innovation. Ce rôle est assumé par les entreprises de production, qu'elles soient publiques ou privées, dont les activités d'innovation et de recherche sont rendues possibles sur une beaucoup plus grande échelle par des conditions-cadres beaucoup plus propices.

La question qui se pose, bien-sûr, est de savoir comment passer de la situation actuelle à celle, plus favorable, qui est décrite dans la figure 0.2. Pour réorienter le système actuel vers un système dont les entreprises de production sont devenues des acteurs centraux, il ne suffira pas de réorganiser les anciens instituts de branche. Il faudra aussi que les entreprises acquièrent la motivation et les capacités nécessaires pour innover et mener de la R-D. Il importera à cet égard d'avoir des conditions-cadres plus favorables à l'innovation ainsi qu'un panachage bien conçu d'incitations financières et d'autres mesures.

Pour opérer cette transformation, il n'existe bien évidemment pas de remèdes-miracles ; plusieurs voies sont possibles, avec des priorités et des compromis différentes, en jouant différemment sur les complémentarités, et en considérant une période plus ou moins longue. L'une des options, qui n'est pas la seule possible, est décrite dans la partie inférieure de la figure 0.2. Après une période pendant laquelle les financements directs ne seraient plus dirigés vers les instituts de branche mais octroyés selon un principe client-prestataire, ces instituts seraient absorbés par des entreprises de production. Comme nous l'avons noté, les chances de succès de cette transformation reposeraient sur la motivation des entreprises à reprendre les instituts, laquelle dépendrait de leur stratégie en matière de recherche et d'innovation. Ces stratégies seraient influencées par les conditions-cadres de l'innovation et les politiques publiques spécifiques en faveur de la science, de la technologie et de l'innovation (STI). L'état de santé des instituts serait aussi un facteur déterminant du choix des entreprises. Certains de ces instituts, souvent les meilleurs, ont déjà été rachetés, mais la question se pose certainement pour un bon nombre d'autres, étant donné la période prolongée de sous-investissement qu'ils ont traversée. Pour certains, la fermeture pure et simple pourrait être la meilleure solution.

Principes directeurs pour l'action publique

Le redressement des déséquilibres qui caractérisent le système d'innovation russe nécessite une politique d'innovation plus équilibrée qui soit axée sur un ensemble plus large d'objectifs et de cibles. Plus précisément, il s'agirait de penser le cadrage de la politique d'innovation de la Russie en termes de « solutions de compromis » :

- *Élargissement et approfondissement de l'activité industrielle :* la diversification de l'économie russe nécessitera un élargissement du champ d'activité de l'industrie pour sortir de la forte dépendance à l'égard des ressources naturelles et s'orienter vers les secteurs émergents (hautes technologies, services inclus) et les secteurs jadis forts qui ont été relativement négligés pendant la période de transition (machinerie lourde, défense, aérospatiale, etc.). Approfondir en même temps les bases de la compétitivité des autres secteurs existants – modernisation technologique par l'assimilation de connaissances de l'extérieur et par des démarches d'innovation internes, et participation à des réseaux d'innovation pertinents par l'établissement de liens tant en amont qu'en aval.
- *Grandes entreprises et PME* : Ces deux catégories de firmes sont parfois présentées comme des moteurs alternatifs de la modernisation et la diversification de l'économie russe ; la réalité est autre car ces deux formes d'entreprises jouent des rôles très complémentaires. La plupart des économies industrialisées reposent surtout sur les grandes entreprises, qui représentent environ 70 % de la R-D effectuée par les entreprises commerciales dans les pays de l'OCDE. Les grandes entreprises ont la portée et l'échelle qu'il faut pour développer et commercialiser des technologies innovantes, mais du fait de leur taille, elles peuvent aussi facilement se retrouver prisonnières d'une option technologique donnée ; si le cours des choses de voit perturbé par un choc, technologique ou autre, il peut être difficile pour elles de se désengager. Les petites et moyennes entreprises (PME) innovantes, pour peu qu'elles évoluent dans un environnement porteur, sont bien placées pour surmonter certaines des rigidités qui caractérisent les grandes entreprises et devenir la matrice de nouveaux domaines de croissance. Il faut toutefois pour cela qu'il y ait une demande de produits et services innovants, laquelle provient généralement des grandes entreprises, des pouvoirs publics, ou des consommateurs finals. En Russie, il serait, certes, souhaitable de soutenir davantage les PME innovantes, mais il importerait aussi de développer la capacité à innover des grandes entreprises, essentiellement par des réformes structurelles dans les entreprises publiques, mais aussi par d'autres initiatives. Cela serait doublement bénéfique pour les petites entreprises car leurs innovations trouveraient une demande plus forte et elles pâtiraient moins de la concurrence léonine de grandes entreprises moins efficientes et moins créatives mais bénéficiant de subventions.

- *Initiatives d'innovation publiques et privées :* Dans les pays de l'OCDE et dans les économies en développement rapide, les entreprises privées constituent la principale source d'innovation, aiguillonnées qu'elles sont par la nécessité d'affirmer leur compétitivité sur les marchés. Si l'on prend la dépense de R-D des entreprises comme variable de substitution de la capacité d'innover des entreprises, il ressort que les entreprises russes sont relativement peu performantes. Les données issues de l'enquête sur l'innovation, qui incluent l'innovation non liée à la R-D, font aussi ressortir la piètre performance d'innovation des entreprises russes par rapport à leurs homologues d'autres pays développés. En principe, les pouvoirs publics peuvent mettre en place des mécanismes qui incitent les entreprises privées à innover. En Russie, la mesure d'action publique la plus utile serait d'améliorer les conditions-cadres de l'innovation. La puissance publique pourrait aussi s'employer à dynamiser la modernisation technologique par le recours aux entreprises publiques, mais cette stratégie n'est pas sans risques sérieux. Il serait irréaliste d'attendre de la recherche publique le renouveau du tissu industriel russe – par essaimage d'entreprises de haute technologie – mais elle peut jouer un rôle important, en collaborant avec des entreprises existantes des secteurs public et privé.

- *Innovation dans les hautes technologies et dans les domaines à faible intensité technologique :* L'une des conclusions qui ressort des travaux récents de l'OCDE est que beaucoup de pays attachent trop d'importance au développement des secteurs de hautes technologies et négligent l'intérêt de l'innovation dans les autres secteurs. Il s'agit souvent de formes assez simples de modernisation technologique, comme le remplacement d'équipements vétustes par des nouveaux, mais qui revêt une importance critique pour relever les niveaux de productivité dans l'ensemble des secteurs de l'économie. Certains commentateurs jugent que la Russie devrait faire un effort sur cette forme d'innovation, étant donné que, dans bien des domaines, le pays se positionne loin de la frontière technologique. Mais c'est confondre la situation actuelle et le potentiel du pays, et faire fi du fait que la Russie possède ou est en passe d'acquérir des atouts dans des domaines de hautes technologies, comme la défense et l'aérospatiale, le nucléaire, les nouveaux matériaux, les technologies de l'information et des communications (TIC). Les programmes en matière d'innovation doivent donc suivre une approche équilibrée entre le soutien aux secteurs de hautes technologiques et aux secteurs non technologiques, et éviter ce travers que l'on pourrait nommer « la myopie aux hautes technologies ».

- *Sources nationales et étrangères de connaissances et de technologies :* Plusieurs exemples de rattrapage réussi illustrent à quel point il est utile d'accéder à des sources étrangères de connaissances, et ce par différents biais, comme l'achat d'équipements, l'investissement direct étranger (IDE), la fabrication en sous-traitance d'équipements d'origine (OEM), la mobilité des étudiants, les projets de R-D en collaboration internationale, etc. En fait, il est quasiment impossible aujourd'hui, pour quelque pays que ce soit, de ne s'en tenir qu'aux connaissances développées par ses nationaux pour assurer durablement sa modernisation technologique et la croissance de sa productivité. Cela vaut aussi bien pour les pays qui se situent à la frontière technologique que pour ceux qui s'en rapprochent et pour les pays qui en sont plus éloignés. De même, il faut que les entreprises russes cherchent à acquérir et adapter des connaissances développées à l'étranger et qu'elles soient soutenues (ou au moins qu'elles ne soient pas freinées) dans cette démarche par les politiques publiques. Cela étant, il faut aussi clairement souligner le rôle essentiel que jouent les capacités scientifiques et d'ingénierie autochtones dans la modernisation, particulièrement dans les domaines où la Russie est proche des frontières scientifique et technologique, mais aussi dans l'amélioration de la capacité d'absorption dans les secteurs moins avancés, et parce qu'elles constituent un terreau propice à l'émergence de nouvelles industries.

- *Dynamique propulsée par la science ou tractée par la demande :* Les découvertes scientifiques et techniques sont d'importants moteurs de l'innovation mais ne suffisent pas à elles seules. La demande - le plus souvent à travers la médiation des marchés, mais aussi par l'intermédiaire des réseaux ou filtrée par la hiérarchie interne des entreprises - joue un rôle crucial dans la promotion et l'orientation de l'innovation. Les utilisateurs sont désormais reconnus comme d'importantes sources de connaissances qui jouent un rôle déterminant dans tout processus d'innovation. La politique russe, comme un reflet atténué celle de l'ère soviétique, reste attachée à l'idée d'une innovation propulsée par l'offre ; il serait bon qu'elle prête davantage d'attention à la demande et au rôle stimulant et prescripteur que peuvent avoir les utilisateurs sur l'innovation.
- *Les technologies militaires et civiles :* Il s'agit-là d'un enjeu crucial en Russie étant donné la part de la R-D liée au secteur militaire dans le total de la dépense publique de R-D et la prééminence du complexe militaro-industriel dans le secteur des entreprises publiques. Les relations entre applications civiles et militaires se sont considérablement modifiées, avec souvent un renversement des flux de connaissances dans certaines des spécialités scientifiques et technologiques aujourd'hui dominantes, en particulier les TIC. L'industrie de l'armement a désormais de plus en plus besoin de technologies qui sont développées dans un environnement civil ouvert. La création annoncée d'un équivalent russe du DARPA (Defense Advanced Research Projects Agency) américain répond au besoin de mieux mobiliser les ressources créatives porteuses d'innovations radicales au profit des applications militaires. Dans le même temps, la politique de défense de la Russie devrait considérer que l'ensemble de la politique d'innovation, notamment la restructuration du secteur des entreprises publiques des secteurs technologiques, est susceptible de l'aider à poursuivre ses propres objectifs.

Recommandations spécifiques pour l'action publique

D'une manière générale, les politiques publiques peuvent être subdivisées en deux catégories : celles qui portent spécifiquement sur la science, la technologie et l'innovation (STI) et celles qui s'emploient à établir des conditions-cadres plus favorables à l'innovation. Les mesures qui relèvent de la première catégorie ont, certes, un rôle essentiel à jouer dans la modernisation, mais elles ne sauraient compenser les mauvaises conditions-cadres qui prévalent en Russie. Les politiques STI doivent par conséquent s'accompagner de politiques visant à améliorer les conditions-cadres de l'innovation, en particulier s'agissant de concurrence, de corruption, de droits de propriété (propriété intellectuelle et autres formes de propriété) et du respect de la règle de Droit. Les recommandations présentées ci-dessous concernent essentiellement les politiques STI, mais on ne saurait omettre l'autre catégorie de mesures.

Gouvernance publique du système d'innovation

La Stratégie de l'OCDE pour l'innovation cite un certain nombre de qualités qu'il est souhaitable de retrouver dans la gouvernance de la politique d'innovation : la légitimité, la cohérence, la stabilité, l'adaptabilité et la capacité à diriger et orienter. Entre ces qualités, il existe autant de complémentarités que de compromis, et l'équilibre souhaitable diffère d'un pays à l'autre. En Russie, la légitimité procède dans une large mesure de l'implication du gouvernement central, en particulier du Président et du Premier ministre. Le renforcement de la structure de gouvernance au plus haut niveau, avec la création de la Commission présidentielle pour la modernisation et le développement technologique, et la Commission gouvernementale pour les hautes technologies et l'innovation, offre une occasion idéale pour parvenir à un consensus au niveau national sur la nature des problèmes à résoudre, pour prendre des décisions déterminantes sur les choix stratégiques, sur les tâches prioritaires, sur la hiérarchisation et la séquence des mesures concrètes à engager sur un front très étendu, notamment pour lever les obstacles majeurs qui ont survécu aux précédentes réformes. Il est important de noter que, paradoxalement, ces initiatives de haut niveau pourraient aussi ouvrir la voie à des modes de formulation des politiques moins centralisés et moins hiérarchisés et, aspect essentiel, réduire les risques d'échec dans leur mise en œuvre, en donnant les moyens d'agir aux principaux acteurs dans tout le système d'innovation et en exploitant mieux la masse de leurs connaissances. Les plateformes technologiques annoncées récemment pourraient à cet égard apporter une contribution utile.

L'un des principaux reproches adressés à la politique scientifique et technologique d'il y a une dizaine d'années était son incapacité à définir les priorités d'investissement et à s'y tenir. Les financements étaient saupoudrés entre les instituts de recherche, lesquels adoptaient, avec un inégal succès, des stratégies défensives. Pour autant, le système n'offrait guère de stabilité. Aujourd'hui, la situation est très différente, du moins en ce qui concerne les nouveaux financements. Par exemple, les commissions ont défini des priorités claires, même si elles sont assez larges ; les conclusions de l'étude de 2006 sur les technologies critiques ont permis de définir le socle d'un Programme fédéral ciblé ; et l'établissement de la corporation d'État Rusnano a donné un fort coup d'accélérateur dans le domaine des nanotechnologies. Le recours à des techniques de prospective, en particulier l'établissement de feuilles de route technologiques, est de plus en plus fréquent à de nombreux niveaux et illustre le caractère plus stratégique et plus anticipatif de la démarche.

Le rôle accru des programmes fédéraux ciblés (PFC) est aussi une nouveauté notable, car ils permettent des mesures ciblées qui transcendent les limites administratives traditionnelles et ils sont limités dans le temps, ce qui permet une certaine adaptabilité. En règle générale, toutefois, il importe de trouver un équilibre entre adaptabilité et stabilité, et cela vaut aussi pour les PFC étant donné que leur financement est limité dans le temps.

Les pratiques d'évaluation apparaissent rudimentaires et encore mal ancrées institutionnellement, en partie en raison de l'absence d'une approche stratégique de la programmation scientifique et technologique pendant les premières phases de la transition. Il semblerait que les PFC comprennent une évaluation ex ante, une évaluation intermédiaire et une évaluation ex post, et certaines nouvelles mesures de grande envergure, comme l'établissement d'universités de recherche nationales, semblent intégrer des dispositifs similaires. Toutefois il ne s'agit pas d'évaluations à part entière. De plus, elles privilégient des approches mécanistes reposant sur des indicateurs quantitatifs (comme le nombre de dépôts de brevets), ce qui risque d'influer d'une manière non souhaitable sur le comportement des acteurs, en les poussant à poursuivre des objectifs factices. A la lumière de ce qui précède, les pouvoirs publics devraient :

- Créer des espaces de discussion entre parties prenantes pour mieux les mettre en cohérence et mieux exploiter la gamme des connaissances réparties dans l'ensemble du système d'innovation. Ces forums doivent réunir les ministères et agences publiques concernés, les entreprises publiques et les corporations d'État, les académies et les établissements d'enseignement supérieur et, bien-sûr, le secteur privé, afin de formuler des objectifs stratégiques et des plans d'action. Faute d'une implication pleine et entière de tous les principaux acteurs impliqués dans l'innovation, les plans et stratégies définis à haut niveau risquent d'être ignorés, malgré un système de gouvernance relativement centralisé comme l'est celui de la Russie. A cet égard, le lancement annoncé récemment d'un certain nombre de plateformes technologiques inspirés de l'exemple européen semble aller dans le bons sens.
- Élargir la portée des études de prospective au-delà du choix des priorités de S-T. Elles devraient être conçues de manière à susciter la constitution de réseaux ouverts d'acteurs au sein du système d'innovation et à faciliter la formation et l'expression de groupes d'intérêt en faveur du changement par et pour l'innovation.
- Évaluer les PFC en fonction de leur succès dans la hiérarchisation des enjeux et des activités importantes pour la Russie, dans la mobilisation de différents types d'acteurs de l'innovation, et de leur contribution à la coopération entre départements ministériels et entre industrie et universités.
- Adopter une approche plus nuancée de l'évaluation, moins tributaire d'indicateurs quantitatifs, et reconnaissant l'évaluation comme un outil autant d'apprentissage que de contrôle.

Conditions-cadres pour l'innovation

La qualité des conditions-cadres est d'importance cardinale pour la dynamique d'innovation. Elle concerne la stabilité macroéconomique, de nombreux aspects du régime réglementaire et fiscal, le degré de concurrence sur les marchés, celui d'ouverture aux échanges internationaux et à l'investissement direct étranger, ainsi que le régime de la propriété intellectuelle qui doit permettre aux innovateurs de tirer profit de leur ingéniosité, sans toutefois empêcher la circulation des idées. Ce sont ces conditions-cadres qui permettent aux investisseurs privés – particuliers et entreprises – de prendre des risques calculables dans l'espérance de bénéfices proportionnés, qui se diffusent en partie à la société dans son ensemble.

Des conditions-cadres mal adaptées peuvent aussi réduire la marge de manœuvre des politiques et interdire l'utilisation d'outils qui ont pu faire leurs preuves dans des circonstances plus favorables. Par exemple, une corruption endémique peut rendre les pouvoirs publics très réticents à octroyer des subventions directes aux entreprises privées. Les pays dans lesquels le système fiscal et l'administration sont faibles et inefficaces sont généralement peu enclins à recourir aux incitations fiscales en faveur de la R-D, et s'ils le font, c'est très timidement. C'est ainsi que des conditions-cadres déficientes peuvent avoir un effet déformant sur l'action publique.

Ces vingt dernières années, la Russie a sensiblement progressé sur de nombreux fronts. D'abord, elle a réussi à évoluer résolument vers une économie de marché et a pris des mesures importantes pour gérer et stabiliser sa situation macroéconomique. Cependant, il reste des handicaps sérieux. Ils ont fait l'objet de nombreuses analyses depuis des années et il faut que la Russie s'y attaque si elle entend s'engager dans une trajectoire de croissance tirée par l'innovation. Parmi ces problèmes : les exceptions à la règle de droit, le caractère trop restrictif de certaines réglementations, la corruption, l'absence de concurrence dans des pans entiers de l'économie, le développement insuffisant de certaines institutions de soutien, notamment en ce qui concerne financement de l'innovation et la protection des droits de propriété intellectuelle.

La combinaison de ces handicaps a un effet inhibant sur les activités d'entreprises créatrices de valeur, notamment par l'innovation. Elle crée un environnement dans lequel les acteurs sont découragés de s'engager dans des activités intrinsèquement risquées, complexes et de longue haleine comme l'innovation. Elle protège plutôt les activités, légales ou non, dont le but est de redistribuer la valeur. Il en résulte un faible niveau d'investissement des entreprises dans l'innovation. Les mécanismes d'incitation déséquilibrés en faveur de la redistribution compromettent gravement les perspectives de développement, et particulièrement la réalisation d'un scénario de développement tiré par l'innovation.

Règle de droit, corruption et pesanteur administrative. Il sera vital pour le succès de toute politique de soutien de l'innovation de faire mieux dans la lutte contre la corruption, le renforcement de la règle de Droit, la réduction de la charge administrative qui pèse sur les entreprises, et la réforme de l'administration publique. L'environnement institutionnel de la Russie laisse encore beaucoup à désirer. Les responsables politiques, à commencer par le Président de la Fédération de Russie ont exprimé à de multiples reprises leur insatisfaction à l'égard de l'administration publique, des autorités d'exécution et des tribunaux, mettant en cause leur efficience, leur efficacité et leur probité.

Concurrence sur les marchés de produits. L'existence d'une corrélation positive entre innovation et concurrence est une évidence. La plupart des entreprises russes semblent être dans une situation dans laquelle l'activité innovante s'accroît avec la concurrence. A l'appui de cette assertion, les résultats d'une enquête qui montre que les entreprises russes qui opèrent dans un environnement concurrentiel dépensent notablement plus en R-D et innovent davantage que les entreprises qui sont à l'abri des pressions concurrentielles. Les entreprises puissantes sur leur marché innovent moins que les autres, les moins innovantes de toutes étant celles qui jouissent d'une situation de monopole. On peut tirer des conclusions comparables concernant les fruits des activités d'innovation en termes de croissance de la productivité totale des facteurs. Dans l'ensemble, les marchés de produits en Russie ne sont pas suffisamment concurrentiels et sont même souvent particulièrement concentrés, en particulier au niveau régional. A bien des égards, les grandes entreprises exercent une plus forte domination dans l'économie de la Russie que dans celles de beaucoup d'autres pays de l'OCDE et hors OCDE. Dans les marchés caractérisés par un petit nombre d'acteurs de grande envergure, l'instauration d'une concurrence véritable et la lutte contre les ententes injustifiables (cartels) sont des défis d'autant plus ardus. Dans beaucoup de marchés régionaux, une poignée d'acteurs historiques opèrent en entretenant des liens étroits avec les responsables régionaux ou locaux. Ce type de situation est souvent symptôme de pratiques de corruption ou de recherche de rente, mais dans certains cas, c'est aussi la conséquence du peu de marge d'action budgétaire dont disposent les autorités infranationales, qui poursuivent souvent leurs objectifs sociaux au moyens d'arrangements plus au moins informels avec de grandes entreprises implantées de longue date sur leur territoire. Cela se traduit généralement par des obstacles de fait à l'entrée de concurrents. Cela dit, concernant la charge administrative, il faut convenir qu'elle a significativement diminué depuis dix ans pour les petites entreprises.

Marchés de capitaux. Un système financier bien développé, qui réduit le coût du financement externe et permet de gérer le risque, est un important catalyseur de l'innovation. Le système financier de la Russie, malgré une expansion rapide depuis quelques années, est encore assez peu développé, ce qui signifie qu'il reste beaucoup de marge de progression dans la sophistication financière qui contribuera à la croissance à long terme. Une grande majorité d'entreprises russes utilisent leurs bénéfices non distribués pour financer leur investissement et leur innovation, et les enquêtes auprès des entreprises évoquent presque toujours l'insuffisance de leurs fonds propres et le coût élevé du crédit comme obstacles principaux à l'investissement. D'où l'importance d'un renforcement du secteur bancaire et des établissements financiers non bancaires. Les fonds disponibles pour financer les investissements risqués et singulièrement l'innovation sont rares en Russie, notamment en raison de la pénurie de capital-risque. Le développement de marchés de capital-risque est encore entravé par le sous-développement général des marchés de capitaux.

Droits de propriété intellectuelle. Le nouveau code des DPI, entré en vigueur le 1er janvier 2008, correspond dans ses grandes lignes avec la législation de la plupart des pays développés dans ce domaine. Il reste toutefois des problèmes au niveau de l'application, avec notamment un certain manque de transparence dans les décisions de justice et des corps administratifs, en particulier pour ce qui est du droit d'auteur.

Venir à bout du maquis de conditions-cadres défavorables et des pratiques opportunistes et de recherche de rente qui se sont développées afin d'en tirer certains bénéfices privés est une entreprise très difficile. Une solution consiste à créer des « zones spéciales » (des enclaves qui peuvent prendre différentes formes : régions pilotes, technoparcs, zones franches, entités commerciales, projets, etc.) protégées de l'environnement ambiant, peu porteur, et à leur octroyer des privilèges particuliers, comme l'accès au plus haut niveau de pouvoir pour contourner les pesanteurs administratives, un accès prioritaire aux ressources, etc. Cette approche n'est pas sans avantages. Très utilisée en Union soviétique, elle a permis d'obtenir des résultats impressionnants dans certains domaines de recherche et dans le développement de technologies dans le cadre de missions bien circonscrites (dans l'industrie aérospatiale et dans le nucléaire). Toutefois, l'expérience soviétique montre aussi clairement les limites d'une telle démarche : elles tiennent justement au caractère exceptionnel de ces initiatives. Pour mettre le pays sur une trajectoire de croissance durable, axée sur l'innovation, il est indispensable d'établir de bonnes conditions-cadres d'application générale.

Pour résumer, même si des progrès sont à noter, il est urgent d'améliorer encore les conditions-cadres de l'innovation ; les avantages que pourraient apporter ces changements seraient plus importants en Russie que dans la plupart des pays de l'OCDE. A cette fin, et pour préparer un terrain solide pour l'innovation et un environnement dans lequel d'autres instruments, plus ciblés, pourraient être utilisés pour la stimuler réellement, les pouvoirs publics doivent évaluer la situation actuelle en ayant à l'esprit les objectifs suivants :

- Entretenir une situation macroéconomique saine, notamment par une gestion viable des finances publiques, conditions nécessaires d'une évolution suffisamment forte et dynamique de l'investissement privé comme de l'investissement public en innovation. En retour, une meilleure performance dans l'innovation contribuera à la santé macroéconomique et à celle des finances publiques.
- Mener une politique qui fasse une place plus importante à la concurrence afin de renforcer la capacité des marchés de récompenser les comportements innovants et poursuivre les initiatives visant à améliorer l'environnement économique et à réduire les pesanteurs administratives, notamment pour les entreprises nouvellement créées. Par exemple, cela pourrait impliquer : la définition d'une politique générale plus audacieuse visant à promouvoir une concurrence libre et équitable sur les marchés par une mise en œuvre plus affirmée et plus uniforme du droit de la concurrence et un renforcement du pouvoir des institutions chargées de l'appliquer ; l'amélioration de la transparence et de la redevabilité des administrations publiques ; et la réduction de l'incertitude et de la place de la de subjectivité dans les décisions administratives.
- Continuer d'améliorer le système financier et la réglementation qui s'y rapporte en prenant en compte la nécessité de faciliter le financement de projets innovants dans le secteur des entreprises, notamment pour les PME.
- Continuer d'œuvrer pour une mise en œuvre plus effective du droit de propriété intellectuelle.

Formation et qualifications

La Russie produit une proportion impressionnante de diplômés des disciplines scientifiques et d'ingénieurs, l'une des plus élevées du monde, se situant bien au-dessus de la moyenne OCDE. Elle a aussi des taux très élevés d'admission à l'université, ce qui a pu susciter quelques doutes quant à la qualité, dans un système conçu pour des effectifs beaucoup plus réduits. De plus, comme les autres domaines, l'enseignement supérieur n'a pas échappé aux pénuries des années de transition, et on peut déplorer une certaine dégradation des équipements et des services, en particulier dans les régions. Les programmes de nombreux départements ont aussi besoin d'être modernisés afin de mieux répondre aux demandes de qualification du marché du travail. Cela concerne notamment les compétences de gestion et les enseignements propres à susciter l'esprit d'entreprise chez les diplômés.

La Russie a hérité de l'Union soviétique d'un système relativement solide de collèges d'enseignement professionnel, mais, quelque peu négligé depuis vingt ans, il se trouve maintenant dans un piètre état. Étant donné l'évolution de la démographie, beaucoup de collèges pourraient être amenés à fermer d'ici quelques années, en particulier dans les régions. La démographie n'est pas la seule raison qui explique la baisse des admissions. Comme dans la plupart des régions du monde, la Russie a vu sa population estudiantine augmenter considérablement, au détriment des établissements d'enseignement professionnel. En fait, il n'est pas inhabituel que les jeunes passent par les collèges d'enseignement professionnel pour accéder à l'université. Les responsables politiques russes devraient donc s'efforcer :

- D'encourager les universités et les collèges à moderniser leurs programmes pour mieux répondre aux besoins de qualifications d'une économie de marché tournée davantage vers l'innovation. A cet égard, il faudrait activement encourager les entreprises à participer à la conception des programmes et aux services de placement, en particulier pour les étudiants diplômés.
- Réfléchir aux moyens d'améliorer l'image de la formation professionnelle et d'améliorer les équipements dans les collèges professionnels. Les difficultés de l'enseignement professionnel en Russie sont les mêmes que dans beaucoup d'autres pays, et il serait utile pour tous de confronter les expériences et de partager des enseignements.

Promouvoir l'innovation dans les entreprises

Gouvernement d'entreprise

On s'accorde à reconnaître que les PME, notamment les entreprises nouvelles innovantes, jouent un rôle important dans l'innovation et la modernisation de l'économie. Mais ce serait une erreur d'ignorer la contribution des grandes entreprises à l'innovation. On voit difficilement comment la Russie pourrait devenir une économie fondée sur l'innovation sans dynamiser l'innovation dans les grandes entreprises, dont beaucoup possèdent des actifs de valeur et pourraient devenir la cheville ouvrière d'une innovation à plus grande échelle. En pratique, nombre de grandes entreprises russes sont loin d'être aussi fermement engagées dans l'innovation qu'on pourrait l'escompter. L'analyse des conditions-cadres concernant l'innovation et le gouvernement d'entreprise doit donc prendre dûment en compte leurs effets sur la propension à innover des grandes entreprises.

Le secteur russe des entreprises, héritage du système soviétique, a connu une phase de privatisations, de turbulences et de restructurations, amorcée dans les années de transition, puis plus récemment une orientation nouvelle visant à renforcer et restaurer l'influence de l'État dans ce que celui-ci percevait comme des domaines stratégiques. Ce secteur présente un certain nombre de spécificités — en termes de structure et de gouvernement d'entreprise — qui peuvent avoir d'importantes implications pour le développement futur des capacités d'innovation du pays. Actuellement, l'État exerce un contrôle important sur l'économie russe, que ce soit par des participations directes ou par le contrôle qu'il assure sur l'activité économique. Les entreprises publiques opèrent dans un large éventail de secteurs, et elles occupent souvent une position dominante dans leur branche. De plus, la frontière est très souvent floue entre les secteurs public et privé, en raison du rôle souvent dominant des entreprises publiques. La concentration industrielle récente au sein de holdings toujours plus importantes s'est faite par fusion-acquisition de quelques grandes entreprises publiques et privées (notamment dans les industries de ressources) et résulte d'une politique gouvernementale de création de « champions nationaux » capables de soutenir la concurrence sur les marchés internationaux.

Bien que la concentration offre la promesse d'économies d'échelle et de gamme plus importantes et qu'elle soit à même, du moins en partie, de compenser l'absence de financements externes pour l'innovation à haut risque, elle pourrait être économiquement préjudiciable si de puissantes entreprises établies étouffent la concurrence et dissuadent en pratique de nouveaux concurrents innovants de se lancer sur le marché. Il pourrait même en résulter à terme un recul de la compétitivité nationale. Ce risque est réel, et il est aggravé par le fait que pour les entreprises publiques, l'efficacité du gouvernement d'entreprise est diminuée par un certain nombre de facteurs, notamment une moindre exposition aux risques de faillite et d'OPA, ce qui réduit la sensibilité des directions des entreprises à la menace de voir les marchés pénaliser l'inefficience. Dans ces conditions, les pouvoirs publics devraient s'attacher à :

- Améliorer les normes de transparence et de divulgation d'information dans les entreprises publiques. Un moyen consisterait à accélérer la nomination de directeurs indépendants et responsables dans les conseils d'administration des entreprises publiques et donner plus d'indépendance aux représentants du gouvernement. Les activités non commerciales des entreprises publiques devraient également être transférées aux services gouvernementaux compétents où elles peuvent être regroupées.
- Faire en sorte que les « champions nationaux » mettent l'innovation au cœur de leurs stratégies d'entreprise, par un éventail d'incitations et d'actions réglementaires, par exemple en réduisant les barrières qui les protègent de la concurrence internationale. Dans le même temps, surveiller étroitement les activités des entreprises publiques pour s'assurer qu'elles restent engagées dans la réalisation de leurs objectifs ambitieux.
- Mener à bien et étendre les plans de privatisation partielle des entreprises publiques et corporations d'État, car cela élargirait l'accès au savoir-faire étranger et accélérerait le programme de modernisation.

R-D dans le secteur commercial

Le secteur des entreprises publiques à vocation technologique est constitué d'entreprises industrielles au vrai sens du terme ainsi que d'organismes de recherche constitués en société qui en dépendent. Toutefois, certains aspects du segment « recherche » de ce secteur sont particuliers. En Russie — comme dans un grand nombre d'autres pays hautement performants tant à l'intérieur qu'à l'extérieur de l'OCDE — les dépenses de R-D des entreprises (DIRDE) exécutées dans le secteur des entreprises représentent près des deux tiers de la DIRD totale. Toutefois, la structure du financement est radicalement différente. En Russie, les dépenses de R-D du secteur des entreprises sont pour l'essentiel financées par le Gouvernement et non, comme c'est la bonne pratique dans les autres pays comparables, par le secteur des entreprises lui-même. Cela montre la position dominante que conservent les anciens instituts de branche et bureaux d'études appartenant pour l'essentiel au secteur public dans l'exécution de la R-D des entreprises. Alors qu'ils réalisent plus de 80 % de la R-D des entreprises, ces instituts, dont peut-être la moitié opèrent dans le secteur de la défense, demeurent organiquement distincts des entreprises de production, ce qui tend à affaiblir leur contribution à l'innovation technologique. Toute amélioration sensible des performances globales du système d'innovation russe appelle une clarification des rôles que ces instituts jouent concrètement dans l'innovation industrielle et des modalités du pilotage de leurs activités.

Pour leur part, les entreprises de production ont exécuté moins de 9 % des dépenses de R-D des entreprises en 2008, tout en fournissant 36 % du financement. Cela montre que les entreprises de production — dont un grand nombre appartiennent à l'État — externalisent une bonne partie de leur R-D aux instituts de branche et bureaux d'études. Elles exécutent relativement peu de R-D en interne et ne sont pas particulièrement encouragées à le faire par la politique gouvernementale. Ainsi, très peu de mesures de la politique de recherche impliquent des transferts financiers directs vers les entreprises de production, et les incitations fiscales et les marchés publics sont insuffisamment développés. En conséquence, le gouvernement devrait :

- Clarifier le rôle des instituts de recherche et bureaux d'études à l'intérieur du secteur des entreprises publiques à vocation technologique, et leur missions dans certains domaines comme la défense ou l'énergie, de même que dans l'ensemble du système d'innovation russe. Il faut plus de transparence concernant les activités, le financement, la gouvernance et les performances de ces organisations.
- Étudier les possibilités envisageables pour la privatisation des instituts de recherche et bureaux d'études et/ou leur intégration dans des entreprises de production. Leur séparation organisationnelle diminue dans bien des cas leur contribution à la production.
- Encourager les entreprises de production à effectuer davantage de R-D en interne. Une première étape essentielle consiste à obtenir de ces entreprises qu'elles mettent l'innovation au centre de leurs stratégies industrielles, créant ainsi un besoin plus important de R-D interne. L'instruction gouvernementale récente à l'intention des entreprises publiques et corporations d'État pour qu'elles mettent en place des « contrats de performance pour la R-D et la technologie », bien qu'inhabituellement prescriptive, est une tentative qui va justement dans ce sens. En dernière analyse, toutefois, il faudra un ensemble de mesures pour encourager davantage les entreprises à faire de la R-D en interne, en s'appuyant notamment sur le financement direct de la R-D, les mesures budgétaires indirectes, la réglementation, les partenariats public-privé et les marchés publics.

Soutenir les PME innovantes

La contribution des PME à l'économie russe est relativement faible comparée à la situation dans les économies de l'OCDE, avec une part d'environ 12 % du PIB et une proportion similaire de l'emploi. Contrairement à ce que l'on observe dans certaines autres économies en transition, en Russie la croissance d'un secteur des PME dynamique a été étouffée par la position dominante des grandes entreprises, notamment dans les industries de ressources qui dominent l'économie, et par des conditions-cadres qui pénalisent le fonctionnement des petites entreprises. Le nombre de PME innovantes, définies comme étant des entreprises à fort potentiel dans les secteurs scientifique et technologique, représente moins de 2 % de l'ensemble du secteur des PME. C'est un chiffre particulièrement bas par comparaison avec les pays de l'UE.

Des changements législatifs récents ont visé à promouvoir le secteur des PME. Il s'agit notamment d'une réduction des contrôles et, s'agissant spécifiquement des PME innovantes, de la Loi sur l'organisation d'entreprises innovantes dans les universités et établissements de recherche et sur le micro financement (loi fédérale n° 217-FZ) qui vise à normaliser la création d'entreprises nouvelles et de jeunes pousses par les établissements scientifiques et d'enseignement à financement fédéral. L'espoir est que ce type de loi contribuera à la création du cadre juridique nécessaire pour promouvoir le développement efficient de PME innovantes et qu'il simplifiera sensiblement leur création.

Depuis 1994, un organisme public sans but lucratif spécialisé, la Fondation (Bortnik) pour la promotion des petites entreprises en science et technologie (FASIE), parvient avec succès à promouvoir l'entrepreneuriat à vocation scientifique. Ses ressources représentent

1.5 % du budget total de R-D civile, qu'elle utilise pour fournir un large éventail de mesures de soutien, depuis le soutien financier direct aux entreprises nouvelles jusqu'à la fourniture d'informations et autres services d'appui aux petites entreprises innovantes. La mesure la plus significative, dénommée « Start », qui cible les entreprises nouvelles est calquée jusqu'à un certain point sur le programme SBIR (Small Business Innovation Research) de la Fondation nationale des sciences des États-Unis. L'aide fournie comprend deux phases, d'abord des capitaux d'amorçage puis des aides au développement. La FASIE a financé environ 10 000 projets. Ces dernières années, elle s'est orientée de plus en plus vers le soutien de l'incubation de l'innovation et l'aide aux jeunes scientifiques (issus plutôt des établissements d'enseignement supérieur que de l'Académie des sciences de Russie).

Dans le domaine financier, le gouvernement fédéral a créé en 2006 la Société russe de capital-risque dans le but de stimuler le développement d'une industrie du capital-risque en Russie. Il a également encouragé la création de fonds régionaux de capital-risque, et 23 fonds de ce type sont apparus dans 21 régions. Le nombre d'entreprises ayant bénéficié de capitaux provenant à la fois du fonds national et des fonds régionaux semble relativement faible — moins de 50 à la mi-2009. Un problème semble être le nombre trop limité de projets éligibles; un autre est sans doute que les fonds de capital-risque ne sont pas suffisamment intéressés par des investissements dans les phases initiales du développement des projets.

Tout un éventail de technoparcs, centres d'affaires et incubateurs ont été créés dans l'ensemble de la Russie, dont certains ont connu quelque succès dans le développement d'activités innovantes (par exemple le Centre d'innovation technologique du technoparc de Tomsk), tandis que d'autres ont obtenu des résultats plus mitigés. Un programme fédéral visant la création d'un réseau de technoparcs a été lancé en 2006, et leur nombre a augmenté au cours des années récentes. Compte tenu de ces évolutions, le gouvernement devrait envisager les mesures suivantes :

- Développer les programmes FASIE, compte tenu de leur succès et de leur popularité. Dans le même temps, il devrait accepter que la grande majorité des entreprises nouvelles issues de la base scientifique, même celles dont les succès sont les plus éclatants, n'auront sans doute que des effets marginaux sur le paysage industriel de l'économie russe dans un avenir proche.
- Reconnaître que le potentiel de croissance limité des PME innovantes en Russie tient au manque relatif d'intérêt des grandes entreprises à l'égard de l'innovation. Si cette situation évoluait, des marchés commenceraient à s'ouvrir pour les produits et services innovants proposés par les PME.
- Améliorer les conditions-cadres pour les PME innovantes. Les petites entreprises sont en général plus sensibles aux conditions-cadres pour l'innovation que les firmes de plus grande taille. Tant que les conditions-cadres demeureront relativement défavorables, la contribution des PME à la croissance globale demeurera limitée.

- Faciliter l'accès au financement, par exemple en augmentant la concurrence sur les marchés de capitaux, en réduisant les risques et les coûts de transaction, en renforçant la capacité des institutions financières à répondre aux besoins des petits clients, etc. La Société russe de capital-risque a un rôle à jouer à cet égard, encore que celui-ci s'exercera sans doute plutôt sur des créneaux spécifiques qu'au niveau général. A cet égard, la création récente par la Vnesheconombank (Banque de développement et de relations économiques avec l'étranger) d'un programme de soutien aux PME innovantes est peut-être plus prometteuse. De façon générale, le gouvernement doit faire davantage pour promouvoir le financement des efforts d'innovation des PME, via par exemple les aides remboursables et les garanties d'État pour les crédits bancaires.

Lier l'enseignement avec la recherche

La R-D réalisée dans les établissements d'enseignement supérieur présente plusieurs avantages, le principal étant le lien étroit entre la formation et la diffusion de connaissances vers d'autres secteurs de la société et de l'économie que génère la mobilité des diplômés. Comme certains autres pays accordant une place importante à la recherche dédiée à des missions d'ordre public (par exemple, Chine, Corée, France), la Russie se caractérise par un système de recherche relativement faible dans les établissements d'enseignement supérieur. Les instituts des diverses académies des sciences sont le lieu traditionnel de la conduite des formes de recherche fondamentale qui sont réalisées dans les établissements d'enseignement supérieur de nombreux pays de l'OCDE.

Depuis 2000, le gouvernement s'est attaché par un certain nombre d'initiatives ciblées à renforcer la recherche dans l'enseignement supérieur. Ces investissements ont conduit à une lente augmentation en valeur tant absolue que relative du nombre de chercheurs dans les établissements d'enseignement supérieur, même si leur part dans le nombre total de chercheurs en Russie — soit 8.8 % en 2008 —demeure très faible par rapport aux normes internationales. De plus, la part de la DIRD exécutée dans le secteur de l'enseignement supérieur en 2008 a été encore plus réduite, soit 6.7 %. Plus récemment, le gouvernement a lancé de nouvelles initiatives phares, notamment le Programme fédéral ciblé sur le potentiel de recherche et d'enseignement d'une Russie innovante (2009-13) et le Soutien fédéral ciblé aux hautes écoles de pointe (2010-12). Ces initiatives qui bénéficient de budgets conséquents — de l'ordre de 3 milliards USD chacune sur l'ensemble de leur durée — visent à renforcer la recherche réalisée dans les établissements d'enseignement supérieur et la diffusion/exploitation de ses résultats. Une bonne partie des nouveaux investissements vise à constituer un noyau d'établissements d'enseignement supérieur d'élite à vocation de recherche, à l'instar de ce qui se fait dans un grand nombre de pays de l'OCDE. Plusieurs mesures importantes ont été prises, notamment : d'importantes dotations à deux institutions d'élite, l'Université d'État de Moscou et l'Université d'État de Saint Petersburg ; la création du statut d'universités de recherche nationales et d'universités fédérales ; l'encouragement de la coopération en matière de R-D avec des entreprises industrielles de haute technologie ; le développement d'infrastructures d'innovation dans les universités pour la création de petites entreprises ; et l'encouragement de la mobilité universitaire depuis l'étranger, en attirant vers les universités russes la diaspora scientifique et d'autres spécialistes éminents étrangers.

Ces investissements significatifs témoignent d'un engagement résolu et bienvenu en faveur du renforcement des liens entre l'enseignement et la recherche, mais ils ne sont qu'un début et beaucoup reste à faire à moyen terme. À cet égard, le gouvernement devrait :

- Institutionnaliser certaines de ces nouvelles lignes de financement afin qu'elles deviennent un élément permanent du paysage de la recherche dans l'enseignement supérieur. C'est un élément important étant donné les niveaux généralement bas des investissements dans la science publique depuis l'époque soviétique. De plus, l'institutionnalisation éliminera les incertitudes quant aux intentions gouvernementales, ce qui aidera les établissements d'enseignement supérieur dans leur programmation stratégique à long terme.
- Conserver l'élément de concurrence dans ces initiatives de financement, car elles peuvent induire des réformes et réorientations utiles des établissements d'enseignement supérieur si les critères de sélection appropriés sont utilisés. Ultimement, la concurrence dans l'accès aux financements au sein d'un système bien doté globalement en ressources devrait reposer sur des mécanismes parfaitement transparents d'évaluation des performances, basé, par exemple, sur des indicateurs comparables de publication, de qualité de l'enseignement et de commercialisation.
- Évaluer le bien-fondé et l'efficacité du portefeuille de plus en plus complexe de mesures désormais en place, au niveau tant des différents instruments individuels que de l'ensemble des mesures. Le caractère novateur dans le contexte russe de nombre de ces initiatives fait qu'elles ont un caractère quelque peu expérimental, et elles devront être considérées comme telles dans les activités de suivi et d'évaluation. À terme, certaines pourraient devoir être remplacées par d'autres instruments, à mesure qu'évoluera le secteur de l'enseignement supérieur.
- Accélérer la transition vers un secteur de l'enseignement supérieur davantage actif en matière de recherche, par une transformation plus radicale de son organisation. Dans certains cas, il pourrait être justifié de ne pas se limiter à la promotion de la collaboration avec les instituts de l'académie des sciences de Russie et assimilés, et d'intégrer plus pleinement certains instituts de recherche existants avec des établissements d'enseignement supérieur, peut-être sur le modèle français CNRS-enseignement supérieur.
- Prendre en compte le fait que la priorité budgétaire donnée à la création d'un noyau d'établissements d'enseignement supérieur d'élite à vocation de recherche se traduira par une stratification implicite de ce secteur, déterminée dans une large mesure par les performances en matière de recherche. Dans le même temps, l'action publique devrait reconnaître que dans la perspective d'une approche large de la promotion de l'innovation il faut aussi prêter attention aux autres segments du secteur — en fait la majorité des établissements d'enseignement supérieur — et s'attacher à identifier et exploiter leurs points forts et à corriger leurs points faibles.
- Intégrer ou aligner les mesures de modernisation des établissements d'enseignement supérieur avec les programmes de développement régionaux. Comme c'est dans les régions autres que celles de Moscou et de Saint-Pétersbourg que seront sans doute situés les établissements pratiquant moins la recherche, il importera pour un développement régional équilibré de les renforcer selon des axes

stratégiques. À cet égard, les établissements d'enseignement supérieur devraient devenir de pôles de croissance régionaux, par exemple, grâce à des politiques actives de promotion des grappes (« clusters ») innovantes au sein desquelles doivent se nouer d'étroites relations entre les entreprises et les instituts de recherche locaux. Dans le même temps, les mesures visant à accroître la contribution des établissements d'enseignement supérieur à la compétitivité régionale devraient être conçues en prenant en compte le fait que la principale contribution de ces établissements à la croissance régionale demeurera sans doute la formation de personnel qualifié dont la mobilité ultérieure au sein de l'économie locale diffusera plus largement le savoir enseigné par l'université.

Organismes publics de recherche

Diverses catégories d'organismes publics de recherche, outre les établissements d'enseignement supérieur, assurent la part principale de la DIRD en Russie. Dans la présente étude, bien que la grande majorité des anciens instituts de branche relèvent encore du secteur public, ceux-ci sont traités dans la section consacrée à l'innovation dans le secteur commercial[2]. La présente section se limite aux diverses académies des sciences et au Programme des centres de recherche nationaux, piloté à l'Institut Kurchatov.

La finalité des académies des sciences est remise en question depuis un certain temps, souvent au motif que la Russie, pays à revenu intermédiaire, peut difficilement se permettre le luxe de financer des centaines d'instituts se consacrant pour une large part, mais non exclusivement, à la recherche fondamentale. Cette opinion tend à ignorer la contribution considérable que les académies apportent à la formation et à l'innovation industrielle, même si ces contributions pourraient certainement être améliorées. Elle ignore également l'importance de la recherche fondamentale pour le développement à long terme de la Russie. De plus, les académies assurent tout juste 15 % de la DIRD, soit une part considérablement plus faible que celle des instituts de recherche appliquée, même si elle est environ le double de celle des établissements d'enseignement supérieur.

Les académies ne sont pas sans rencontrer des problèmes propres. Elles ont été à plusieurs reprises critiquées pour leurs stratégies de préservation et elles sont soumises depuis cinq ans à des pressions considérables pour réduire leurs effectifs et le nombre de leurs instituts, en échange de ressources supplémentaires. De fait, le nombre de personnel de R-D dans l'Académie des sciences de Russie a baissé d'environ 12 % sur la période 2002-08, bien que le nombre d'instituts soit demeuré relativement stable. En retour, les salaires ont augmenté sensiblement, mais ils demeurent non compétitifs dans les grandes villes et ils ne sont pas encore parvenus à prévenir le vieillissement à long terme des effectifs. Les bâtiments et les équipements ont également besoin d'être rénovés dans la plupart des instituts. Certains progrès ont été réalisés sur ce front au cours des dernières années, mais les académies n'ont pas bénéficié de soutiens financiers pour les infrastructures dans la même mesure que certains établissements d'enseignement supérieur, en raison de la priorité gouvernementale accordée au développement d'un secteur de l'enseignement supérieur plus robuste car plus impliqué dans la recherche.

2. Cela est également conforme à la façon dont les autorités russes comptabilisent statistiquement ces instituts, en les englobant dans les chiffres de la DIRDE.

Bien que ces problèmes de ressources aient nui à la productivité des académies, les critiques font valoir qu'un de leurs points faibles majeurs tient à la part prépondérante des financements sous la forme de dotations globales et à un régime inadapté de surveillance et de récompenses/sanctions en cas de bonnes/mauvaises performances. L'Académie des sciences, pour sa part, se propose de porter la part des financements accordés sur une base concurrentielle à 25 % (elle est actuellement de l'ordre de 15 %). C'est un pas dans la bonne direction, mais ce taux est cependant faible comparé à ce qui se pratique dans d'autres pays, sans doute car un taux plus élevé menacerait le maintien en activité d'instituts qui échouent systématiquement dans les procédures avec appel à la concurrence. Le gouvernement a essayé de contourner le problème en créant des canaux de financement parallèles allouant un financement par appel d'offres à la concurrence, notamment par le truchement de la Fondation russe pour la recherche fondamentale et des programmes fédéraux ciblés. Une plus forte proportion du budget fédéral pour la recherche fondamentale devrait être allouée par l'intermédiaire de la Fondation.

Indépendamment des académies, l'objectif du nouveau programme pour les Centres nationaux de recherche est d'établir des plates-formes pour la réalisation d'avancées radicales dans des technologies clés où la Russie souhaiterait développer ou maintenir une position de leader mondial, comme les nanotechnologies ou les neurosciences. Le programme est piloté par l'intermédiaire de l'Institut Kurchatov, qui est le premier d'une série éventuelle de huit instituts qui pourraient être mis en place au cours des prochaines années. Des procédures de financement spéciales offrent davantage de flexibilité et visent à limiter le plus possible les lourdeurs administratives. Ainsi, les instituts sont libres de passer des contrats de R-D, et leurs chercheurs sont libres d'investir dans la commercialisation de leurs recherches et dans des entreprises et jeunes pousses à vocation technologique.

S'agissant des organismes publics de recherche, le gouvernement devrait :

- Renforcer les contributions des académies à la formation (doctorants notamment) et à l'innovation industrielle dans les industries stratégiques. L'enjeu pour des instituts d'académie est d'identifier et d'exploiter des canaux de diffusion des connaissances autres que les publications universitaires, pour accroître leur contribution au système d'innovation national.
- Faire en sorte que le principe d'excellence de la recherche soit au cœur des activités des académies. Dans cet esprit, les parts des dotations globales et des financements concurrentiels alloués aux instituts devraient être rééquilibrées au profit des derniers et le recours aux évaluations sur résultats devrait être développé. Une participation accrue aux programmes à financement international (voir la section ci-après sur l'internationalisation) apportera également des informations additionnelles sur la qualité de la recherche.
- Réformer la structure de gouvernance de l'Académie des sciences de Russie pour permettre une approche plus stratégique de la gestion de son vaste portefeuille d'instituts et lui donner davantage de réactivité face aux nouvelles opportunités apparaissant sur le front mondial de la recherche.

- Suivre et évaluer avec rigueur le programme NRC, étant donné l'importance des investissements en jeu. L'extension du programme devrait peut-être se faire par étapes pour donner le temps nécessaire à l'apprentissage des bonnes pratiques. De plus, tout devrait être mis en œuvre pour exploiter les possibilités de diffusion de ces bonnes pratiques, concernant la commercialisation de la recherche par exemple, à d'autres secteurs du système public de recherche.
- Prendre de nouvelles mesures pour réduire la dépendance de l'ensemble des instituts de recherche de Russie à l'égard des dotations globales. Bien que la Russie ait fait des progrès indéniables sur la voie de l'établissement d'un système d'allocation des financements davantage fondé sur la concurrence, une proportion encore trop importante des crédits prend la forme de dotations globales aux instituts bien établis. Cela ne veut pas dire que ces dotations devraient être éliminées car elles sont importantes pour orienter les instituts vers des objectifs de long terme tout en leur assurant un minimum de stabilité financière. Il conviendrait plutôt de mettre en place des régimes d'évaluation des résultats permettant des évaluations transparentes périodiques (espacés de cinq à dix ans), dont les résultats conditionneraient l'importance des dotations globales reçues.

Internationalisation

La Russie dispose de nombreux canaux pour s'approvisionner en connaissances et technologies étrangères et pour exporter ses productions dans les mêmes domaines. L'investissement direct étranger (IDE) est une des voies les plus fécondes, et la Russie accueille de plus en plus nombre d'entreprises technologiques mondiales de premier plan, par exemple dans les secteurs de l'aérospatiale et des technologies de l'information et des communications, soucieuses de tirer parti de compétences élevées à des prix compétitifs au plan international.

À l'instar d'un grand nombre d'autres pays, la Russie s'est efforcée d'attirer l'IDE dans des zones économiques spéciales (ZES). Les quatre ZES à vocation technologique de Saint-Pétersbourg, Zelenograd, Dubna et Tomsk sont des exemples particulièrement intéressants. Comme elles sont de création assez récente, il est toutefois difficile de formuler un jugement définitif. A ce stade, elles ne semblent pas avoir rencontré beaucoup de succès dans l'attraction des IDE. Plus récemment, le gouvernement a annoncé le projet de création d'une cité de l'innovation à Skolkovo, sur un site vierge aux environs immédiats de Moscou. L'exemple de la Silicon Valley en Californie a été beaucoup évoqué comme source d'inspiration dans la genèse du projet Skolkovo. Mais la Silicon Valley est à l'évidence un phénomène qui repose pour une large part sur l'auto-organisation et il n'est pas étonnant que les nombreuses tentatives volontaristes de reproduire ce modèle dans d'autres parties du monde se soient soldées généralement par des échecs. Les propositions concernant Skolkovo ne semblent pas bercées de ces illusions et visent plutôt à créer un microcosme dans lequel seraient abolies les contraintes pesant sur l'innovation qui sont propres au contexte russe. Un petit nombre de grandes entreprises de haute technologie, notamment Cisco et Nokia, ont déjà fait part de leur intention d'investir à Skolkovo et il est permis d'espérer que beaucoup d'autres leur emboîteront le pas.

L'IDE peut bien sûr s'effectuer dans deux directions et beaucoup de grandes entreprises russes procèdent au rachat d'entreprises étrangères, se transformant en entreprises multinationales opérant sur une pluralité de marchés. Certaines de ces acquisitions ont été motivées par désir d'accéder à des technologies ou des capacités technologiques particulières. Les coentreprises avec des entreprises étrangères sont aussi un moyen populaire d'accéder à des technologies et de partager les risques. Un exemple récent est la collaboration entre Sukhoi et Finmeccanica (Italie) pour le développement de l'avion de transport Superjet 100.

De façon plus générale, les chiffres de la balance des paiements technologiques (BPT), qui enregistrent les flux internationaux de propriété industrielle et de savoir-faire (par exemple, par le biais des achats et cessions de brevets, marques de fabrique, services techniques, etc.) font apparaître une augmentation rapide des paiements et des recettes au cours des années récentes, signe de l'internationalisation croissante de l'industrie russe. Les paiements en 2008 ont été environ 2.5 fois plus importants que les recettes, la Russie affichant un déficit de sa BPT d'environ 1.4 milliard USD. Le canal sans doute le plus utilisé pour l'approvisionnement en connaissances techniques étrangères est l'importation de biens d'investissement, ce que confirment les enquêtes auprès des entreprises, qui indiquent que l'achat d'équipements constitue la principale source d'innovation, bien que les niveaux restent encore très bas comparés à ceux d'autres pays.

L'avancement et, enfin, la conclusion avec succès de la procédure d'adhésion de la Russie à l'OMC sont importants pour le réussite d'un « scénario pour l'innovation » tel qu'envisagé dans la déclaration « Russie, en avant ! » du Président Medvedev. On peut considérer que l'adhésion à l'OMC prémunira la Russie contre la tentation d'adopter approche indûment autocentrée de son développement économique, qui pourrait à terme étouffer l'innovation. Par ailleurs, plus positivement, elle aidera l'innovation en éliminant des barrières auxquelles se heurtent actuellement les entreprises russes sur les marchés internationaux, notamment dans les secteurs de haute technologie. L'adhésion à l'OMC sera aussi un levier pour faire avancer plus rapidement les réformes en faveur de la concurrence.

Dans le domaine scientifique, la Russie négocie avec l'Union européenne pour acquérir le statut de membre associé au Programme-cadre. Des chercheurs russes pourraient ainsi participer au Programme-cadre sur le même plan que leurs homologues européens, ce qui pourrait avoir des retombées potentiellement importantes. Par exemple, les équipes de recherche russes seraient mieux intégrées dans les groupements de R-D européennes hautement concurrentiels, ce qui devrait contribuer à améliorer leur compétitivité et la qualité de leurs travaux scientifiques et technologiques. Une autre dimension importante de l'internationalisation du système scientifique russe est le développement des liens avec la très importante diaspora russe. Les pouvoirs publics ont pris conscience des possibilités qu'offre des liens plus étroits et structurée avec cette diaspora, par exemple, par des initiatives de jumelage de laboratoires, des primes à la mobilité et un nouveau mécanisme destiné à faciliter le recrutement à l'étranger de personnels hautement qualifiés. En poursuivant et élargissant ces efforts, la politique gouvernementale devrait :

- Intégrer l'achat de technologies à l'étranger dans la stratégie plus générale de modernisation des capacités technologiques de l'industrie russe. Plusieurs canaux sont intéressants, notamment l'IDE entrant et sortant, les coentreprises avec des entreprises étrangères et les achats d'équipements. Tous devraient être exploités autant que possible pour promouvoir l'apprentissage technologique.
- Utiliser l'initiative de la ville de l'innovation de Skolkovo comme un espace d'expérimentation pour faire l'essai et la démonstration de mécanismes susceptibles d'être étendus à l'ensemble de l'économie. C'est principalement de cette façon que Skolkovo peut contribuer à la modernisation de la Russie. Dans le

même temps, d'autres références, et pas seulement la Silicon Valley, devraient être trouvées pour guider la réflexion et cadrer des objectifs réalistes pour Skolkovo, par exemple le technopôle de Zhongguancun à Beijing.

- Veiller à ce que les investissements consentis pour l'initiative Skolkovo ne se fassent pas au détriment d'autres également vitaux pour améliorer la performance de la Russie dans le domaine de l'innovation et pour accroître la présence des acteurs russes dans les réseaux mondiaux d'innovation.
- Conclure les négociations avec l'UE sur le statut de membre associé à son Programme-cadre. Les décideurs devraient toutefois reconnaître qu'une participation réussie nécessitera une familiarisation et peut-être même une certaine adaptation de la part des équipes de recherche russes, ce qui naturellement prendra du temps.

Aspects régionaux

La Fédération de Russie est divisée en 83 unités constitutives ou sujets fédéraux, dont 21 sont des républiques, de taille et de spécialisations économiques très variées. En dehors de Moscou et de Saint-Pétersbourg, un petit groupe concentre l'essentiel du reste des activités à forte intensité de technologie basée sur la science et des établissements d'enseignement supérieur très performants. La recherche du meilleur dosage entre les politiques fédérales et régionales pour améliorer leur potentiel d'innovation est reconnue comme une question importante mais non encore résolue. En revanche, la question du rôle de l'innovation dans les régions moins bien dotées en ressources scientifiques et technologiques, de manière à éviter que se creusent les écarts dans le développement régional, semble être quelque peu négligée.

En ce qui concerne le premier point, la Russie peut faire davantage pour mieux utiliser les moteurs de croissance induits par l'innovation régionale, au profit de la performance nationale. La sensibilisation et la volonté politique se sont développées et des activités encourageantes sont apparues dans les régions. Une tendance à la centralisation dans le fédéralisme budgétaire russe a de fait encouragé certaines régions riches en pétrole et en gaz, comme Tomsk et le Tatarstan, à miser davantage sur un développement fondé sur la connaissance. Un problème est que les régions sont devenues encore plus dépendantes de l'aide financière fédérale pour financer leurs initiatives dans cette nouvelle direction. Ce qui conduit à deux types d'inefficience. Premièrement, cela incite les régions à rivaliser dans des domaines où elles devraient plutôt coopérer. Deuxièmement, les priorités nationales et les critères déterminant l'accès aux aides fédérales coïncident rarement de façon parfaite avec les besoins et les capacités des régions. Ce qui réduit leur impact à la fois sur le développement local et sur l'efficience globale des dépenses fédérales dans l'innovation. Un autre problème est que même lorsqu'elles disposent de ressources suffisantes pour agir de leur propre initiative, les régions se heurtent à des restrictions juridiques dans certains domaines importants, comme l'investissement dans les universités pour faire en sorte que leurs programmes de recherche et d'enseignement soient mieux en accord avec la demande locale.

En ce qui concerne le deuxième point, l'absence généralisée d'attention à l'égard de l'innovation non technologique a contribué à l'indifférence des autorités fédérales et à des attitudes plutôt passives des autorités locales. On en sait trop peu sur le potentiel réel d'innovation de régions dont les économies sont à moins forte intensité de R-D que la moyenne nationale. Il conviendrait de s'intéresser bien davantage au rôle de toutes les formes d'innovation dans leur modernisation.

Des évolutions intéressantes sont à noter au niveau infrarégional de gouvernance, par lesquelles des villes créés au départ pour constituer des complexes scientifiques et industriels militaires fermés ont, au fil du temps, acquis une identité sociale. C'est notamment le cas pour des cités scientifiques comme Dubna et Zhukovski dans la région de Moscou. Les populations et municipalités sont désireuses de contribuer au développement local, en améliorant l'attractivité de leurs villes pour les investisseurs, y compris en soignant la qualité de vie. En conséquence, le gouvernement devrait :

- Aider à la mise en place d'une plate-forme d'apprentissage interrégionale dans le domaine de la politique d'innovation. Pour alimenter ce processus d'apprentissage et renforcer ses propres capacités de suivi et d'évaluation des évolutions régionales, la Fédération pourrait promouvoir l'élaboration harmonisée de statistiques et autres instruments d'évaluation comparative par les régions. L'évaluation comparative internationale devrait faire partie de ce processus, avec le choix d'un panel de régions étrangères correspondant aux grandes catégories de régions russes (grandes/petites, diversifiées/hautement spécialisées, à forte intensité de connaissance/à industries plus traditionnelles, etc.). L'Association des régions innovantes auto-organisée par certains régions qui vient de se créer en 2010 pourrait servir de support à une telle plate-forme.
- Reconnaître que beaucoup d'initiatives fructueuses sont le résultat d'une approche conjointe et concertée des autorités fédérales et locales/régionales. Cette coordination est essentielle pour le financement et le déploiement de tout projet d'une certaine envergure.
- Encourager le développement de capacités d'auto-organisation aux niveaux régional et local. Parallèlement, revoir les restrictions existantes qui pèsent sur l'action régionale visant à dynamiser l'innovation, l'idée étant d'assouplir celles qui n'ont guère de justifications dans le nouveau paradigme de la politique économique.
- Concentrer le financement fédéral sur les domaines dans lesquels les régions ont un avantage comparatif, afin d'éviter un saupoudrage des ressources. Cela devrait décourager l'imitation et la concurrence interrégionales sources de gaspillages, notamment la prolifération d'infrastructures pour l'innovation sous-dimensionnées et mal conçues, et en revanche renforcer le soutien aux initiatives prometteuses de création de pôles d'activité (« clusters ») pilotées par les régions, associant acteurs publics et entreprises.
- Éviter de se focaliser sur la haute technologie et prendre conscience du potentiel d'innovation dans les secteurs manufacturiers de faible technologie et les services, comme de l'innovation non technologique, pour la création d'emplois et de richesses.
- Articuler les efforts de promotion de l'innovation dans les grandes entreprises avec les programmes de développement régionaux. Actuellement dans beaucoup de régions, de nombreux obstacles s'opposent au couplage des structures d'enseignement et de recherche, de même qu'à celui des petites entreprises avec des industries établies, faute d'intérêt pour l'innovation chez les grands acteurs en place.

Chapter 1

Economic performance and framework conditions for innovation

This chapter provides an overview of Russia's economic performance over the decade preceding the global financial and economic crisis. The severe, though brief downturn of the Russian economy is discussed with a view to drawing some lessons for the future. It highlights some salient features of the country's economy, including its openness to international trade and foreign direct investment (FDI), the structure of production and trade, and patterns of change. It looks at major aspects of the framework conditions for innovation, the improvement of which is a key means of boosting Russia's overall innovation performance. Next, it looks at the relationship between innovation and growth, both globally and in Russia, and explores the particular reasons why innovation policy should be a particular priority for Russia at present. Finally, it provides an overview of Russia's innovation performance and offers some conclusions.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1.1. Economic performance: An overview

1.1.1. Macroeconomic performance in the medium term

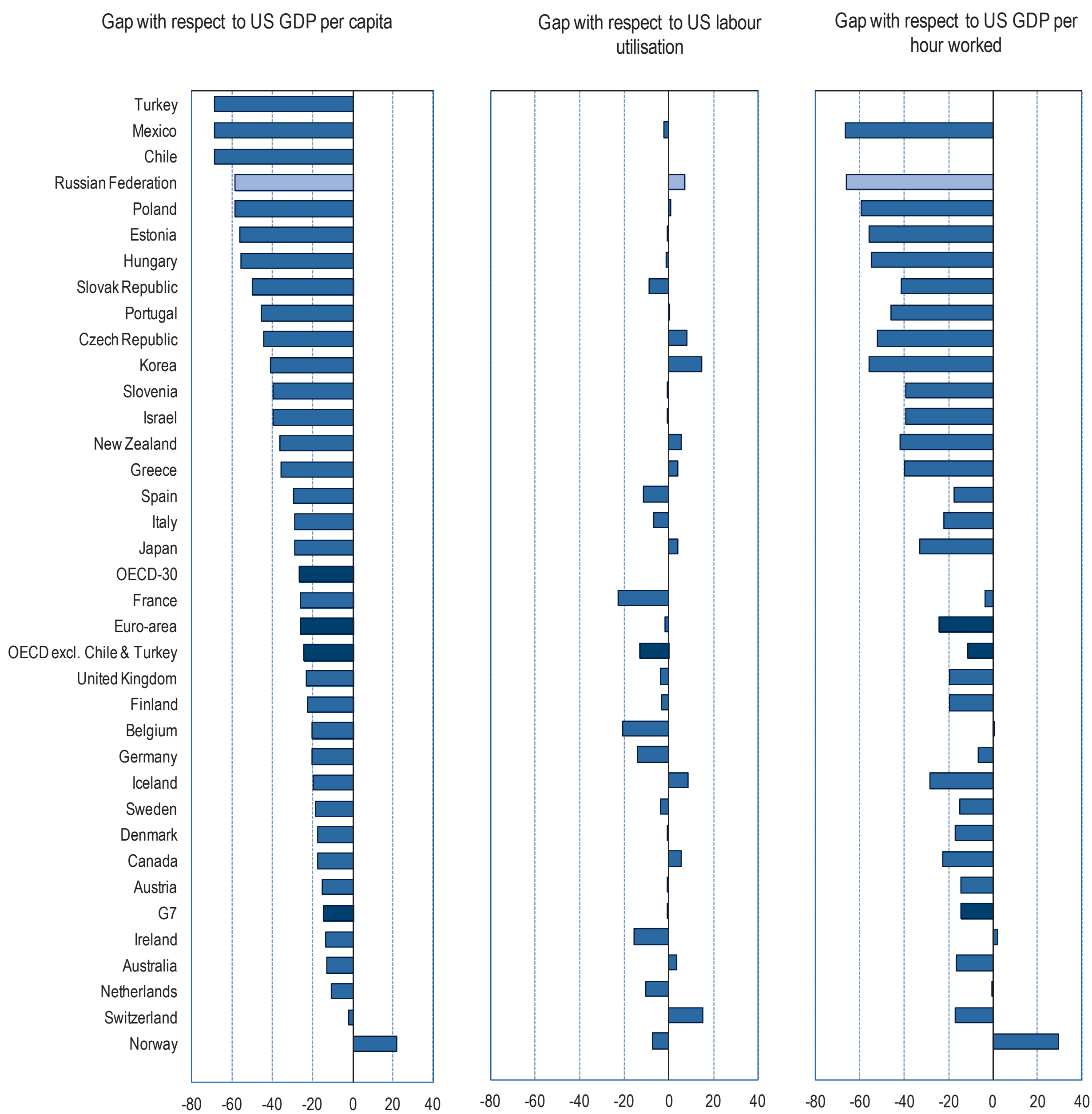
Russia had barely emerged from the transitional downturn of the first half of the 1990s when it was faced with a grave crisis in 1998. In the aftermath of that crisis, however, growth picked up swiftly. Throughout the decade up to the recent global financial and economic crisis, Russia enjoyed unprecedented economic growth. From 1999 to 2008, real GDP expanded at an average of about 7% a year. Owing to a gradual decline in the population, per capita GDP grew even faster. GDP per capita (at purchasing power parity) was converging rapidly towards EU27 and OECD averages. Absolute and relative poverty levels were falling (OECD, 2009a). To some extent, the favourable economic development of Russia's economy during that phase was due to a recovery from the low levels of economic performance in the 1990s. In fact, real per capita income reached the level of the end of the Soviet period only in 2006. In the years before the latest crisis, a sustained surge in commodity prices, especially of oil, was associated with a significant improvement in Russia's terms of trade. As a result "command GDP",which reflects the "real" purchasing power of domestic residents, grew even more rapidly than GDP, at an average 11% a year during 2003-08 (OECD, 2009a; Havlik, 2010). The boom ended rapidly towards the end of 2008. Indeed, the global financial and economic crisis hit the Russian economy particularly hard and made clear the vulnerability of a growth and development model that has been highly dependent on primary commodities, notably oil and gas. The growth pattern of the past will not be sustainable in the long term.

Despite the rapid growth prior to the financial crisis, Russia's GDP per capita still lags behind the OECD average and falls farther behind when benchmarked against leading high-income countries. In 2009, Russia's per capita GDP lagged that of the United States by nearly 60 percentage points (Figure 1.1). The gap in GDP per hour worked, is even wider, despite rapid growth in labour productivity (exceeding 5% a year on average during 2001-07). In fact, the gap in GDP per capita *vis-à-vis* the United States is entirely accounted for by the gap in labour productivity, which even eliminates the positive contribution of Russia's higher labour utilisation. To achieve sustainable growth in income per capita and improve the standard of living of its population in the longer term, Russia needs to boost productivity growth. This is a core task for Russia's economic policy.

A feature of the Russian economy that should be emphasised in a discussion of innovation is the fact that investment as a share of gross domestic product (GDP), although it rose gradually prior to the crisis, has been relatively low by the standards of other fast-growing catch-up economies (Figure 1.2).[1] Raising private sector involvement in research and development (R&D) and innovation more broadly is thus closely linked to the broader issue of raising investment overall. Increased investment would speed up the renewal of the capital stock, potentially boosting the technology content of capital goods. Beyond this, a favourable investment climate would tend to strengthen incentives for investment in R&D.

Figure 1.1. Income and productivity levels, 2009

Percentage point differences with respect to the United States

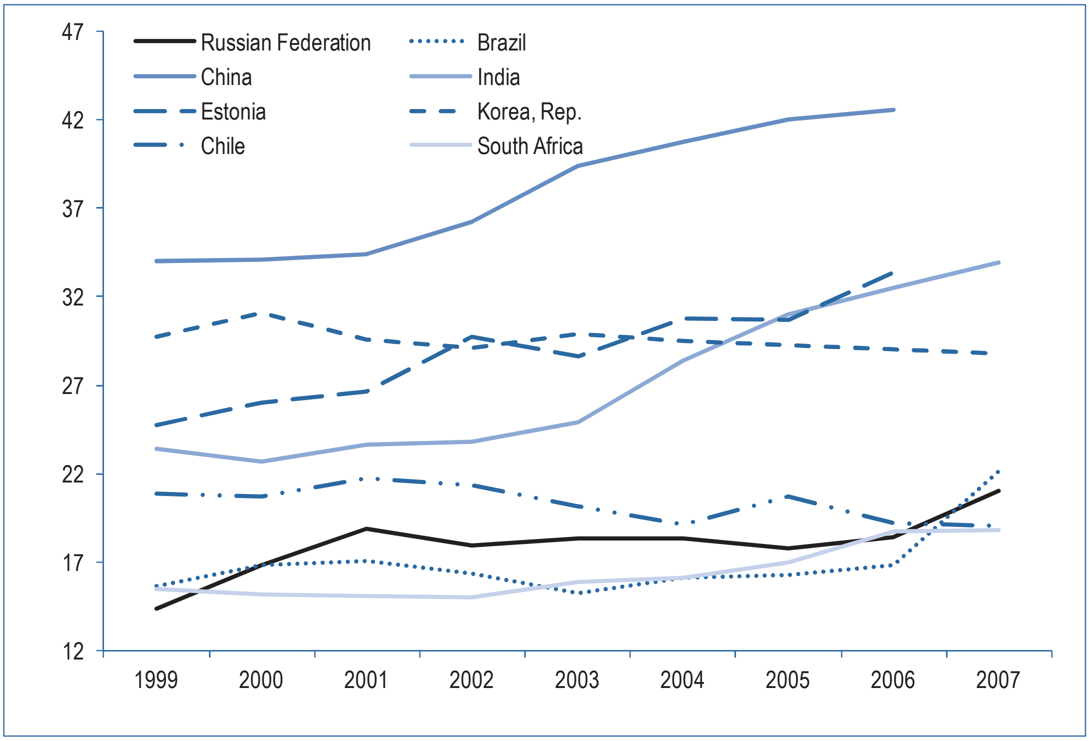


Note: Labour productivity and income levels are calculated using GDP at current prices and converted in US dollars using 2009 purchasing power parities. Labour utilisation is measured as total hours worked per capita. Labour productivity and labour utilisation levels estimates for Israel, Slovenia and the Russian Federation are based on hours worked for 2008. The euro area includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, the Slovak Republic, Slovenia and Spain. France includes overseas departments.

Source: *OECD Productivity Database*, August 2010. Direct link: *www.oecd.org/statistics/productivity*.

Figure 1.2. Gross fixed capital formation

% of GDP



Source: OECD (2009a), *OECD Economic Surveys: Russian Federation*, OECD, Paris.

1.1.2. A severe, although brief, recession 2008-09

The severity of the blow dealt by the global financial crisis to the Russian economy came as a shock to the authorities and to most outside observers. Russia had enjoyed a decade of economic growth that had seen a doubling of real GDP, a threefold rise in real wages and a halving of both the unemployment and poverty rates. To be sure, there was growing concern about the quality and sources of Russian growth during the oil-driven boom of 2003-08, as well as widespread awareness of the structural weaknesses to be addressed. Nonetheless, when the crisis erupted, Russia appeared well placed to weather the global financial turbulence. Its growth momentum was largely unchecked through mid-2008, and the main near-term danger for Russia in the spring of that year appeared to be the risk of overheating. Even after oil prices peaked in the middle of the year and growth began to slow, there was little expectation that the slowdown would turn into a sharp contraction. External and fiscal balances were relatively healthy, and commodity prices, though down from their peaks, remained at relatively high levels by historical standards. The fiscal reserves accumulated during the boom years left the combined assets of the Reserve Fund and the National Welfare Fund at more than RUB 6.6 trillion at the start of 2009 (equivalent to almost 16% of 2008 GDP) and left the authorities plenty of scope for financing anti-crisis measures. Even in the final quarter of 2008, the government continued to express confidence that Russia would remain one of the engines of global growth. The authorities were not alone: the consensus growth forecast for 2009 stood at 2.9% as late as December 2008 and did not turn negative until two months later.[2]

The downturn that followed was as dramatic as it was unexpected. Real GDP growth, which had averaged 7% a year in 1999-2007, turned negative from the third quarter of 2008, culminating in a severe contraction in the first quarter of 2009, when it fell by 9% in (seasonally adjusted) quarter-on-quarter terms. Though sharp, the recession was relatively short-lived. Real GDP fell only marginally in the second quarter, as stronger government consumption and a rebound in inventories almost offset weak consumption and investment, and growth resumed in the third quarter. About half of the 11% peak-to-trough decline in output was recovered in the second half of the year. By May 2010, wages and salaries had surpassed the pre-crisis peak recorded in September 2008. While unemployment was slow to fall, the authorities could take some satisfaction from the fact that the crisis-induced rise in unemployment had been relatively limited, especially as compared with the magnitude of the contraction.

When the crisis first began to affect Russia, the authorities moved quickly to shore up the banking sector, which was initially seen as the point of greatest vulnerability,[3] and they resisted downward pressure on the rouble, allowing enterprises and banks to acquire foreign exchange for debt service without suffering major valuation losses. The government also moved to lighten the tax burden on corporations and adopted a range of fiscal stimulus measures, including a rise in unemployment benefits and a number of measures aimed at assisting major industrial firms under pressure. Like some other countries, Russia succumbed to protectionist pressures, raising tariffs on imported second-hand cars, extending subsidies to domestic enterprises and adopting preferential public procurement practices. While fiscal stimulus clearly played a role in preventing a more protracted downturn, Russia's relatively quick return to growth in 2010 owed much to the recovery of global trade in general and commodity prices in particular. High oil revenues provide an opportunity to address the long-term challenges to be faced by Russia.

1.1.3. Lessons from the downturn – dangers of Russia's continued dependence on natural resources

The crisis and its aftermath have exposed the structural weaknesses of the Russian economy, highlighting the extent to which Russia remains dependent on its hydrocarbons sector. The impact of oil-price movements on the economy goes well beyond the direct contribution of the oil sector to GDP, which has been relatively modest since the growth of output slowed in 2003. The effect of the oil-price cycle is amplified not only by the explicit link between oil and gas prices but also by the very high correlation between oil and metals prices. Ferrous and non-ferrous metal exports constitute the largest non-fuel component of Russia's export bill, and no serious attempt was made to sterilise the windfall metals revenues. Commodity revenues were thus a huge source of the growth of domestic demand and the consumption boom during the period to mid-2008. They contributed to the emergence of real-estate bubbles in some cities and to very rapid accumulation of debt by households and corporates. Increasingly, growth was concentrated in non-tradable sectors, as the extractive sector lost momentum in volume terms and manufacturing struggled to cope with cost pressures. The authorities were well aware of the dangers presented by the spectacular increases in commodity prices in the mid-2000s. They put in place a number of measures aimed at maintaining macroeconomic – particularly fiscal – discipline and insulating the domestic economy from oil-price fluctuations, not least by saving a large proportion of the windfall revenues generated by very high oil and gas prices. However, the scale of fiscal sterilisation failed to keep pace with the flood of windfall revenues into the country. As a result, the non-oil fiscal balance began to deteriorate from 2005, eventually moving into deficit despite very fast GDP growth, and reached -14.0% of GDP in 2009; the non-oil trade deficit increased almost tenfold over five years to USD 130.4 billion (7.8% of GDP) in 2008.

OECD (2006a) argued that Russian growth was increasingly driven by transitory factors, most notably dramatic terms-of-trade increases, and that the principal challenge to Russian policy makers was to take the steps needed to facilitate the transition to a period of self-sustaining, investment- and innovation-led growth. However, relatively little was done to meet that challenge while external conditions remained favourable (OECD, 2009a). Through mid-2008 the growth model remained broadly the same as in preceding years, as growth in domestic demand continued to accelerate in response to improving terms of trade. This pattern was interrupted with the onset of the global financial crisis. The scale of the shock highlighted the urgency of the challenge, and the ensuing recovery has not diminished it.

While the innovation sector has suffered from the budget cuts that took effect during the crisis (see Box 1.3 below), the tighter fiscal environment may actually lead to an improvement in the quality, if not the scale, of innovation-promotion efforts. The need to put public finances back on a healthier footing implies increased attention to priorities and outcomes. To some extent, fiscal pressures have already begun to compel the authorities to clarify their aims: in the science and innovation sector, as elsewhere, the budget cuts of 2009 fell unevenly across priorities and institutions. Among the least affected were grants and prizes for younger scholars, which were reduced in number but increased in value, and grants to support leading scientific schools. The first of these measures, at least, may be having an effect: the share of researchers aged 30-39 rose in 2008, for first time in over a decade, and the share of under-29s continued to rise gradually despite growing competition for young specialists from large concerns like Rosnano and Rosatom. On the whole, budget cuts seem to have fallen hardest on such expenditure items as equipment, with considerable effort made to protect the financing of measures aimed at retaining qualified personnel (Gaidar Institute, 2010). Similarly, the crisis seems to have intensified the ongoing process of "hierarchisation" of higher education institutions on the basis of research potential, via the designation of specific institutions as "federal universities", "national research universities", and so on.

More recent developments have begun to highlight the potentially positive long-term consequences of the crisis for innovation performance. First, the shock of 2008-09, by throwing the economy's structural weaknesses into sharp relief, led to a renewed sense of urgency about economic reform in general and about fostering innovation and modernisation in particular. There is a general awareness that the current global recovery is very unlikely to allow Russia to sustain rapid growth on the basis of primary exports supported by terms-of-trade gains. Moreover, many other countries have recognised the need to strengthen their innovation performance in order to maintain growth in the tougher conditions of the post-crisis world. In short, the competitive environment is likely to be harsher over the coming years. This makes enhancing Russia's capacity to innovate all the more important. A Presidential Commission for Modernisation and Technological Development was created in 2009 and moved rapidly to identify innovation priorities and advance its first proposals. In February 2010, the government's Commission on High Technologies and Innovation was also upgraded when the prime minister took over as chairman.

These and other initiatives, such as the plan to create a high-technology hub around the business school at Skolkovo, near Moscow (often referred to as a future Russian

"Silicon Valley"), are examined in more detail in the chapters that follow. In general, the renewed emphasis on innovation is to be welcomed. However, there is a risk that the new measures may continue the traditional science-push approach to innovation and that a top-down approach to innovation will prevail at the expense of measures aimed at creating more decentralised and deconcentrated opportunities and incentives to foster innovative activities.[4] That said, some of the top-down initiatives could be beneficial if they generate needed feedback about conditions in knowledge-intensive sectors and the barriers to their growth (Guriev and Zhuravskaya, 2010). What will be crucial is a recognition that such policies complement, rather than substitute for, a vibrant model of private-sector entrepreneurship.

1.2. International trade and foreign direct investment

Openness to trade and foreign direct investment is, for various reasons to be discussed below, a critical aspect of the overall framework conditions for innovation. International trade and FDI are, on the one hand, channels of technology flows; on the other hand, they have a number of indirect effects on the innovation environment and performance, *e.g.* by increasing competition and the associated pressure on companies operating on the domestic market to "innovate their way out".

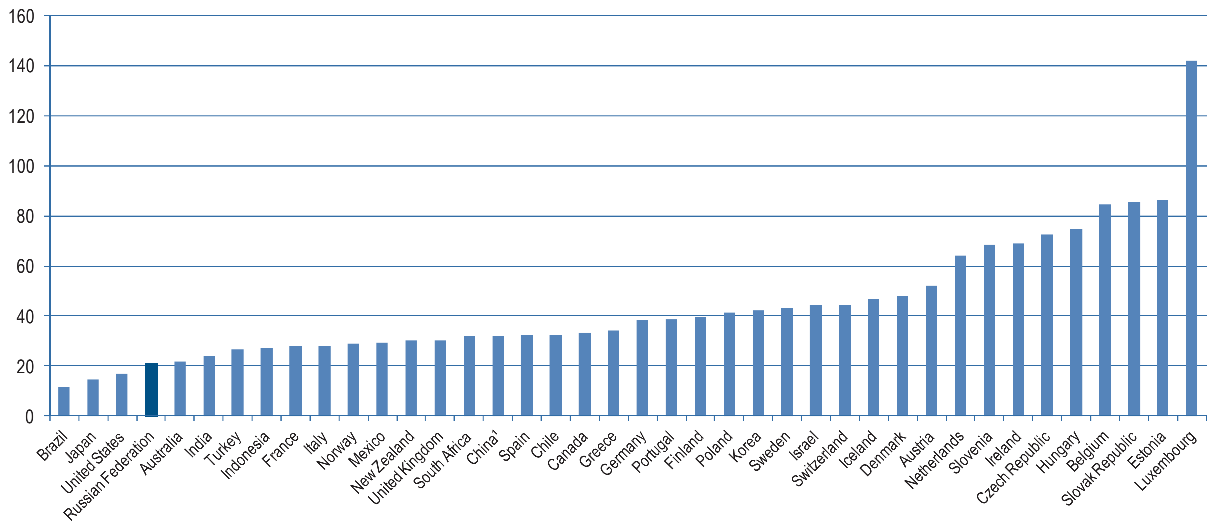
Since the transition to a market-based economy, Russia's integration into the global economy has made great progress along a number of dimensions. Yet, its full potential does not appear to have been realised. For example, according to the KOF Index of Globalisation 2011[5] – which provides a synthetic measure of economic, social and political globalisation – Russia ranks 52nd overall (out of 208 countries), but only 110th on the economic dimension of globalisation, behind large emerging economies such as South Africa, Indonesia, Brazil, Turkey and China.

Progress in negotiations and, eventually, the successful conclusion of Russia's accession to the World Trade Organization (WTO) can be expected to help innovation by removing barriers Russian companies currently face in international markets, including in high-technology areas. WTO accession may also support Russia's innovation agenda in other ways, *e.g.* by safeguarding against the adoption of an overly inward-looking approach to economic development that could eventually stifle innovation. WTO membership would also exercise some leverage for making more progress with competition-enhancing reforms and help advance Russia's innovation agenda (Havlik, 2010).

In some respects, the internationalisation of the Russian economy has progressed significantly. FDI flows and stocks, both inward and outward, have grown significantly over the past decade and a half. The technology balance of payments (TBP), which reflects international transactions involving industrial property and know-how (*e.g.* patent purchase and licensing, transactions involving trademarks, technical services, etc.), has also seen payments and receipts expand rapidly in recent years; this is a sign of a surge in trans-border technology flows (see the section on innovation performance below). In many respects, however, Russia remains a relatively closed economy. Openness to imports, as measured by the ratio of imports of goods and services to GDP, is lower than in most OECD countries and in emerging economies (except Brazil) (Figure 1.3). The development and structure of exports is discussed below.

Figure 1.3. Openness to imports

Imports of goods and services as a share of GDP, 2005-07



1. 2006-06.

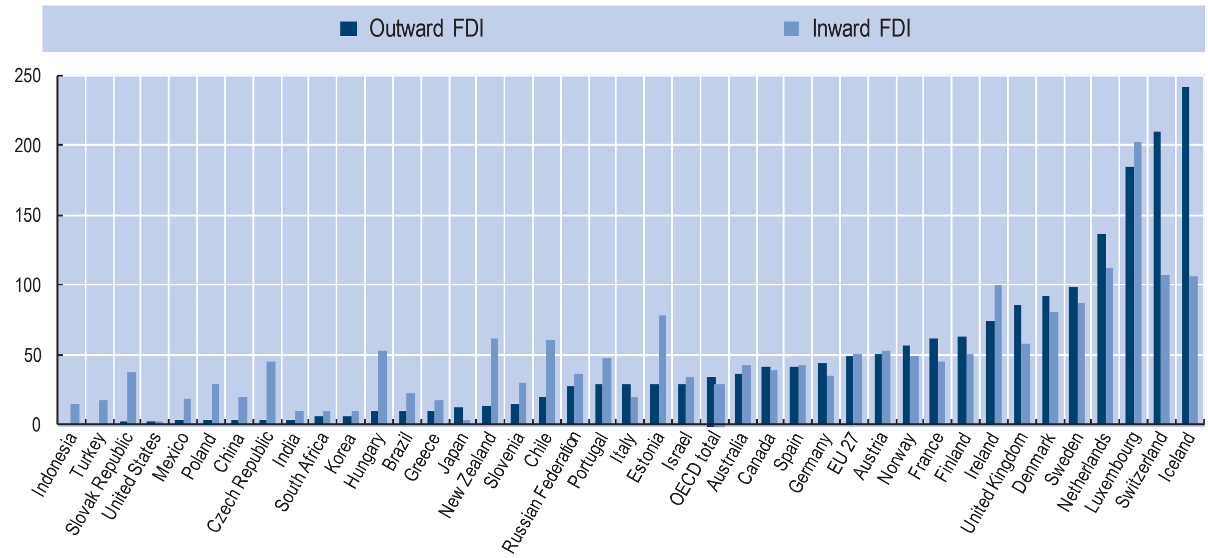
Source: OECD (2009a), *OECD Economic Surveys: Russian Federation*, OECD, Paris.

Russia started with very low stocks of FDI in the 1990s. Given a buoyant economic environment, Russia's international investment position improved strongly in the years before the global financial and economic crisis. Inward FDI has been growing since 2003 and Russia became a net recipient of FDI in 2004 (OECD, 2008a). In the following years, Russia confirmed its strong position in the international investment landscape.[6] In 2007, Russia's stock of inward FDI was 36.4% of GDP, and its outward stock reached 27.4% of GDP (Figure 1.4). These ratios exceed those of many large emerging economies, including Indonesia, Turkey, China, India, South Africa and Brazil. According to UNCTAD (2010), Russia's inward FDI performance, measured by the amount of FDI the country receives relative to the size of the economy, has improved strongly over time (rank 57 among 141 economies in 2009, up from 109 in 2000). Nevertheless, Russia does not seem to realise its potential. On the Inward FDI Potential Index, which measures the potential to attract FDI, Russia ranked 37th in 2000, 7th in 2007 and 9th in 2008.

In the wake of the global crisis FDI flows to Russia "almost halved in 2009, due to sluggish local demand, declining expected returns of ventures related to natural resources, and the drying-up of round-tripping FDI" (UNCTAD, 2010). However, in relative terms, Russia retained a strong position, ranking sixth in UNCTAD's global ranking of top investment locations in 2009. During that year, the Russian Federation, the largest source of outward FDI from Southeast Europe and the Commonwealth of Independent States, became a net outward investor. Russian multinational enterprises continued to look for strategic assets, including in developed countries, particularly in the hydrocarbons sector.

Figure 1.4. FDI stocks

As a percentage of GDP, 2007 or latest available year



Source: OECD Factbook 2010.

Russia is among the world's top outward investors (UNCTAD, 2010). Large Russian enterprises are active in acquiring overseas companies and transforming themselves into multinational enterprises with operations in various locations around the globe. Some of these acquisitions have been directed at accessing particular technologies or acquiring technological capabilities. Joint ventures with foreign companies are also widely used to access technologies and risk sharing. A recent example is the collaboration between Sukhoi and Finmeccanica of Italy on the development of the Superjet 100 airliner.

The patterns of Russia's FDI, both inward and outward, differ markedly from those that have developed in the central and eastern European countries (CEECs) after their transition to market-based economies. The Czech Republic, Hungary and Slovakia have emerged as European manufacturing platforms; this has been facilitated by their proximity to main European markets, and reinforced by their industrial capabilities and open stance towards FDI (OECD, 2008b). As a result, they have received significant flows of inward FDI. In contrast, their outward FDI position, unlike Russia's, remains relatively weak.

In the context of this review it is important to note that Russia hosts many of the world's leading technology-based companies, as the aerospace and information and communication technology (ICT) sectors, for example, seek to access high skills at an internationally competitive price. Like many other countries, Russia has sought to attract FDI through the establishment of various types of special economic zones (SEZ), including the four technology-oriented SEZ in Saint Petersburg, Zelenograd, Dubna and Tomsk. More recently, the government has announced plans to establish an innovation city at Skolkovo, a greenfield site outside of Moscow. Some large high-technology firms, including Cisco and Nokia, have signalled their intention to invest in Skolkovo, and the hope is that many more will follow. In order to increase its attractiveness to investors, the Russian Federation recently amended its Law on Special Economic Zones to reduce the minimum investment threshold, broaden the list of permitted business activities, and simplify land acquisition and administration procedures (UNCTAD, 2010).

For inward FDI, policies and institutions that facilitate the absorption and diffusion of knowledge are critical to overall innovation performance, notably for countries and sectors that do not operate at the world technological frontier. This underscores the importance of openness to innovation. Indeed, obstacles to (trans-border) absorption and diffusion are likely to reduce the effectiveness of efforts aimed at boosting innovation. Moreover, as such problems may also limit the impact of policy interventions aimed at stimulating innovation, resolving them may be critical to the success of innovation policy. Yet – despite positive examples – this appears to be a Russian weak point, at least in the eyes of business people: one of Russia's lowest ratings in the World Economic Forum's Executive Opinion Survey for 2009 concerned technology absorption and technology transfer, whether via FDI or the licensing of foreign technology (WEF, 2009). This suggests that Russia is missing a major opportunity to facilitate industrial modernisation and restructuring.

"Imports" of foreign know-how via FDI and collaborative R&D and innovation are affected by framework conditions and the regulatory environment.[7] Openness to flows of foreign knowledge can be expected to play an important role in boosting innovation in Russia, since its human capital endowments are well equipped to absorb it. Indeed, given the right framework conditions, this could be one of its major strengths. Erken *et al*. (2005) see the quality and skill of the labour force, together with the quality of knowledge institutions, as a critical factor in attracting foreign R&D.

Despite strong FDI inflows in the years before the crisis, Russia retains comparatively high barriers to foreign ownership, owing in part to the 2008 law on "strategic" industries, which defines 42 sectors in which control by foreign investors requires prior authorisation from a government commission (OECD, 2008a, 2009a). While regulation of investment inflows is arguably more transparent and less problematic than the often informal and *ad hoc* regime that prevailed earlier, its sectoral coverage is unusually broad and notification delays are longer than recommended by the OECD. Recent proposals to lower these barriers and reduce the coverage of the law are thus to be welcomed. However, other problems remain. The dominant position of large state-controlled conglomerates acts as a deterrent to FDI (OECD, 2009a), and foreign investors are likely to find the weakness of formal institutions more of a deterrent than domestic entrepreneurs, since "insiders" embedded in local social networks are likely to manage things better when informal rules and norms often matter as much as formal ones.

As is well known, the importance of FDI cannot be simply inferred from the sums invested but needs to take full account of the positive spillovers to be expected for domestic firms from the international transfer of state-of-the-art managerial expertise, technology and know-how. Savvides and Zachariadis (2005) find that foreign R&D has a particularly strong positive impact on total factor productivity (TFP) and the growth of value added. Moreover, the greatest potential spillovers are likely to occur in manufacturing, an areas in which greenfield FDI is still relatively low. Studies of FDI in Russia suggest that the beneficial spillovers from foreign-owned firms to other firms in the same industry are significant, although the benefits of trade and FDI liberalisation also depend on other policies, including financial sector reform, measures to improve labour mobility and reductions in regional bureaucracy (Bessonova *et al*., 2003). Overall, Russia so far does not appear to fully exploit the potential of FDI; this limits the potential benefits from international spillovers, including from R&D.

1.3. Specialisation and structural features of the Russian economy

Industrial structure and the size of firms tend to influence the level of R&D and the innovation performance of the economy as a whole. The Russian economy's specific features are rooted in its past as a centrally planned economy, in its abundant natural resources and in its geography.

1.3.1. Production and international trade

At 4.9% Russia has a higher share of agriculture in total value added than any OECD country except Turkey (8.5%) and is far above the EU27 average of 1.8%. At 36.1%, the share of industry (including mining and quarrying) is also high by international standards. It is similar to that of other formerly centrally planned central and eastern European economies such as the Slovak Republic and the Czech Republic (both with shares around 38%), but higher than that of other OECD countries, such as Austria (30.7%) and Germany (29.8%), which have shares well above the EU27 average of 26.5%. China's industry share is nearly twice as high (48.6%). The share of services is 59.0%, also close to that of the Czech Republic and Slovak Republic (59.9% and 58.8%, respectively), while the EU27 average is 71.7%.

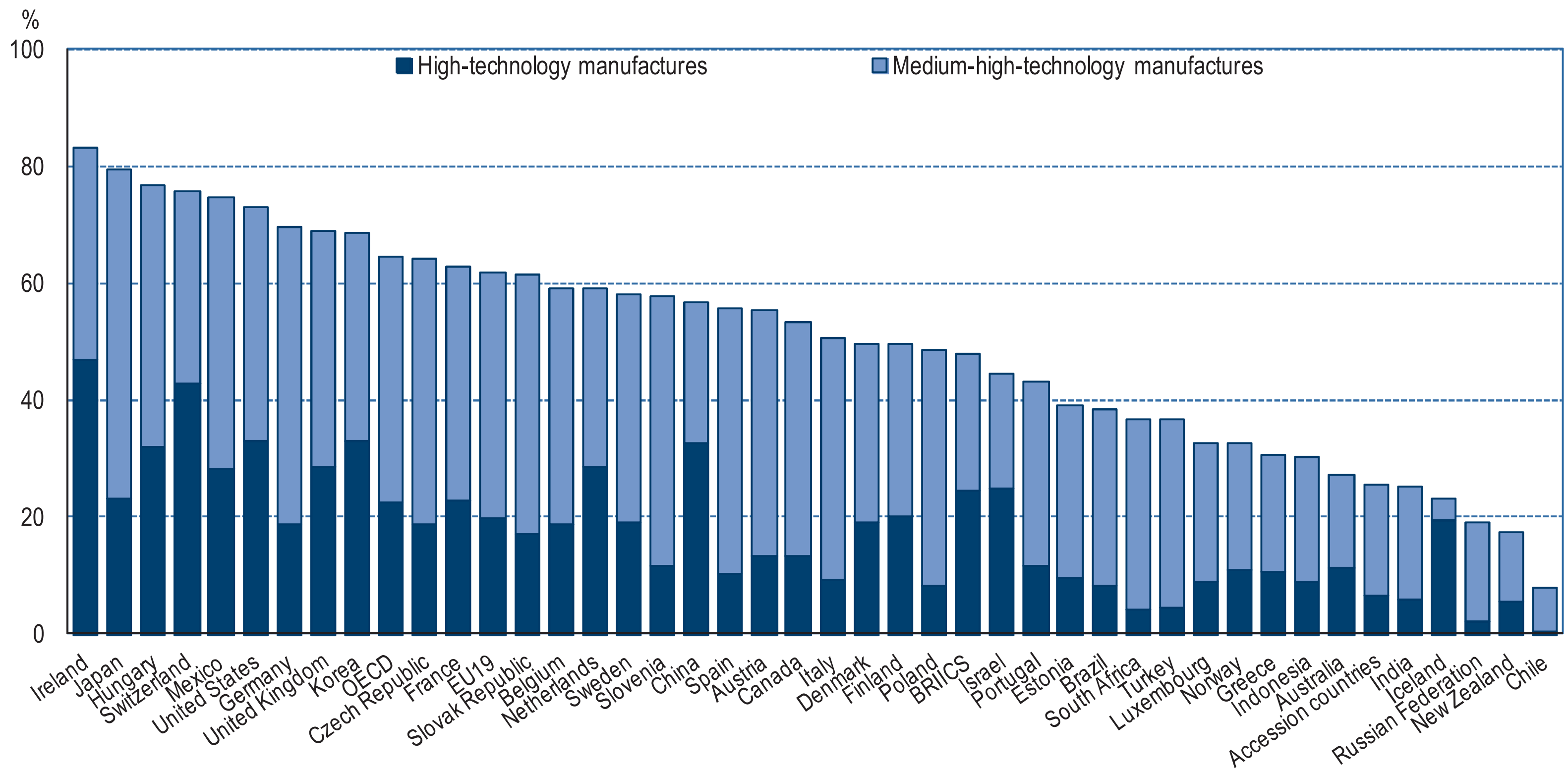
During 2006-08 value added in agriculture grew by an annual 4.7%, faster than in any OECD country except Israel, the Slovak Republic and Sweden. Real value added in industry expanded at a rate of 4.9%, far more rapidly than the EU27 and total OECD (2.3% and 1.8%, respectively). By far the most rapid growth was in the services sector, at 9.3%, faster than in any OECD country. By comparison, the EU27 and OECD averages of 2.7% and 2.6%, respectively, were modest.

Broadly speaking, Russia's export structure has the following features:

- Predominance of raw materials in total exports. Mineral fuels account for a large part of total exports (about two-thirds in 2008).
- A high share of medium-low and low-technology manufacturing exports.
- Relatively weak exports of high- and medium-high technology products, which account for less than one-fifth of total manufacturing exports.
- In the medium term, export specialisation has increased in the medium-low technology segment of manufacturing.

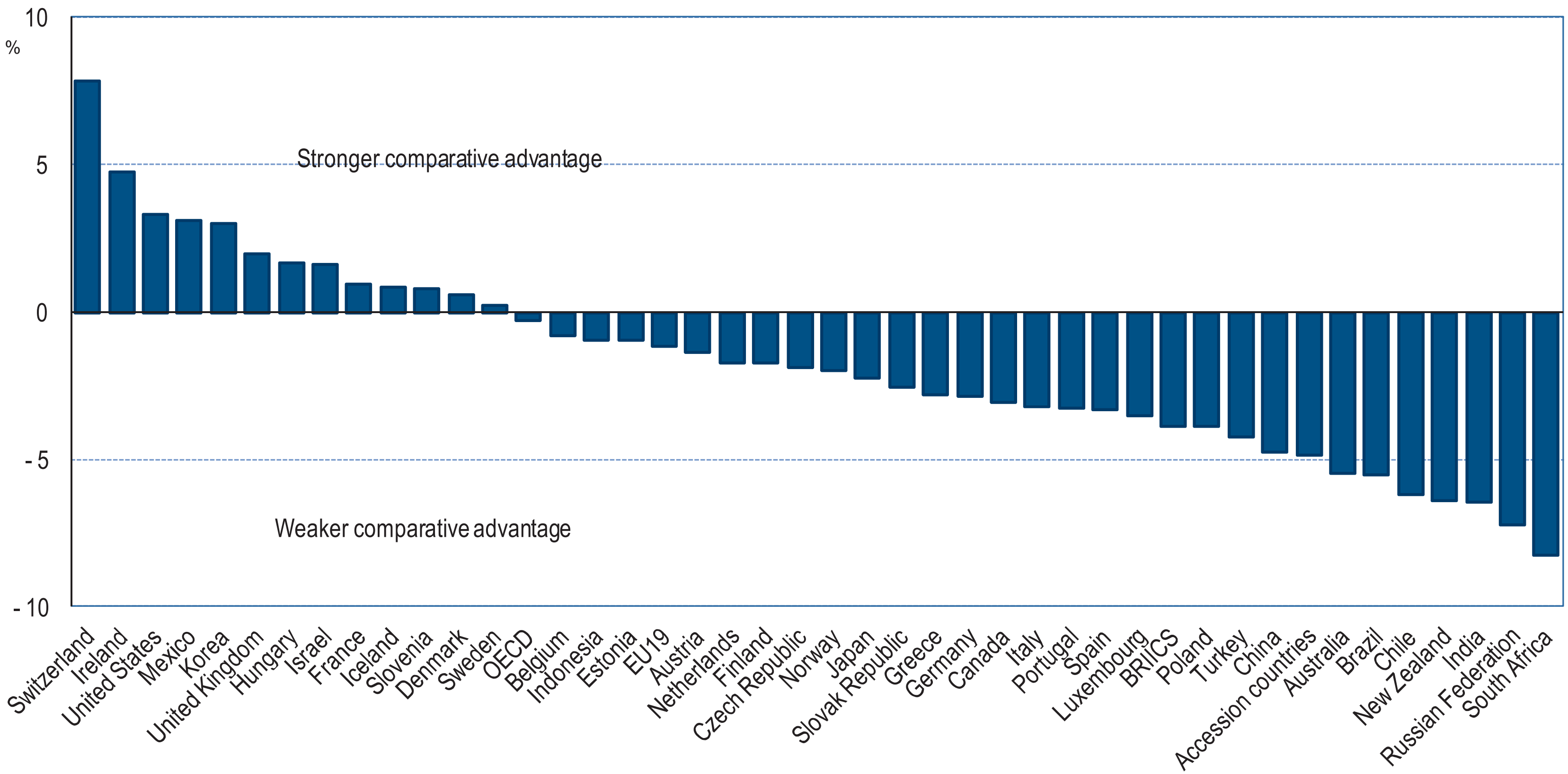
The share of high and medium-high technology in Russia's manufacturing exports is low by international standards and the share of high-technology exports is particularly small. Only two OECD economies, New Zealand and Chile, both resource-based and much smaller than Russia, had lower shares in 2007 (Figure 1.5). Given the structure of exports it is not surprising that the contribution of high-technology industries to Russia's manufacturing trade balance is strongly negative. During 1998-2008, Russian manufacturing exports expanded annually by 19.1% on average, compared to 8.8% for the OECD overall (Figure 1.6). However, high-technology exports grew by just 9.3%, a pace much more in line with the OECD average of 7.8% (Figure 1.7).

Figure 1.5. Shares of high and medium-high technologies in manufacturing exports, 2007



Source: *OECD Science, Technology and Industry Scoreboard 2009*.

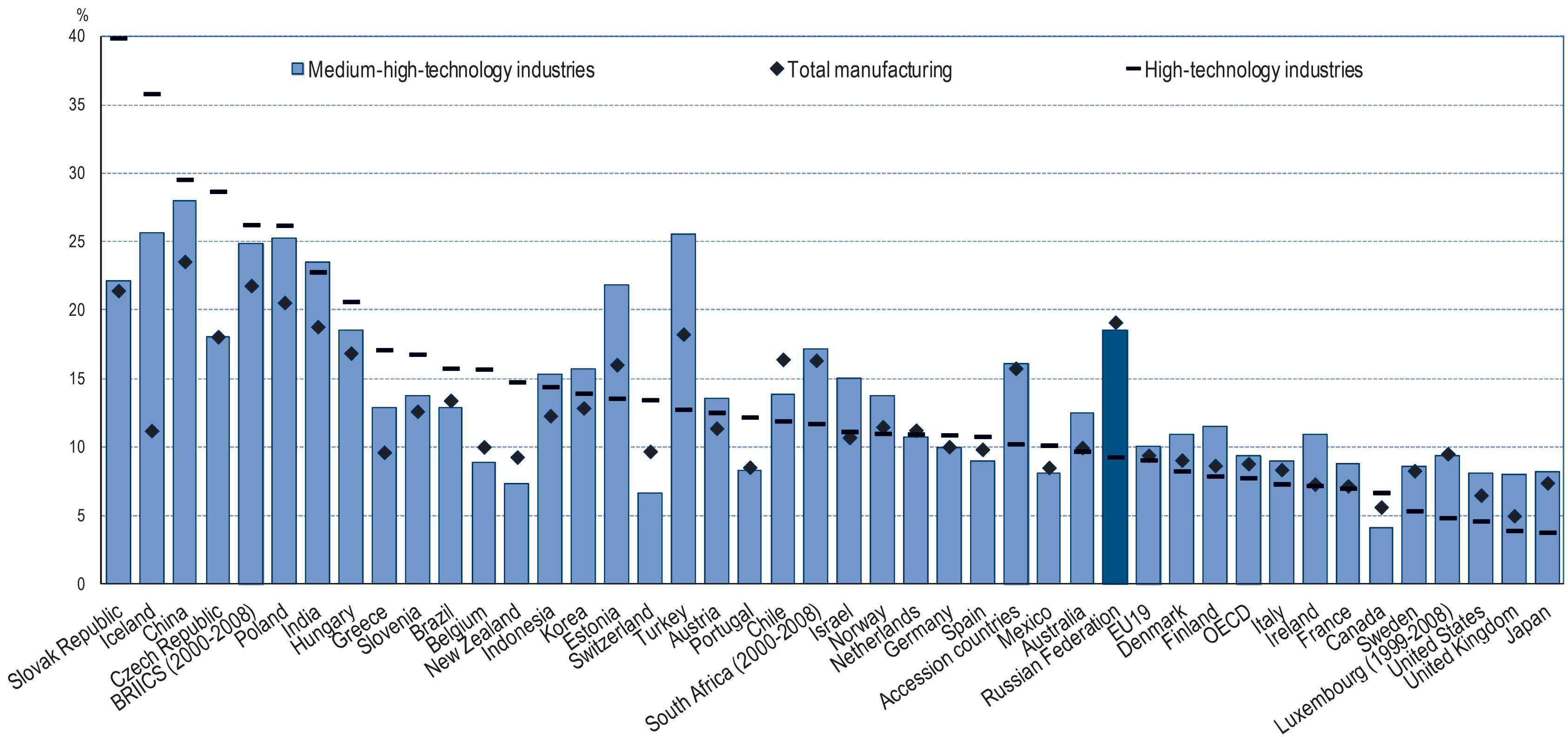
Figure 1.6. Contribution of high-technology industries to the manufacturing trade balance, 2007



Source: *OECD Science, Technology and Industry Scoreboard 2009*.

Figure 1.7. Growth of high- and medium-high technology exports, 1998-2008

Average annual growth rate



Source: OECD Science, Technology and Industry Outlook 2010.

Between 1995 and 2007, Russia's market share (total exports) has increased most strongly in the medium-low technology range and to a lesser extent in medium-high technology (Table 1.1). Market shares declined in both the high-technology and the low-technology segment of exports. Russia's manufacturing export specialisation, as measured by an index of revealed comparative advantage, has also shifted considerably since the mid-1990s,[8] increasing especially in the medium-low technology segment (to a RCA index value above 3 in 2007) and away from its initial specialisation in the low technology segment. The index for medium-high technology remained almost unchanged. Russia was not specialised in the export of high-technology manufacturing in 1995, but was even less so in 2007.

Table 1.1. Export market shares and revealed comparative advantage (RCA)

	Market share (total exports)		RCA (manufacturing)	
	1995	2007	1995	2007
High technology	0.33	0.16	0.43	0.11
Medium-high technology	0.35	0.74	0.46	0.51
Medium-low technology	1.75	4.41	2.26	3.07
Low technology	1.10	0.81	1.42	0.57

Source: CEPI/OECD.

1.3.2. Size structure of firms

Russia's industrial "ecosystem" is dominated by a few very large players. The 100 largest enterprises accounted for close to 60% of Russia's GDP in 2007. A mix of private financial-industrial groups (FIGs) and state-owned enterprises/state corporations dominate this top 100, which includes Gazprom, Lukoil, Alfa Group, Rosneft, Renova, Severstal, Norilsk Nickel, Evraz Group, Sistema, Rostechnologii, Mechel Steel Group, Tatneft, and Basic Element. The role of these large enterprises as actors in the Russian innovation system is discussed in Chapter 2.

However, Russia's firm ecology also includes a growing population of small and medium-sized enterprises (SMEs). There are about 1.6 million SMEs registered in Russia, and around 4 million individual entrepreneurs (Box 1.1). Their combined turnover in 2009 was USD 660 billion and accounted for around 21% of Russian GDP. They were responsible for employing 16.5 million workers, around 23% of the workforce (Table 1.2). The size of the SME sector is therefore relatively small as compared to OECD countries, but shows robust growth, with the number of firms growing by around 9% in 2009 (Figure 1.8). Around 41% of SMEs are in the wholesale and retail trade sector, 18% in services, 12% in construction, and 11% in manufacturing (OPORA, 2010). The share of small innovative enterprises is believed to be less than 2% of the total SME population, although what counts as an innovative enterprise is unclear and there are discontinuities in the collection of statistics about them.

Box 1.1. The Russian definition of SMEs

General definition

Federal Law No. 209-FZ of 24 July 2007 “On Development of Small and Medium-sized Enterprises” defines small and medium-sized enterprises (SMEs) as business entities (a co-operative, a commercial organisation, except for state and municipal unitary enterprises, or an individual carrying out entrepreneurial activities without establishing a legal entity, or a farm enterprise) which meet the following criteria (Art. 4):

- State and foreign ownership together shall not exceed 25%.
- Ownership by non-SME entities together shall not exceed 25%.
- Headcount does not exceed 250 employees for medium-sized enterprises, 100 for small enterprises and 15 for microenterprises;
- Annual turnover excluding VAT or value of the balance sheet assets does not surpass the threshold set by the government once every five years. The following annual turnover thresholds were set in 2008: RUB 60 million (USD 2 million) for microenterprises, RUB 400 million for small enterprises (USD 13.5 million) and RUB 1 billion (USD 33.5 million) for medium-sized enterprises.

Definition of small innovative companies

The Russian Federation does not yet have an agreed legal definition of innovative SMEs, although the Ministry of Finance is trying to develop one before approving programmes targeted at supporting such firms. In Russia today the term mainly refers only to enterprises that operate in the science and technology sector. Several years ago, innovative SMEs were also those that used high technology, innovation and ICT to add value to their production, but this very broad definition led to confusion.

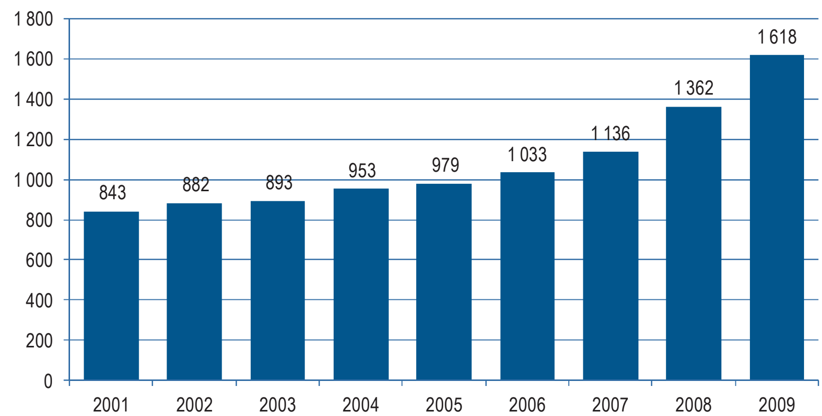
Table 1.2. Number of SMEs and employees, 2009

Firm size	Number of firms	Number of employees
Micro	1 374 777	4 531 400
Small	227 744	5 727 100
Medium	18 012	1 976 300
Total	1 620 533	12 234 800
Individual entrepreneurs	3 985 350	
Overall total	5 605 883	

Source: NISSE (2010), OPORA (2010).

Figure 1.8. Growth in the number of SMEs in the Russian Federation, 2001-09

Thousands



Note: Break in series between 2007 and 2008.

Source: NISSE (2010), OPORA (2010).

The 2008 Global Entrepreneurship Monitoring (GEM) Report for Russia (Verkhovskaya and Dorokhina, 2009) indicated that the level of entrepreneurial activity in Russia increased before the downturn. The government's measures aimed at reducing barriers to market entry and improving access to physical infrastructure may have contributed to this. However, among the 43 GEM countries, Russia still ranks low on this indicator. First-time participation of individuals in entrepreneurial activity is lower than in the other GEM countries. The bulk of new firms are created by an experienced entrepreneur. About 70% of the population see entrepreneurs as having high status in society. However, few people believe their knowledge is sufficient to start a business (17.5%, the second lowest share among GEM countries). In addition, fear of failure is a key obstacle to starting a business for 60% of Russians. According to the GEM Report, a relatively high share (11.5%) of Russian early-stage entrepreneurs define their business or product as innovative. This is in sharp contrast to established business entrepreneurs. Early-stage entrepreneurs are also more active in adopting new technologies than established business entrepreneurs, and 70% of early-stage entrepreneurs and 93.5% of entrepreneurs in established businesses are using technology that is more than five years old.

1.4. Framework conditions for innovation

1.4.1. The importance of good framework conditions for innovation

Good framework conditions are essential for achieving strong innovation performance. They include macroeconomic stability, many aspects of the regulatory regime and the tax system, competitive markets, openness to international trade and foreign direct investment, as well as an intellectual property rights regime which provides incentives for innovators by allowing them to benefit from their innovations while not unduly impeding the diffusion of ideas. It is these framework conditions that allow private innovators – both individuals and firms – to plan ahead and take risks, because they can reap the gains of their innovation effort and also benefit society at large.

Good framework conditions are important because innovation activity, particularly when it involves R&D and more fundamental types of innovation, requires a medium- or long-term horizon and a sufficiently stable environment. Because the rewards from innovation are partially reaped by society, the risk-reward relationship for the innovating entrepreneur is less generous than it is for society or for the non-innovating firm (which do not generate positive externalities). Therefore, conditions that increase the entrepreneur's risks raise the barriers to innovation. Under conditions of economic and political instability and weak institutions, the potential innovator will heavily discount the potential future benefits of any long-term innovative activity and will in fact be unlikely to invest in any activity that does not generate rapid returns. A poor environment for contracts also tends to shorten a potential innovator's time horizons. Moreover, in sectors that are far from the technology frontier, the catch-up process relies heavily on an imitation strategy, for which general framework conditions are critical. International openness and the regulatory framework are of crucial importance for rapid diffusion, and in some cases also for the generation of specific new technologies (as demonstrated by development in telecommunications).

Flawed framework conditions can also constrain and distort policy responses. They can reduce policy makers' room for action and prevent the use of policy tools that have been proven effective in more favourable circumstances. For instance, pervasive corruption can make governments very reluctant to give direct subsidies to business firms. Countries with a weak or ineffective tax system and administration tend to be reluctant to introduce fiscal incentives for R&D or do so very cautiously. In addition, unfavourable framework conditions are likely to reduce the effectiveness of specific policy measures designed to foster innovation.

Cross-country empirical work suggests that sound framework conditions for business are a *sine qua non* condition for boosting private innovative activities. A good deal of research highlights the importance of good framework conditions for R&D activity (Jaumotte and Pain, 2005a; OECD 2006b). It also finds that most innovation policy initiatives are likely to prove ineffective if appropriate framework conditions are lacking. At a minimum, innovative activity requires sound macroeconomic conditions. Analysing cross-country differences, Jaumotte and Pain (2005b) find that robust output growth, low inflation and low real interest rates have a positive influence on the rate of growth of R&D. The micro-level characteristics of the investment environment are also critical: secure property rights, effective enforcement of contracts, low barriers to market entry and a stable institutional environment all have a role to play in fostering innovation. Survey evidence suggests that innovative companies suffer more than other firms from problems with the investment climate (Goldberg, 2006).

Favourable framework conditions are necessary for achieving strong innovation performance, but specific policy measures are also needed to address market or systemic failures that hamper R&D and innovation activities. Targeted innovation policies are an essential complement to sound institutions and healthy framework conditions for entrepreneurship. However, the impact of specific interventions is likely to depend in no small measure on the capacities of the public bodies charged with implementing them and on the quality of the overall institutional environment.[9]

The following sections discuss aspects of the institutional setup, the macroeconomic framework, competition, the intellectual property rights regime, product market regulation, entrepreneurship and the adminstrative burden, insofar as they are relevant for successful innovation, as well as some aspects of financing innovation.

1.4.2. Institutional environment

Progress in reducing corruption, strengthening the rule of law, reducing the "bureaucratic burden" on business and reforming the public administration are vital elements of any policy aimed at fostering innovation. Russia's basic institutional environment still leaves much to be desired. Policy makers from the president on down have repeatedly expressed dissatisfaction with the performance of the public administration, law enforcement agencies and the courts, in terms of efficiency, effectiveness and probity. Despite significant improvements in some areas over the last decade, Russia's scores on all but one of the World Bank's comparative governance indicators in 2008 were in the bottom third of the more than 200 countries rated (Table 1.3). Surveys of executives and entrepreneurs paint a similar picture. The World Economic Forum's *Global Competitiveness Report* ranks Russia 118th out of 139 countries with respect to the quality of public institutions (WEF, 2010). Survey respondents gave particularly low scores to protection of minority shareholders' interests, the security of property rights and intellectual property protection. Corruption is widely reckoned to be endemic, and the evidence suggests that this perception not without foundation (Box 1.2).

Table 1.3. Selected governance indicators, 1996-2008

Indicator	1996	2000	2004	2008
Voice and accountability				
Estimate (-2.5 to +2.5)	-0.43	-0.46	-0.58	-0.97
Percentile rank (0-100)	34.9	33.7	31.3	21.6
Political stability				
Estimate (-2.5 to +2.5)	-1.04	-0.72	-1.00	-0.62
Percentile rank (0-100)	15.4	23.1	17.8	23.9
Government effectiveness				
Estimate (-2.5 to +2.5)	-0.51	-0.58	-0.28	-0.32
Percentile rank (0-100)	34.6	33.2	47.4	45.0
Regulatory quality				
Estimate (-2.5 to +2.5)	-0.39	-0.78	-0.24	-0.56
Percentile rank (0-100)	28.3	19.0	47.3	31.4
Rule of law				
Estimate (-2.5 to +2.5)	-0.67	-1.06	-0.82	-0.91
Percentile rank (0-100)	28.6	14.8	21.4	19.6
Control of corruption				
Estimate (-2.5 to +2.5)	-0.80	-0.99	-0.75	-0.98
Percentile rank (0-100)	23.3	13.6	25.7	15.5

Source: World Bank Governance Research Indicator Country Snapshots (2009).

Box 1.2. Combating corruption

Evaluations of the Russian business environment continue to highlight corruption as a major problem. While it is clearly not possible to measure the scale of corrupt activity with precision, the available evidence gives grounds for concern. It is by a wide margin the most problematic factor for doing business cited by respondents to the WEF's 2009 Executive Opinion Survey, and Russia ranked 146th among 180 countries in Transparency International's (TI) 2009 Corruption Perceptions Index, on a par with Ukraine and well behind its western neighbours. To be sure, assessments based on *perceptions* of corruption should not be confused with direct evidence of its extent, although perceptions alone can have an impact on investor sentiment. Perception indexes can be a misleading indicator of corruption levels (as, for example, when a single high-profile case has a big impact on outsiders' perceptions), but only up to a point. Countries with a reputation for corruption generally have serious problems.[1]

This view finds some confirmation in a survey conducted for the 2009 Global Corruption Barometer, which asks respondents directly about their experience with official corruption. In Russia, around one respondent household in three had paid a bribe in the preceding 12 months. Russian respondents overwhelmingly identified public officials, rather than parliamentarians, judges or the police, as the group most affected by corruption, though all of these institutions were believed to have serious problems with corruption. Using enterprise surveys taken between 2000 and 2008, Frye (2010) concludes that corruption actually increased over the past decade, a conclusion reinforced by Russia's steady decline in international comparisons, such as those undertaken by TI, WEF and the World Bank.

The authorities are well aware of the problem, which has been the focus of increasing attention in recent years, and an anti-corruption committee headed by the President has been created. Tackling corruption will take time and will require a multi-faceted approach – there is no simple solution. Measures to increase the transparency and accountability of public institutions would help, as would regulatory reforms that reduce bureaucrats' opportunities to extract bribes from private-sector firms, the introduction of stricter conflict-of-interest laws and the imposition of more effective sanctions. Judicial and civil service reforms are needed to increase the fairness, transparency and efficiency with which laws and regulations are administered.

1. See Olken (2009) for a recent overview of this literature; see also Mocan (2004).

1.4.3. Macroeconomic environment

A stable and predictable macroeconomic framework is of key importance for a country's innovation performance. High and stable rates of output growth in particular provide favourable conditions for business firms to pursue their medium- to long-term strategies. A medium- to long-term time horizon is needed for R&D investment and for the more demanding types of product, process and organisational innovation. A sound macroeconomic framework may also encourage investment in R&D and innovation through low and stable rates of inflation and lower and less volatile real interest rates (Jaumotte and Pain, 2005b). While the recent temporary downturn of the Russian economy had a dampening effect on the funding of R&D and innovation activity (Box 1.3), the preceding period of sustained high growth provided a good environment for stabilising and expanding innovation activity in the public and the business sectors.

Box 1.3. Impact of the crisis on innovation acivity in the Russian Federation

Both the crisis and the policy response have had a significant – and mixed – impact on Russia's innovation system. The negative impacts stem largely from firms' response to the shock and from government measures adopted in response to the rapid deterioration of public finances:

- The private sector sharply curtailed its investment in innovation-related activities. According to the Federal Agency for Science and Innovation (Rosnauka), by September 2009, the share of enterprises engaged in innovative activity was down one-third on the level of 2005. The number of small innovative enterprises was down by half. Many of these enterprises were small firms working under contract to large firms that had outsourced R&D activities and cut their R&D spending in the wake of the recession (Gaidar Institute, 2010). Companies also began to default on their obligations under government contracts concluded under the federal targeted programme for R&D for 2007-12. The National Association for Innovation and the Development of Information Technologies (NAIRIT) estimated in late 2008 that private firms' expenditure on innovation projects had been cut by almost 80% and venture-fund activity by 40% (Mel'nik, 2008).
- The (limited) available evidence also suggests that private firms that cut their R&D spending did not, for the most part, offset this with greater co-operation with public sector bodies; in general, private firms continue to find it difficult to work with the state research bodies or higher education institutions. In addition to complaints about the speed and efficiency of public sector R&D organisations, there remain concerns about intellectual property rights when the public and private sectors collaborate (Gaidar Institute, 2010).
- Budgetary expenditure on R&D was also cut by around 30% in 2009, though the severity of the cuts varied widely across programmes and institutions. In some instances, current-year allocations were withheld at very short notice (Gaidar Institute, 2010). The 2010 budget included further cuts from the levels of 2009. Whereas fiscal stimulus packages allowed many OECD countries to increase R&D spending and spending on fundamental science (OECD, 2009b), innovation-related priorities did not figure prominently in Russia's anti-crisis measures. Extra-budgetary public expenditure was also affected, not least because of the failure of enterprises to meet their commitments under the federal targeted programme mentioned above; the Ministry of Education and Science estimates that only about 60-70% of planned off-budget expenditure under that and related programmes was executed (Gaidar Institute, 2010).
- Funding cuts led to the departure of researchers. The number employed fell by an estimated 4.2% in 2008. Total employment in the R&D sector fell by around 5% (IPRAN, 2009). Moreover, the decline took place chiefly in response to private-sector adjustment; it does not include the impact of subsequent budget cuts, imposed in 2009.

1.4.4. Product market regulation, competition and entrepreneurship

The 2008 Product Market Regulation (PMR) Assessment of the Russian Federation (OECD, 2009a) shows that, despite liberalisation in a number of areas, the regulatory system is generally still highly restrictive. Using the OECD PMR indicators system (see Box 1.4), Russia tops the list of the most restrictive countries covered (Figure 1.9). In addition, all three of the high-level sub-components of the overall PMR index mentioned in Box 1.4 are higher than those of comparator countries, but "state control" and "barriers to international trade and investment" stand out as particularly restrictive. Some of the barriers are discussed further in the section on competition in Russian product markets.

Box 1.4. The OECD product market indicators system

The OECD's PMR indicators assess the extent to which the regulatory environment promotes or inhibits competition in markets in which technology and market conditions make competition viable. These indicators have been used extensively over the last decade to benchmark regulatory frameworks in OECD and other countries and have proven useful in encouraging countries to implement structural reforms that enhance economic performance.

The PMR indicator system summarises a large number of formal rules and regulations that have a bearing on competition. The regulatory data cover most of the important aspects of general regulatory practice as well as a range of features of industry-specific regulatory policy, particularly in the network sectors. This regulatory information feeds into 18 low-level indicators that form the base of the PMR indicator system. These low-level indicators are progressively aggregated into three broad regulatory areas: *i)* state control; *ii)* barriers to entrepreneurship; and *iii)* barriers to international trade and investment. At the top of the structure, the overall PMR indicator serves as a summary statistic on the general stance of product market regulation.

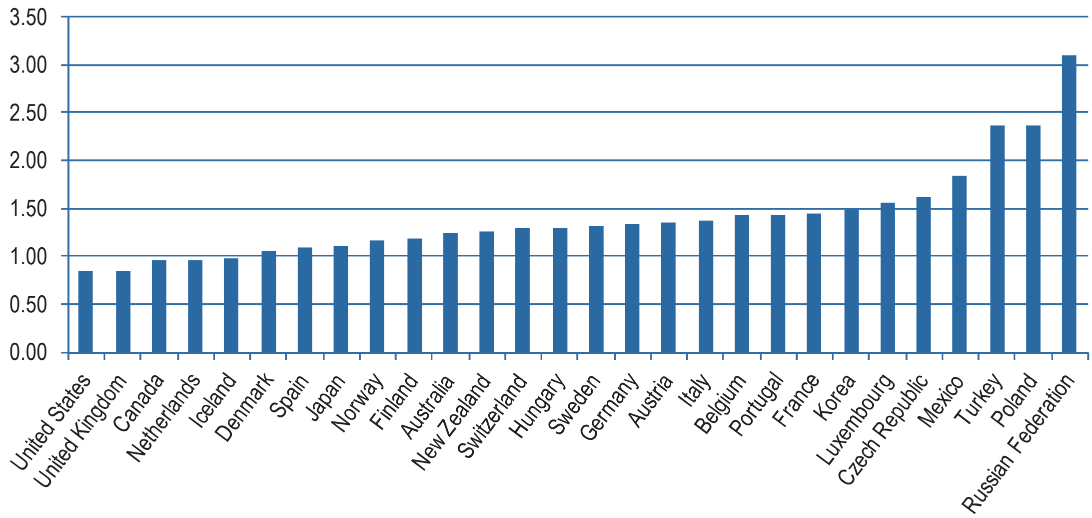
The PMR indicators have a number of characteristics that differentiate them from other indicators of the business environment. First, in principle, the low-level indicators only record "objective" information about rules and regulations, as opposed to "subjective" assessments of market participants as in indicators based on opinion surveys. This isolates the indicators from context-specific assessments and makes them comparable across time and countries. Second, the PMR indicators follow a bottom-up approach, in which indicator values can be related to specific underlying policies. One of the advantages of this system is that the values of higher-level indicators can be traced with an increasing degree of detail to the values of the more disaggregated indicators and, eventually, to specific data points in the regulation database. This is not possible with indicator systems based on opinion surveys, which can identify perceived areas of policy weakness, but are less able to relate these to specific policy settings.

Source: OECD (2009a).

The World Bank's Doing Business surveys shed some additional light on the obstacles and barriers encountered by businesses.[10] In the most recent of these international comparisons, Russia ranks 123rd among 183 economies (Table 1.4), ahead of India (rank 134) and Brazil (127) but behind China (79). The country fared worst in "Dealing with construction permits" (rank 182), "Trading across borders" (162, compared to 114 for Brazil, 100 for India and 50 for China) and "Starting a business" (108). It appears that while starting a business is difficult it may be even more challenging to operate it.

The World Bank (2011b) compares Russia with a number of country groupings, such as the OECD, the G20, the upper-middle income countries, the BRICs (Brazil, Russia, India and China) and ECA (Eastern Europe and Central Asia). Russia, for example, ranks lowest overall in comparison to OECD countries. It has a rather low overall rank (38th) among 46 upper-middle income countries, with a few bright spots (such as "enforcing contracts"), and it ranks 2nd overall among the four BRICs.

Figure 1.9. Overall indicator of product market regulation, 2008



Source: OECD (2009a), *OECD Economic Surveys: Russian Federation*, OECD, Paris.

Table 1.4. Russia's ranking in Doing Business, 2011

	Rank 123 (out of 183 economies)
Ease of doing business	**123**
Starting a business	108
Dealing with construction permits	182
Registering property	51
Getting credit	89
Protecting investors	93
Paying taxes	105
Trading across borders	162
Enforcing contracts	18
Closing a business	103

Source: World Bank (2011a).

Overall, Russia could increase its economic performance by further improving its regulatory framework. For example, there is empirical evidence (OECD, 2007a, based on Conway *et al.* 2006) that competition-restraining regulations slow the rate of catch-up with the technological frontier, where labour productivity is the highest. Countries with the most restrictive product market regulation, or those with the lowest productivity and hence the greatest scope to move towards the frontier, are likely to achieve the greatest improvement in productivity growth. There is evidence that better product market regulation is also associated with increased foreign investment inflows (Nicoletti *et al.*, 2003) which in turn provides opportunities to benefit from international technology spillovers.

The importance of competition for innovation

Product market competition is a driver of productivity growth (Baumol, 2002) by spurring innovation either directly or indirectly, through what Joseph Schumpeter termed processes of "creative destruction". Yet the effect of competition in product markets on innovation activity that is predicted by economic theory is somewhat ambiguous: competition among incumbents can stimulate innovation, but the possibility of gaining a certain degree of market power may also provide a strong incentive to innovate (the so-called Schumpeterian effect). Nonetheless, most empirical research has found evidence of a positive correlation between innovation and competition.[11] Recent work by Aghion *et al.* (2005) suggests however that the relationship is a concave ("inverted-U") one, with the Schumpeterian effect dominating at higher levels of competition.

In Russia, the empirical evidence suggests that openness to foreign competition boosts domestic productivity growth (Aghion and Bessonova, 2006; OECD, 2009a). The effect is found to be stronger for firms close to the technological frontier. For less productive firms, the threat of entry may create a disincentive to innovate by reducing their "life expectancy" and thus shortening their time horizons. The incentive to innovate to escape competition from new entrants appears to predominate, so an increase in threat of entry usually appears growth-enhancing overall (Aghion *et al*., 2002; Aghion and Bessonova, 2006). Kozlov and Yudaeva (2004) find that competition from both foreign and domestic competitors has an inverted-U effect on the innovation efforts of Russian producers. However, they conclude that most Russian firms are located on the upward-sloping part of the curve, where innovation activity increases with competition. This result is reinforced by survey data showing that Russian firms in more competitive environments spend significantly more on R&D and also innovate more than firms facing less competitive pressure.[12] Firms with greater market power innovate less, and monopolistic firms innovate least of all (Goldberg, 2006).

The conclusion is similar for the impact of competition on the outcomes of innovation activity rather than the inputs. Recent empirical work points to a negative correlation between growth in total factor productivity and concentration (Gianella and Tompson, 2007; Aghion and Bessonova, 2006). The effect is found to be stronger for import-competing industries.[13] Finally, the incentive to innovate also increases with the degree of similarity between firms in a given sector (the degree of "neck-and-neckness" in terms of their distance from the technological frontier).

Competition in Russian product markets

The question that naturally arises from the foregoing discussion is whether or not product markets in Russia are sufficiently competitive. OECD (2009a) finds that, in general, they are not. The share of highly concentrated markets in Russia increased from 43% to 47% between 2001 and 2007.[14] Although differences in methodology and sectoral coverage make comparison difficult, this is high compared to OECD countries; it is also consistent with OECD (2006a), which found that Russian product markets were unusually concentrated, particularly at the regional level. It is also consonant with the views expressed in the WEF's Executive Opinion Survey, which consistently suggest that Russian executives believe competition in most markets to be weak, market dominance common and anti-monopoly policy ineffective (WEF, 2010). The perceived inefficiency of state institutions is matched by the perceived inefficiency of markets. OECD (2009a) cites some evidence that the trend towards large-firm dominance has been checked since

2005. However, when measured by the share of total net profits or market capitalisation, large firms still loom larger in the Russian economy than in many OECD and other countries. Sales data likewise confirm the dominance of large firms, with the total sales of the 10 and 50 largest firms equivalent to almost 30% and 50% of GDP, respectively.

In markets characterised by a small number of large firms, the challenge of ensuring effective competition and preventing cartels is particularly significant, and the Federal Antimonopoly Service considers cartel formation one of the major threats to competition in Russia. It estimates that as many as one in five industries may be prone to cartel activity (Federal Antimonopoly Service, 2008). In many regional markets, a few incumbent firms co-operate closely with regional or local officials. While this is often a sign of corruption and rent-seeking behaviour, such arrangements also arise as a result of the limited fiscal autonomy of sub-national authorities. Regional governments and municipalities often pursue their social objectives through more or less informal arrangements with large incumbent enterprises operating in their territory. These typically translate into effective barriers to entry from outside competition (OECD, 2009a).

While in some sectors consolidation is probably the result of a healthy shake-out, in others it is due to the ability of large incumbents created in the Soviet era to limit entry, often by relying on political support at regional or national level. Competition is also diluted by Russian firms' marked preference for dealing with familiar counterparts and a reluctance to change suppliers, attitudes which are understandable given the difficulties of enforcing contracts. In surveys conducted by the Gaidar Institute, managers regularly cite established relations between producers and consumers as a major obstacle to competition. A weak contracting environment also gives firms a greater incentive than elsewhere to control customers and suppliers through the vertical integration of supply chains (Bessonova, 2009). Finally, political support has allowed large conglomerates to expand into new markets by acquiring non-core assets and diversifying product lines, especially in the case of some state-owned enterprises (OECD, 2006a; Tompson, 2010).

OECD (2009a) underscores the extent to which overly restrictive product-market regulation effectively limits competition. This raises the question of regulatory obstacles to business development. Anti-competitive barriers are now perceived to be one of the major problems for businesses, along with corruption and frequent changes in the law.[15] According to the Federal Antimonopoly Service, entry barriers are a particular problem when regional authorities seek to protect local markets from outside penetration: the service has seen a sustained increase in violations of competition law by regional and municipal authorities.[16] If lowering barriers to entry and improving the predictability of state policy for business would benefit the business community in general, it would likely have an even greater effect on innovation.[17]

While serious problems remain, this is an area in which there appears to have been real improvement over the last decade. In an effort to monitor the impact of the government drive, launched in 2001, to reduce the bureaucratic burden on small firms, the Centre for Economic and Financial Research undertook seven rounds of enterprise surveys in 20 provinces over 2001-07. The results showed that many principles enshrined in the law were still violated by officials at the end of the period. Inspections, for example, were more frequent than allowed by law and documentation requirements for different procedures were often more extensive than allowed under the new legislation. However, each successive round did provide evidence of improvement, particularly in the areas of registration, inspections and licensing. At the same time, the importance that respondents attached to the level of competition as a factor affecting business development increased in each round, suggesting that small entrepreneurs were increasingly concerned with "normal" business problems.

According to the OECD 2008 Product Market Regulation Assessment, Russia performs rather well on barriers that affect the entry of private-sector firms and vertical integration in network sectors (gas, electricity, rail, air transport, postal services and telecommunications). On this indicator, barriers are only slightly higher than the average in OECD countries. However, they vary widely. The mobile telecommunications market is fairly well regulated, with low barriers to entry. In contrast, the fixed-line market is still controlled by a state-owned, vertically integrated incumbent, Svyazinvest (OECD, 2009a). In terms of innovation, the telecommunications sector is of particular interest, as it is not just a major actor in innovation in its own right but is also a provider of infrastructure of critical importance for innovation throughout the economy. A lack of competition in this area can adversely affect consumer welfare and downstream producers and have a detrimental effect on innovation. In many instances, a lack of competition has a negative effect on the diffusion of some ICT applications.

1.4.5. Intellectual property rights[18]

Protection of intellectual property rights (IPR), through patents or in other ways (trademarks, copyright, etc.), stimulates research by enabling successful innovators to reap rewards and by preventing free riding. The related publication requirements also contribute to the dissemination of scientific and technological knowledge and help prevent costly duplication of research efforts. However, the benefits have to be weighed against the social cost arising from the delayed diffusion and thus reduced use of the invention over the lifetime of the patent, the administrative costs, etc. While the relationship between IPR and innovation is complex (Jaumotte and Pain, 2005c) the adoption and implementation of modern IPR legislation is an essential part of the overall framework conditions for innovation.

Russia's IPR regime provides protection for copyright and related rights, trademarks, geographical indications, patents, industrial designs, topographies of integrated circuits and computer programmes. The regulations are administrated by the Russian Federal Service for Intellectual Property, Patents and Trademarks (ROSPATENT).[19] Part IV of the Civil Code, which was voted in December 2006 and entered into force on 1 January 2008, replaced all previous IPR legislation and combined all Russian IP laws into a single legal instrument. The new legislation introduced a number of improvements aimed at making progress towards WTO accession; however, several additional draft amendments remain.

The Russian Federation succeeded the former Soviet Union as a party to a number of international treaties which include the World Intellectual Property Organization (WIPO) Convention, the Patent Cooperation Treaty (PCT) and the Paris Convention. In 1992, Russia began negotiations for accession to the WTO, which incorporates a number of IPR-related disciplines. Since then, Russia has adhered to several additional international treaties.[20] The development of Russian IPR legislation has also been influenced by bilateral treaties concluded by the Russian Federation, notably the bilateral market access agreement signed in November 2006 with the United States, which includes a binding IPR agreement on a number of critical IPR issues such as optical disc piracy, Internet piracy, protection of pharmaceutical test data, etc.[21] However, negotiations on accession to the WTO are still ongoing, and IPR protection remains an outstanding issue.

Russian legislation provides for enforcement under the Civil Code, the Administrative Code, the Criminal Code and the Customs Code. A number of recent reforms have improved IPR enforcement, including the amendment of the Criminal Procedure Code in 2006, which provided police with powers to initiate criminal investigations (the power was previously reserved to prosecutors); the amendment of the Criminal Code in 2007, which increased the maximum penalty and redefined "serious" crimes; a number of amendments to Part IV of the Civil Code in 2008; and accession to the WIPO Internet Treaties on 5 February 2009.

While the international business community has acknowledged some progress in the reforms of laws and institutions, the strength of intellectual property provisions and the enforcement of IPR protection are still problems. Significant areas for progress concern the level of piracy,[22] in particular massive online piracy, which is a serious and growing problem, and the protection of test data submitted to the government to obtain product approvals for the biopharmaceutical, agriculture and agrochemicals sectors, according to the Business and Industry Advisory Committee to the OECD.

According to the Ministry of Economic Development of the Russian Federation (2009), a number of further legal reforms are under way to bring Russian legislation into conformity with the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement and other international treaties on IPR protection.[23] It is also suggested that a number of further reforms to Part IV of the Civil Code will likely be necessary to further strengthen IPR protection.[24]

With regard to IPR policy in the public research sector, Federal Law 217 (August 2009) provides the possibility for public research institutions (PRIs) and universities to establish businesses to commercialise and transfer the IPR produced from public research. Based on this legislation, PRIs and universities own the IPR arising from federally funded public research and can formulate their own policy regarding the distribution of proceeds from its commercialisation. However, as of 2010, the majority of PRIs and universities had not adopted IPR policies, owing to a relative lack of interest in commercialisation.

In summary, Russia has taken steps to strengthen its system of intellectual property rights and to comply with its international obligations by bringing its legal framework for intellectual property to international standards. However, the evidence indicates that significant deficiencies remain, especially in the area of enforcement.

1.4.6. Financing innovation

A well-developed financial system, which reduces the cost of external financing, is an important catalyst of innovation activities (Jaumotte and Pain, 2005b). Russia's financial system, despite the rapid expansion of recent years, is still relatively underdeveloped, with considerable scope for financial deepening to further long-term growth. A large majority of Russian firms rely on retained earnings to finance investment and innovation, and enterprise surveys almost always report the shortage of own funds and the cost of borrowing as the principal barriers to investment and innovation. This points to the importance of strengthening the banking sector (see OECD, 2009a, for specific proposals) and non-bank financial institutions.

Funds devoted to innovation and risk financing are scarce in Russia, partly owing to the dearth of venture capital. Jaumotte and Pain (2005d) find that the development of venture capital in OECD countries is negatively correlated with enterprises' assessment of the difficulty of securing external finance, and a similar situation appears to obtain in Russia. In Russia, however, the development of risk capital markets is still impeded by the overall underdevelopment of financial markets. A lack of venture capital, an important resource for innovative businesses, notably in their early stages, can hinder the rejuvenation of the economy through the activities of dynamic entrepreneurs and innovative start-ups.

1.5. The role of innovation in Russia's future economic development

1.5.1. Innovation and long-run growth

The challenge of diversifying Russia's economic structure and reducing its reliance on natural resource sectors has loomed large on the policy agenda for well over a decade.[25] Even during the boom years before 2008, there was widespread awareness that growth was being driven by transitory factors and that steps were needed to facilitate Russia's transition to self-sustaining, investment- and innovation-led growth.[26] Since late 2008, the global financial and economic crisis has underscored the importance of this challenge. Russia was far more seriously affected by the global crisis than the authorities or most other observers had anticipated. Although the contraction in Russia was relatively short, it was extremely sharp, and the ensuing recovery has so far been fairly restrained. The shock of 2008-09 highlighted once again just how reliant Russia remains on primary commodities, particularly oil and gas. It is highly unlikely that an economic model based on exports of primary commodities can deliver a return to the very high growth rates seen in the years before the crisis. Increasing attention has therefore been focused on modernisation and, in particular, innovation, as the keys to Russia's successful long-term economic growth (Box 1.5).

The challenges are enormous, and it is easy to be sceptical of Russia's capacity to bring about such a transformation. However, such a shift would not be unprecedented: few observers in the 1950s or early 1960s would have anticipated the innovative dynamism that drove the growth of countries such as Finland or Korea, that India would emerge as a major player in software development and that China would be on the way to becoming a major power in global R&D. These countries' experience, and that of others, demonstrates the potential of even developing economies to generate step changes in their innovation performance in a comparatively short time. Of course, Russia, or any other country, cannot simply copy the policy mixes or growth trajectories of a Finland or a Korea. Reform strategies and innovation policy must reflect a country's specific institutional and economic context. Even when common problems can be identified, simple "transplants" of policies and institutions from one environment to another rarely take root. Some degree of adaptation is usually required. Nevertheless, the experience of OECD countries in a wide variety of policy domains, including knowledge-creation and innovation, points to considerable potential for policy learning across countries.

Box 1.5. The role of innovation in driving long-term economic growth

Modern economic growth is ultimately founded on innovation (OECD, 2010a). For more than a half-century, it has been clear that innovative activity is the single most important driver of long-term growth. Pioneering studies as long ago as the late 1950s sought to determine the extent to which long-run performance could be explained in terms of increasing inputs of capital and labour. Despite differences in methodology and data coverage, they consistently found that the measured growth of inputs could account for no more than 15-20% of actual output growth over periods of a century or more (Abramowitz, 1956; Solow, 1957; Kendrick, 1962). The balance came from increases in total factor productivity (TFP) – increases in the output generated by a given volume of inputs. This finding, which has been broadly confirmed by a large body of subsequent research (for an overview, see Rosenberg, 2003), points to the overriding importance of innovation – not only technological, but also organisational, financial and institutional – for long-run growth (Donselaar *et al*., 2004; Keller, 2004).

Of course, the large share of TFP in such "growth accounting" exercises is a residual result: it tells us how much growth *cannot* be explained in terms of the growth of inputs of labour and capital. By inference, the balance reflects the greater efficiency with which inputs are employed, but problems for measuring innovative activity make it difficult to quantify the precise contributions of various forms of innovation to overall growth. In general, empirical assessments must rely on indirect or highly imperfect indicators of innovation, such as patent data or R&D spending. Nevertheless, a large and growing body of research in recent years has underscored the link between indicators of knowledge creation and growth. The positive relationship between R&D activity and TFP growth, for example, has been confirmed by numerous studies using both panel and cross-sectional data (Scherer, 1982; Griliches and Lichtenberg, 1984; Aghion and Howitt, 1998; Frantzen, 2000; Griffith *et al*., 2004; Zachariadis, 2003). Science infrastructure and foreign knowledge both enhance productivity growth in developed and developing economies alike (Coe *et al*., 1997; Guellec and van Pottelsberghe, 2001; World Bank, 2006). Although some evidence suggests that the link between domestic R&D investment and innovation is far stronger in large developed economies (Ulku, 2004), there is good evidence that R&D spillovers from developed countries have positive effects on the TFP growth of developing and transition economies (Coe *et al*., 1997; Griffith *et al*., 2004).

Studies on the determinants of growth (OECD, 2001, 2003a) highlight the role of investment in ICT and human capital, combined with more efficient and innovative ways of producing goods and services. The development of ICT spurs innovation and economy-wide productivity growth via three main channels: growth of both output and productivity in ICT-producing sectors; greater use of ICT in the production of other goods and services; and spillover effects arising as a result of complementary innovations (*e.g.* organisational innovation) in conjunction with increased use of ICT (OECD, 2003b; Hempell, 2002; Van der Wiel, 2001).

Many countries, particularly those engaged in rapid "catch-up", have at times sustained high growth rates for relatively long periods through factor mobilisation rather than growth along the TFP-dominated trajectory described above (Krugman, 1994). As is well known, the Soviet Union followed such a path. While Soviet planners succeeded for quite some time in sustaining growth via labour mobilisation and capital accumulation, Soviet performance in respect of TFP growth appears to have been consistently low. As the Soviet system matured, it became ever harder to identify and mobilise new reservoirs of labour. Since nothing could be done about growth of the labour force except in the very long term, there was an acute need to substitute capital for labour and to raise TFP growth. Easterly and Fischer (1994) argue that the inability to do this was the Achilles' heel of the Soviet economy. Indeed, they find that, controlling for investment and human capital, Soviet growth during 1960–89 was the worst in the world and that its relative performance worsened over time. In other words, ever higher rates of investment were required to sustain declining rates of growth. Ofer (1987) estimates that TFP growth actually turned negative from 1970, reflecting both poor resource allocation and the system's inability to stimulate innovation.

Post-Soviet Russia passed through a phase of relatively easy "recovery growth". For a number of years after the transitional recession that lasted until 1998, enterprises were able to raise output and productivity very rapidly, on the basis of little investment or innovation, by drawing on existing under-employed stocks of capital and labour. The economic reforms of the 1990s and early 2000s made an important contribution, as the efficiency of capital, labour and product markets increased dramatically. Such a growth trajectory, however, was only possible for a limited period.[27] Enterprise surveys suggest that capacity constraints began to bite in many sectors by 2005. By 2006 or so, the most efficient enterprises had also largely shed their excess labour, so the scope for further "cheap" TFP growth was limited (OECD, 2009a). Finally, although the economic reform agenda remained substantial, the "easiest" gains from market-oriented reforms had been realised by the mid-2000s: for all its structural weaknesses and problems, Russia had become a market economy. If it is to sustain strong growth over the longer term and to diversify its production and export structure away from reliance on raw materials, Russia must generate higher returns from investments in human capital and ICT and by fostering knowledge creation.

This conclusion is reinforced by the comparative analysis of Sala-i-Martin *et al.* (2010), who argue that, as countries grow richer, the determinants of their competitiveness change. Initially, they compete primarily on the basis of factor endowments, before moving to an efficiency-driven stage of development, in which the key factors include the country's human capital, the efficiency of its financial, labour and product markets, and the quality of its institutions. Finally, the most advanced countries come to depend on their ability to generate commercially useful new knowledge and thus to produce new and unique processes, products and services. They, like others, identify Russia as one of the countries that now face the challenge of making the transition to an innovation-driven growth model. The problem is that there is still a great deal of unfinished business at the second stage – in terms of quality of institutions and market efficiency – that will make the transition to the third stage particularly difficult.

1.5.2. Russia's innovation imperative

In addition to the foregoing general considerations on the role of innovation as a driver of economic growth, there are a number of specific reasons why Russia might benefit from improved innovation performance. These include the need to diversify the structure of production and exports, demographic challenges and the need for cleaner, more energy-efficient growth.

Innovation could facilitate diversification and help Russia build on its strengths

It is well known that Russia's economy is heavily dependent on a limited range of natural resource sectors. In 2008, primary products accounted for 85.4% of total exports, of which oil and natural gas constituted the largest share (69.7%), followed by metals and precious stones (13.2%). Machinery, equipment and vehicles accounted for just under 5%. Russia's export performance in most other sectors is disappointing. Overall, its global market shares in pharmaceuticals, electronics and office machinery/computers were all below 1% in 2008. The corresponding figures for aerospace and instruments were around 3-4%. Resource sectors loom far larger in Russia's export structure than they do in the structure of GDP or employment – the oil and gas sector together account for around 20% of GDP and roughly 1% of employment – but they have been crucial to growth since the end of Russia's recession in 1999. Oil-price movements alone are estimated to account for as much as half of Russia's growth during the decade between the crises of 1998 and 2008 (Guriev and Zhuravskaya, 2010). Movements of other commodity prices were also important. This is not to deny the very real contribution of the economic reforms of the 1990s (Ahrend and Tompson, 2005), but it does suggest that, without the oil boom, Russia's performance in the early 2000s would have been rather lacklustre by the standards of large emerging markets. Moreover, while the large share of hydrocarbons in GDP owes something to movements in international prices, a recent assessment based on physical volumes (output of primary energy per unit of GDP at PPP exchange rates) shows that the relative weight of energy production in Russia's economy is roughly six times the OECD average and eleven times the average of the EU27. It is in fact rather closer to the OPEC average (IEA, 2009).

This energy dependence raises a number of problems. A growing body of empirical research suggests that countries endowed with great natural resource wealth tend to lag behind comparable countries in terms of long-run real GDP growth, a finding that has given rise to widespread debate about a so-called "resource curse" or a "paradox of plenty".[28] Explanations focus on a wide range of economic and political factors. The most prominent lines of argument emphasise the impact on the competitiveness of other tradables ("Dutch disease"); the impact of commodity-price volatility, particularly on fiscal revenues; and the interaction of commodity-price volatility with financial market imperfections, which can lead to inefficient specialisation.[29] Resource dependence also looms large in any discussion of structural reforms, as resource-dependent development can complicate efforts to build new institutions (Tompson, 2006). The Russian authorities have long been aware of these dangers, but despite their efforts to use fiscal policy to shield the domestic economy from the consequences of commodity-price movements, the Russian economy showed many signs of succumbing to these economic pathologies prior to the crisis. As noted above, growth was increasingly linked to oil prices, and by 2008 the fuel and energy sector's share of federal budget revenues had reached 43%.[30] OECD (2009a) drew attention to the emergence of real estate bubbles and other undesirable secondary effects of the oil boom.

This structure of growth can hardly be maintained over the long term, particularly because the resource sector's contribution to growth has in recent years been driven more by price increases than by rising production volumes (OECD, 2006a, 2009a). This makes Russia very vulnerable to fluctuations in commodity prices. While the prices of oil and other commodities remain high by historical standards, even following the crisis,[31] it is important to recognise that it is changes to the terms of trade that affect economic growth rather than their level. To be sure, the impact of such changes may be felt over time (the impact of oil-price changes in one period may still be felt in subsequent periods), but a price-driven growth pattern requires continually rising prices, hardly a realistic expectation. If prices stabilise, even at very high levels, the growth effect will eventually dissipate, as the economy adjusts to the new terms of trade. Moreover, in terms of production volume, given the current state of producing fields and existing depletion rates, Russia will need innovation and technical modernisation to sustain, let alone to increase, oil and gas output over the long run (Ahrend and Tompson, 2006; UNDP, 2010). While often seen as a very "traditional" industrial sector, the oil and gas industry is increasingly "high-tech", owing to the growing need to tap unconventional sources and to develop fields in very difficult environments. Russia will thus need innovation not only to develop new economic strengths but also to make the most of those it already has. There is no contradiction between an innovation/diversification agenda and the desire to continue to develop Russia's hydrocarbon resources. The example of Norway has shown that innovation capability developed around the hydrocarbon sector can be a springbooard for the development of new products and services (OECD, 2007b).

Finally, common sense suggests that, given Russia's population and human capital endowments, a flourishing non-resource urban sector is likely to be crucial to long-term social and political stability. As Sutela (2005) observes, Russia can never become a northerly Kuwait. Its resource sectors alone will never be able to provide an acceptable standard of living for the great mass of the population, even under extreme assumptions about future resource prices and Russia's ability to increase resource extraction. This points to the need for diversification in directions that will create more high-productivity employment.

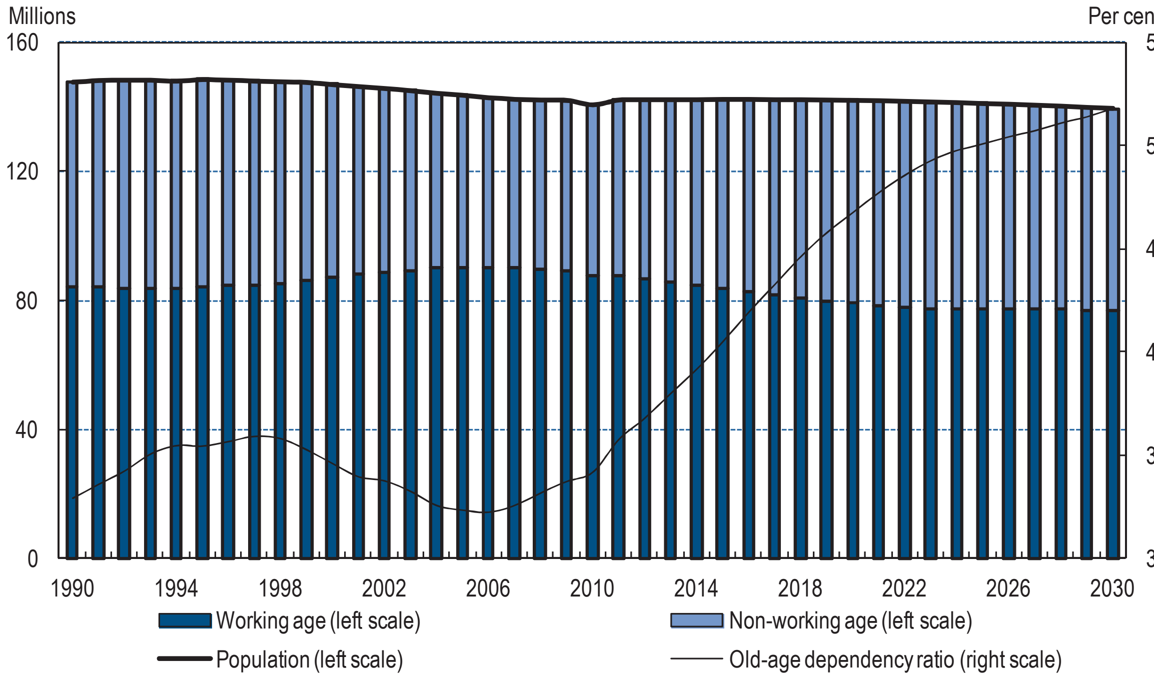
Demographic trends point to the need for sustained strong productivity growth

The second reason why Russia needs to shift to a more innovation-oriented development track stems from its demographic challenges. In many respects, it has a particularly problematic combination of demographic trends that are typical of both developed and developing countries.

- Russian women, like their counterparts in the developed countries, are bearing far fewer children than a generation ago: the total fertility ratio (TFR) fell from 2.0-2.2 in the 1980s to 1.16 in 1999, before recovering to an estimated 1.49 in 2008.[32] While the rise in the TFR over the last decade is welcome news, it is not expected to rise much further. The very sharp drop in the 1990s that was associated with the trauma of Russia's transitional recession is now in the past, and official demographic projections are based on the belief that Russian households have shifted towards long-term fertility patterns characteristic of most other European countries and will not return to the levels of fertility seen in the late Soviet era.
- Russian mortality rates, by contrast, are typical of countries with far lower levels of *per capita* income. They remain extremely high by the standards of both regional peers and OECD countries. Despite some improvement in recent years, mortality rates in 2008 were still more than 30% above the levels of 1990; while cohort effects account for some of this rise,[33] the official data show that mortality rates were higher in 2008 than in 1990 – in some cases, substantially higher – for men in all age groups between 20 and 70, and for women between 20 and 60. The share of deaths from infectious diseases, which are traditionally related to living standards, is also high for a country at Russia's level of *per capita* income, and the incidence of tuberculosis and other "poverty-related illnesses" remains high, although viral hepatitis infection rates have fallen.

The combination of these two trends has led to a declining population and falling life expectancy. Despite significant immigration, the total population decreased by around 6.4 million between 1991 and 2010. The baseline scenario of Rosstat's demographic forecast envisages a further decline of around 3 million by 2030 and its "low-growth" variant, which closely matches the UN projection for Russia, envisages a drop of up to 14.5 million.[34] Life expectancy at birth has recovered from the very low levels of the mid-1990s, but it remains very low by the standards of both regional peers and OECD countries: 61.8 years for men and 71.6 years for women in 2008, as compared with OECD averages of 76.2 and 81.8 years, respectively. It is not only average life expectancy that is exceptionally low for a country at Russia's level of development: healthy life expectancy, as estimated by the World Health Organization (WHO), is very low as well, compared to the regional average. The gap is particularly large for Russian women. Their average life expectancy at any given age is higher than that of Russian men, but they also tend to spend much more of their lives in ill health.[35]

Figure 1.10. Demographic trends, 1990-2030



Note: Figures for 1990-2010 are actual. Figures for 2011-30 are projections.

Source: Federal Service for State Statistics, OECD calculations.

This is not to suggest that there has been no improvement in recent years. While life expectancy overall has not yet risen much from the lows of the 1990s, there has been a significant rise in the average life expectancy of persons diagnosed with chronic illnesses over the last decade; this suggests that the economic recovery and rising health-care expenditure have had a positive impact. Nevertheless, on current projections, labour-force growth will remain negative for the foreseeable future: the working-age population is set to decline by almost 14 percentage points by 2030. On Rosstat's baseline scenario, the old-age dependency ratio will rise by 19 percentage points and the overall dependency ratio (children as well as the elderly) will rise by nearly 24 percentage points (Figure 1.10). Both average hours worked and participation rates are already comparable to OECD levels, so the potential for increasing the labour supply through these channels is limited. More promising would be to extend Russians' working lives, by raising the retirement age from its current level of 55/60 for women/men: as OECD (2004) argues, this will be necessary in any case, if pension replacement rates are to be maintained at acceptable levels.[36] A gradual increase in retirement ages would make it easier to raise replacement rates without greatly increasing the burden on the working population. However, even if such a policy led to the activation of half of the elderly population – a change that would also depend on raising healthy life expectancy substantially – the labour force would shrink by around 10 million, and the old-age dependency ratio would continue to rise.

Given the limited room for manoeuvre with respect to the labour supply, therefore, sustaining strong productivity growth will be crucial for rapid catch-up and for ensuring the sustainability of the pension system. This will require a combination of capital deepening and increases in TFP. The key to the former lies in raising Russia's investment rate, which is low by the standards of the advanced OECD economies, and spurring innovation.

Innovation is necessary to improve environmental performance and energy efficiency

The environmental challenges facing Russia constitute another important reason to raise innovation performance. A recent Russian analysis highlights a number of long-term environmental challenges over the next two decades (Safonov, 2008). These include:

- Rising energy consumption. On current trends, rising consumption will imply substantial growth in coal-fired heat and power generation, in an environment with few incentives to install pollution-reduction equipment or modern technologies.
- Growing pollution from industrial sources, especially in urban areas. At present, atmospheric pollution is estimated to cause up to 40 000 deaths annually among the urban population (UNDP, 2010).
- Increasing greenhouse gas emissions.
- Water-pollution. Safonov (2008) cites evidence that the quality of drinking water could deteriorate if action is not taken.
- Threats to biodiversity as a result of economic development.
- Questions about the sustainability of forest resources.

The Russian authorities are aware of these challenges, and, in March 2010, the Security Council asked the government to draft measures for adaptation to global climate change, which has now been identified as an issue of national security. Yet the green growth/innovation nexus involves more than addressing threats: there are also opportunities to be seized. Its role as a major producer of hydrocarbons notwithstanding, Russia has considerable potential in the field of renewable energy, which is now seen as a major source of long-term innovative development (UNDP, 2010). Renewables could represent a particularly important development opportunity for rural areas, especially in the far east and the north, which have suffered from poor economic performance and large-scale out-migration since the 1980s.

Closely linked to the question of climate change and environmental quality is the issue of energy efficiency. Russia has in recent years made great progress in eliminating artificially low energy tariffs for households and businesses, possibly the most important step that can be taken to reduce wasteful use of energy.[37] It also reduced the energy-intensity of GDP (energy consumed per unit of output) by around 2.5% a year during 1990-2007, a far faster rate than in the leading OECD economies (OECD/IEA, 2009). Nevertheless, there is more to be done. The energy intensity of GDP in Russia in 2008 was estimated to be somewhat more than double the world average (in PPP terms) and triple the European average (Charap and Safonov, 2010). The improvement since 1990 appears primarily to reflect structural change, rather than improvements in technical efficiency: the industrial capital stock inherited from the Soviet era is highly energy-inefficient, and buildings in Russia typically consume 50-100% more energy per square metre than buildings in similar climates in the OECD area.[38] The government estimates that the country could reduce energy consumption per unit of output by a further 40-50% from the levels of 2000 ("Energeticheskaya strategiya", 2003; World Bank, 2008; OECD/IEA, 2009). In November 2009, a new law on energy efficiency reached the statute books, with a strategy to encourage energy saving over the period to 2020. There is an obvious link between increased energy efficiency and reduced greenhouse gas emissions. Policies creating significant incentives for enterprises to invest in cleaner, more energy-efficient technologies could thus pay substantial dividends. However, their ability to do so successfully will depend on the creation of conditions that favour technology transfer and innovation.

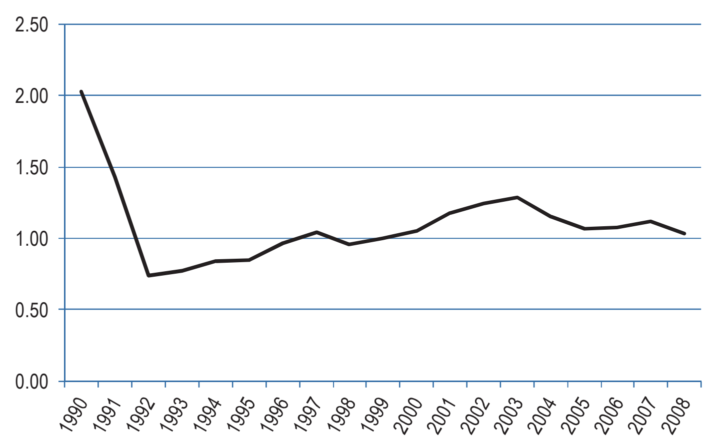
1.6. Innovation performance

This section provides an overview of the performance of the Russian innovation system, outlining major trends and developments. As far as possible, it allows comparing Russian innovation performance to that of OECD (and occasionally other non-member) countries. It covers indicators of the main innovation inputs – including R&D spending, human resources and ICT investments – followed by an assessment of innovation outputs, including scientific publications and patents. It finishes with a brief overview of the regional distribution of R&D and innovation activities.

1.6.1. Gross domestic expenditure on R&D

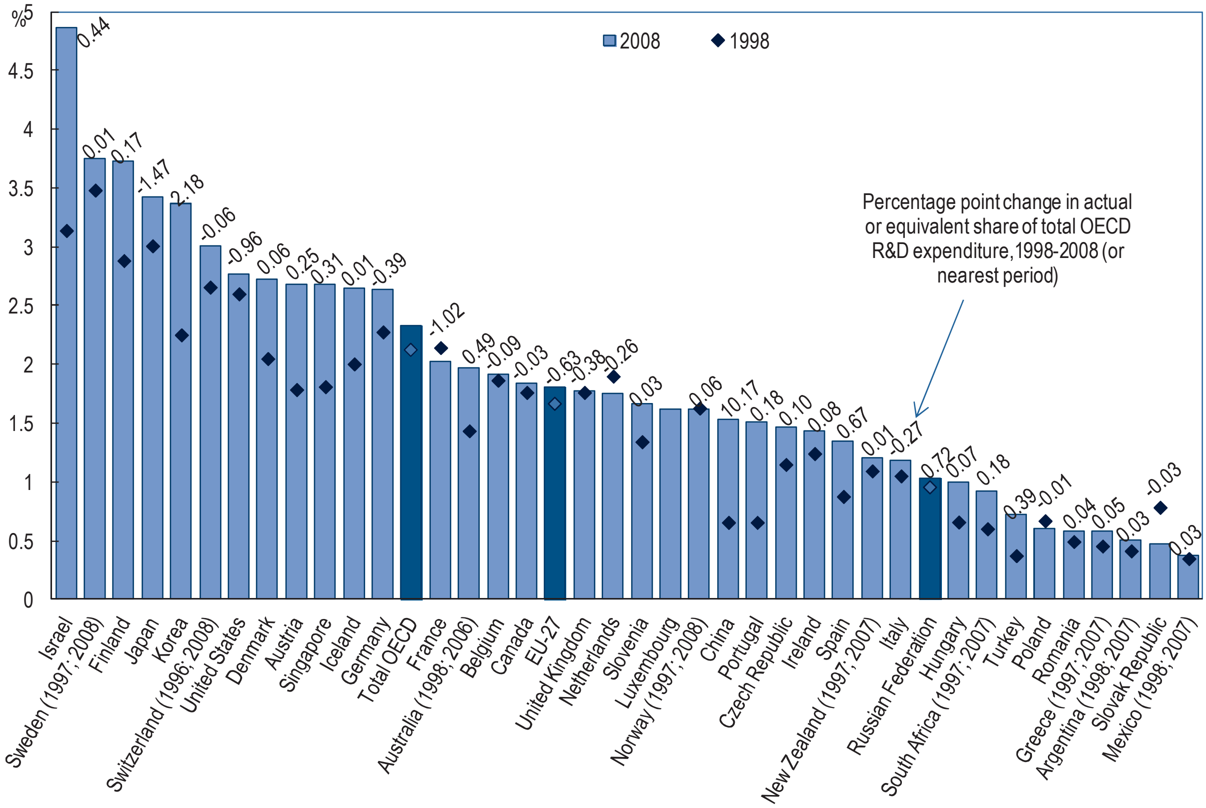
The level of gross domestic expenditure on R&D (GERD) as a percentage of GDP has climbed slowly after the initial shock of the early 1990s (Figure 1.11). In 2008, GERD accounted for 1.03% of GDP, down from more than 2% during the late Soviet period. It has also fallen more recently from a 2003 peak of 1.28%. This recent decline can be explained by robust growth in GDP, which has tended to outstrip growth in GERD, rather than by decreased spending on R&D. Indeed, among OECD countries, only Korea had a larger percentage point increase in its share of total OECD R&D expenditure over the ten-year period to 2008 (Figure 1.12). Nevertheless, the Russian GERD/GDP ratio is well below levels seen across the OECD, where the average stands at 2.33%.[39] This reflects both Russia's emerging economy status (more developed economies tend to be more R&D-intensive so as to remain at technological frontiers) and its industrial structure, which is dominated by extraction industries with traditionally low R&D intensities.

Figure 1.11. Evolution of gross domestic expenditure on R&D as a percentage of gross domestic product



Source: *OECD Main Science and Technology Indicators 2010/1*.

Figure 1.12. Gross domestic expenditure on R&D as a percentage of gross domestic product in selected countries



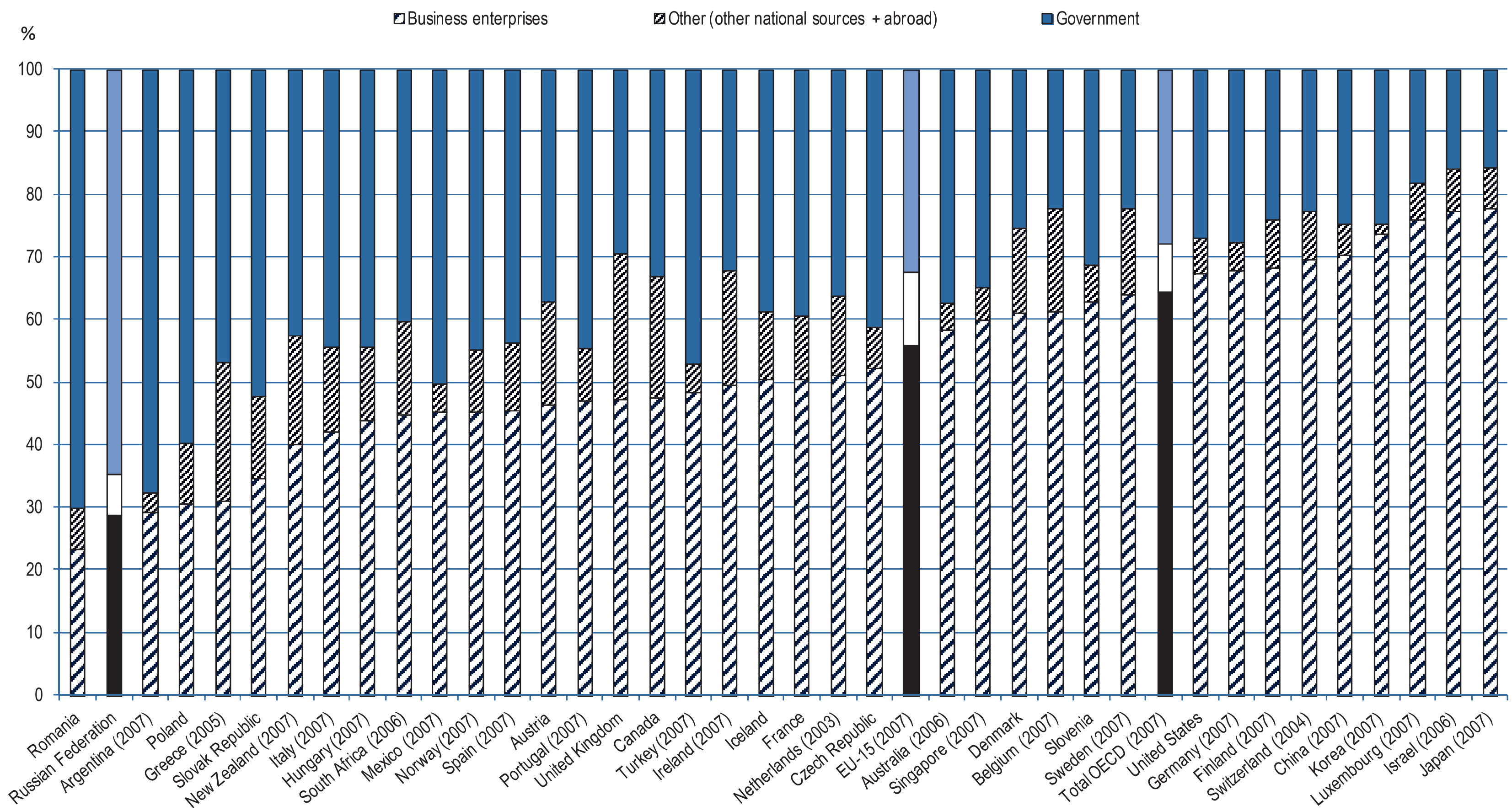
Note: In Israel, defence R&D is not covered. Furthermore, humanities and law are only partially covered in the higher education sector. Owing to the lack of a comprehensive business register for South Africa, R&D expenditure may be underestimated by 10% to 15%.

Source: OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

Another major contributing factor to Russia's low R&D intensity is the low level of financing by the business sector. As Figure 1.13 shows, the government contributed approximately two-thirds of GERD in 2008, the percentage contributed by the business sector on average in OECD countries. This pattern has changed little over the last 15 years, except during the 1998-99 crisis, when the proportion of government funding fell dramatically (Figure 1.14). Since then, the proportion of government's contribution to GERD has increased steadily. In 2008, it surpassed the 1994 level to reach 65% as a result of recent increases in budget expenditures on R&D. The business sector is the second highest contributor to GERD, but the proportion of its contribution has declined steadily over the last 15 years (Figure 1.15) to around 29% in 2008, a figure well below the OECD average of 65%. The proportion of funding from abroad, the third most important contributor to GERD, increased sharply during the 1990s but then fell back and stabilised in the 2000s to a level close to the OECD average (Figure 1.16).

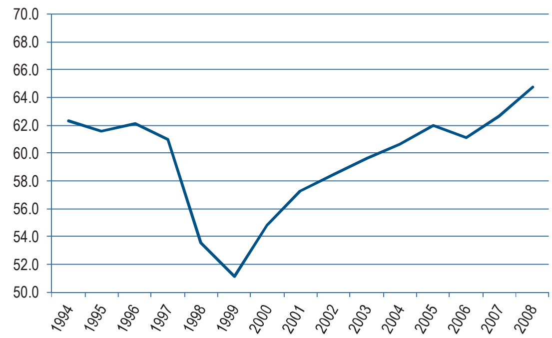
While source of funding is one useful way to analyse GERD, another is to examine the sectors in which R&D is actually performed. Although it is by far the largest funder of R&D, the government sector is not the main performer of R&D. The business sector carried out 63% of Russia's R&D in 2008. The government sector performed 30% of Russian GERD and higher education institutions around 7% (Figure 1.17).

Figure 1.13. R&D expenditure by source of financing in selected countries (2008)



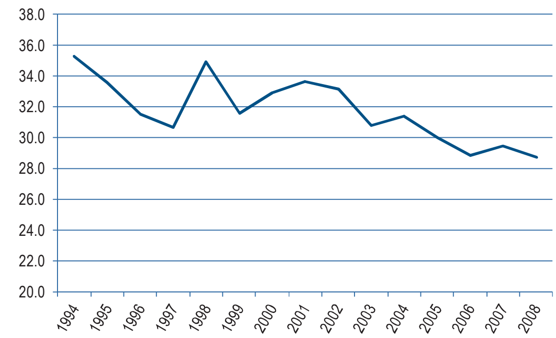
Source: OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

Figure 1.14. Percentage of GERD financed by government



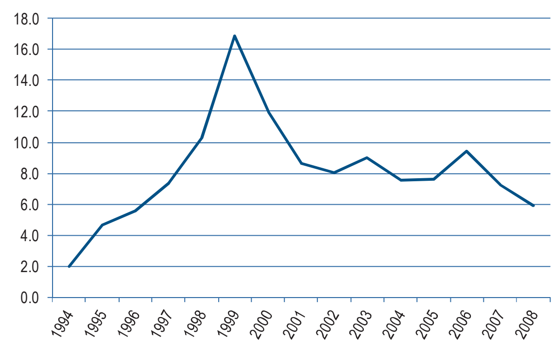
Source: OECD Main Science and Technology Indicators 2010/1.

Figure 1.15. Percentage of GERD financed by business



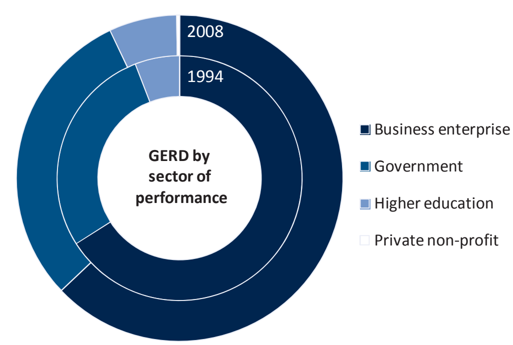
Source: OECD Main Science and Technology Indicators 2010/1.

Figure 1.16. Percentage of GERD financed from abroad



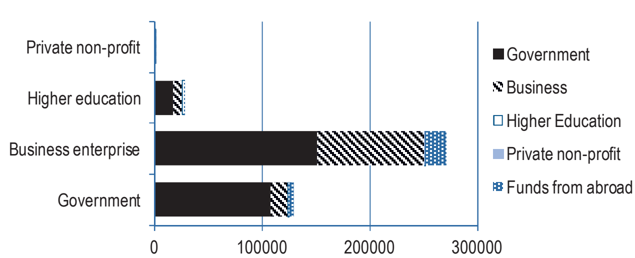
Source: OECD Main Science and Technology Indicators 2010/1.

Figure 1.17. GERD by sector of performance



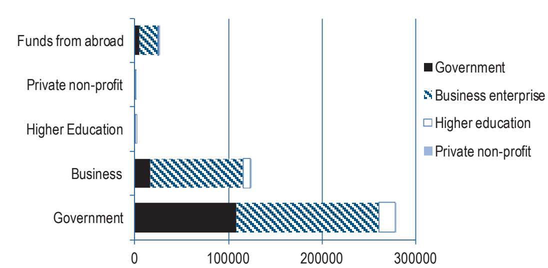
Source: OECD Main Science and Technology Indicators 2010/1.

Figure 1.18. Target sectors of R&D financing from different sources (million RUB), 2008



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.19. Sources of finance for R&D in different sectors of performance (million RUB), 2008



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

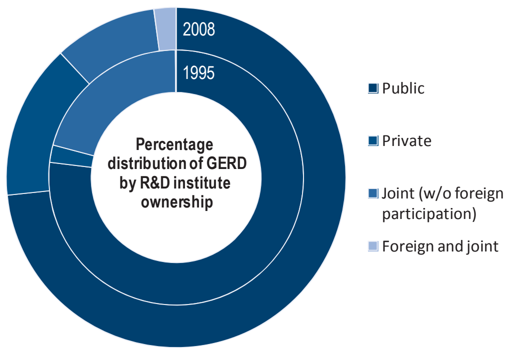
This unusual, almost inverse, relationship between R&D funding and performance is mostly accounted for by the large share of government funding spent in the business sector (Figure 1.18). In 2008, some 54% of government funding was spent in this way, while 39% went to the government sector and just 6% to higher education institutions. Unsurprisingly, the vast majority (80%) of the business sector's funding remained within the sector, while 13% went to the government sector and 7% to higher education institutions. Similarly, 76% of funds from abroad were spent in the business sector, 20% in the government sector and just 3% in higher education institutions.

Taking each of the main sectors in turn (Figure 1.19), in 2008, 56% of expenditure on R&D in the business enterprise sector (BERD) came from government sources, 37% from the business sector and 7% from abroad; 83% of government intramural expenditure on R&D (GOVERD) came from the government, 12% from business and 4% from abroad; and 62% of expenditure on R&D in the higher education sector (HERD) came from government sources, 29% from business, 6% from own resources and just 3% from abroad. In all three main performing sectors, the government is the largest funder of R&D.

The large contribution of government funding to BERD appears to be particularly anomalous when compared to the situation in OECD countries, where the vast majority of BERD is funded by the business sector. The explanation lies in the ownership of R&D institutes and assets. Public ownership extends to almost three-quarters of R&D institutes (Figure 1.20),[40] 86% of R&D machines and equipment (Figure 1.21) and 88% of R&D fixed assets (Figure 1.22). This is evidence that much of the R&D capacity in the Russian business sector is in fact publicly owned and still largely supported by direct government funding. This highly unusual arrangement – at least by OECD country standards – is a legacy of the Soviet science system and its relation to industrial production. During that period, R&D was organisationally segmented according to fundamental, applied and developmental research and was largely separate from production (the arrangements are discussed more fully in Chapter 2). More specifically, various research institutes – working on both fundamental and applied research – were (and remain) the main type of R&D performer. They were joined, along a projected linear path of development, by R&D-performing design organisations, construction project and exploration organisations, experimental enterprises, and industrial (production) enterprises.[41]

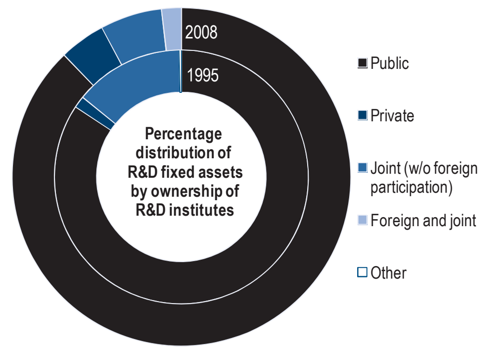
The proportions of the different types of R&D institutes have changed significantly since the Soviet era (Figure 1.23). In 1991, for example, there were 4 564 R&D institutes, of which 40% were research institutes (essentially institutes of the various academies of science and the so-called "branch" institutes of various government departments and agencies), 20% were design organisations, 12% construction project and exploration organisations, 10% higher education institutions and 9% industrial enterprises. The 1990s saw an overall decrease of 10% in the number of R&D institutes, but some types fared much worse than others. Those closer to the end of the "pipeline" decreased drastically: the number of design organisations decreased by two-thirds, construction project and exploration organisations by 85%, and industrial enterprise R&D institutes by almost one-third. As Figure 1.24 shows, much of the decline occurred during the chaos of the early transition years.

Figure 1.20. Percentage distribution of GERD by ownership of performing institutes



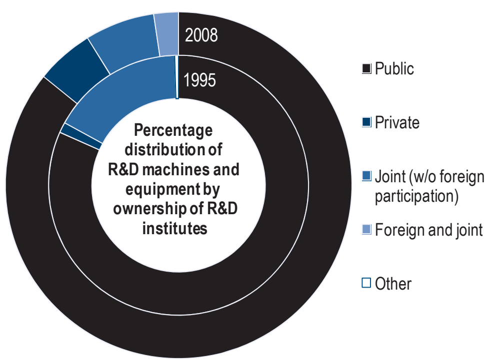
Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.21. Percentage distribution of R&D fixed assets by ownership of R&D institutes



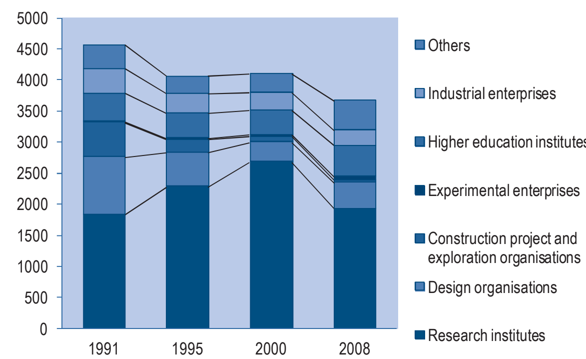
Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.22. Percentage distribution of R&D machines and equipment by ownership of R&D institutes



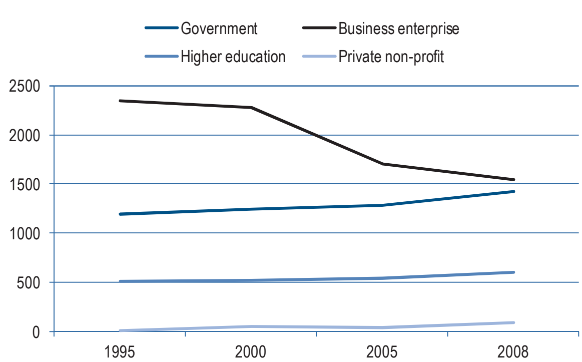
Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.23. Number of R&D institutes by type



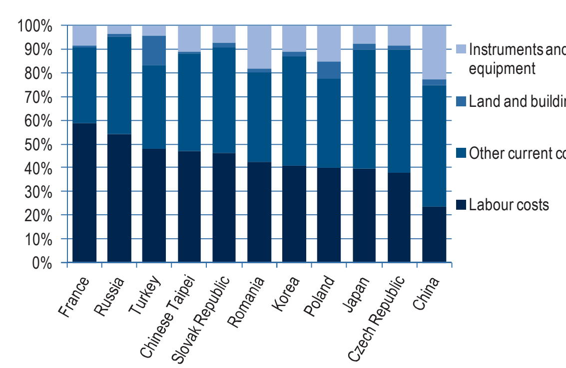
Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.24. Number of R&D institutes by sector of performance



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.25. GERD by type of costs in selected countries (2008 or nearest year)

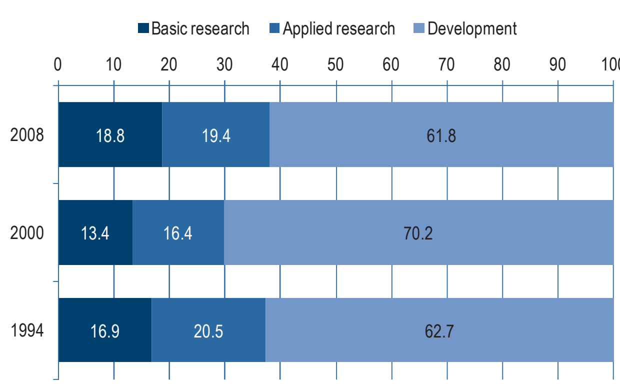


Source: OECD.Stat. *http://stats.oecd.org*

By contrast, the number of research institutes increased during the 1990s – by 47% – and constituted around two-thirds of all R&D institutes by the turn of the millennium. This was the result of the partial reorganisation and fragmentation of research institutes, particularly among the branch institutes. At the same time, the number of research institutes of the various academies of science remained relatively stable, owing to the academies' successful preservation strategies. However, over the 2000-08 period, the number of research institutes fell by 28% to account for just over half of all R&D institutes by 2008. Again, the number of research institutes of the various academies of science remained relatively stable. Much of the decrease can be ascribed to shrinkage and consolidation among branch institutes and the re-designation of several as design organisations, which explains the growth in number of the latter (Figure 1.24). The number of industrial enterprise R&D institutes has continued to decrease, though at a slower rate than in the 1990s; they represented 7% of the total in 2008. The number of higher education institutions engaging in R&D increased by 29% over the period to more than 500 in 2008, for 14% of the total.

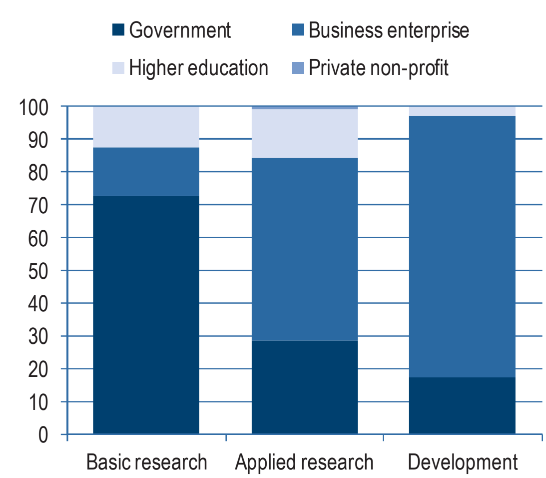
In 2008, more than half of Russian GERD went towards paying direct labour costs and another 40% to other current costs (Figure 1.25). Just 3.4% was invested in instruments and equipment, the lowest level among the selection of countries shown in Figure 1.25.[42] These figures are indicative of a general lack of investment in R&D infrastructure over the last couple of decades; equipment has consequently become worn out and/or obsolete. As Chapter 3 points out, the government is currently seeking to rectify this long-standing neglect of spending on infrastructure but has a long way to go to modernise its thousands of facilities.

Figure 1.26. Percentage distribution of intramural current expenditure on R&D by type of activity



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.27. Percentage distribution of intramural current expenditure on R&D by type of activity and sector of performance (2008)



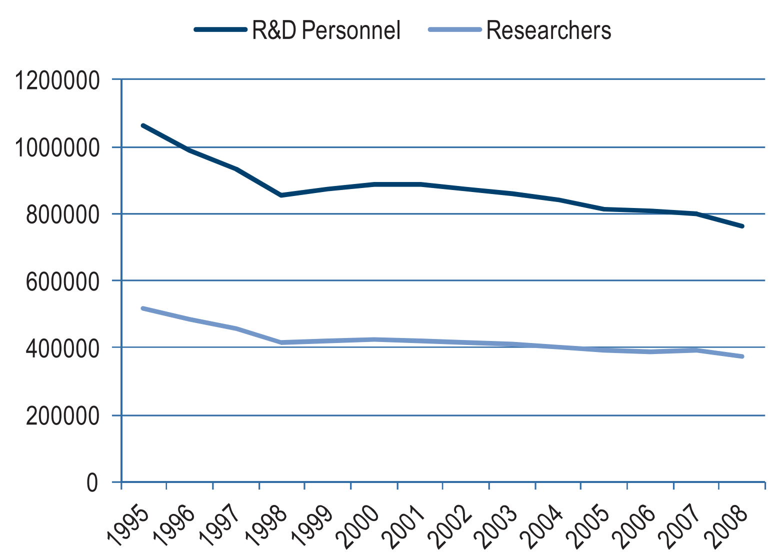
Source: CSRS (2010), *Russian Science and Technology at a Glance*, Centre for Science Research and Statistics, Moscow.

The proportion of GERD going to basic research, applied research and experimental development is broadly similar to the ratios in many large OECD countries. The proportions have fluctuated slightly over the last 15 years or so, with a relative decline in basic research during the 1990s when many R&D institutes sought to compete in more near-market development activities (Figure 1.26). The proportion of basic research funding has since recovered and currently stands at around 19% of GERD, more than 70% is carried out in the government sector, mostly by the various academies of science (Figure 1.27). It is noteworthy that the business sector is responsible for a larger share of basic research (15%) than the higher education sector (12%), owing to the still weak role of the latter as research performer. As expected, the business sector is by far the largest performer of applied research and development – much of which is carried out in the branch institutes and design bureaus – but the government sector is also a major performer of these types of R&D.

1.6.2. R&D personnel

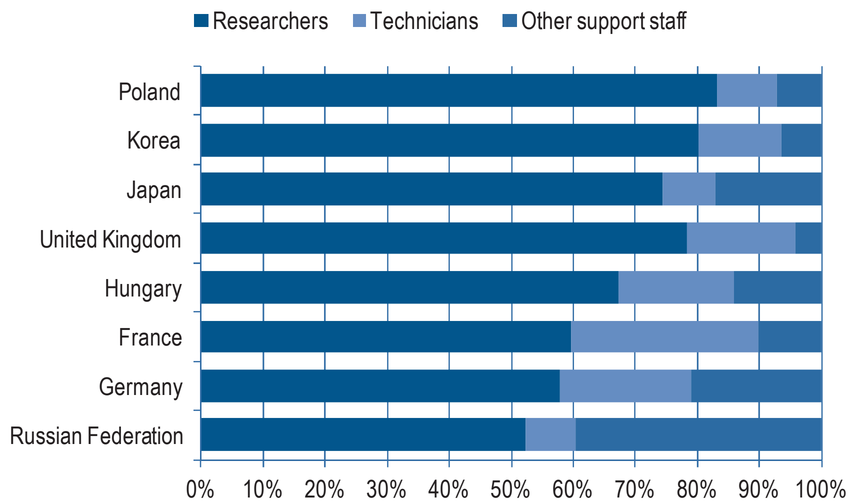
Perhaps more than changes in the number and sectoral distribution of R&D institutes, changes in R&D personnel provide a dynamic picture of the scale and nature of R&D activity. As Figure 1.28 shows, the number of R&D personnel has continued to decline, to 761 252 in 2008. Of these, around one-half were researchers. Figure 1.29 shows this to be a rather low proportion by international standards. Moreover, the proportion of support staff, at almost 40% of total R&D personnel, is much higher than in other countries. The reasons for this are not altogether clear but it is suggestive of a system laden with too many administrators. Russia had 6.4 researchers per thousand total employment in 2008, close to an OECD average of 7.6 and higher than several countries that spend significantly more of their GDP on R&D, *e.g.* the Netherlands and Switzerland (Figure 1.30). This finding can be interpreted in various ways, but a likely explanation is that many R&D personnel in Russia remain under-utilised.

Figure 1.28. Total R&D personnel (headcount)



Source: HSE (2010) *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.29. R&D personnel by occupation in selected countries (percentage)



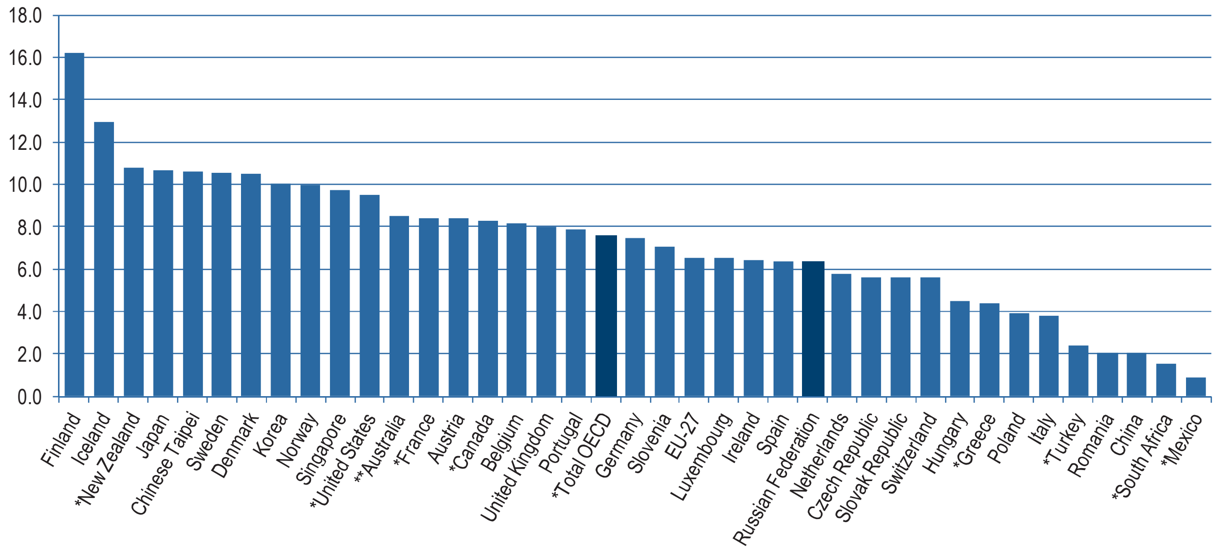
Note: 2008 data for France, Germany, Japan and Korea; 2009 data for the Russian Federation, Hungary and Poland; 2010 data for the United Kingdom.

Source: OECD MSTI 2010/1.

The distribution of R&D personnel across sectors of performance broadly aligns with the distribution of R&D expenditures by sector, though the data show some shift over the last 15 years or so (Figure 1.31). The proportion of R&D personnel in the business sector declined by almost 10% to 59% of the total in 2008, while those in the government sector grew by almost the same amount to 34% of the total. This reflects the relative decline of the branch and other business-oriented R&D institutes, as noted above. The proportion of R&D personnel employed in the higher education sector remains small by OECD standards at just 6.3% in 2008, though this represents an increase from 4.9% in 1995, owing to the government's recent attempts to strengthen the R&D capabilities of universities.

Similarly, the distribution of R&D personnel by ownership of R&D institutes is broadly aligned with the distribution of R&D expenditures by ownership (Figure 1.32). The only important shift over the last 15 years or so has been the decline in the proportion of R&D personnel employed in joint public-private institutes as a result of full privatisation. Nevertheless, at a little under 10% of the total, the private sector remained a relatively minor employer of R&D personnel in 2008.

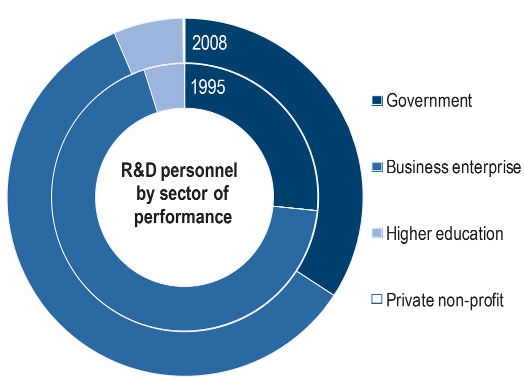
Figure 1.30. Total researchers (full-time equivalent) per thousand total employment in selected economies (2008)



*2007 data. **2006 data.

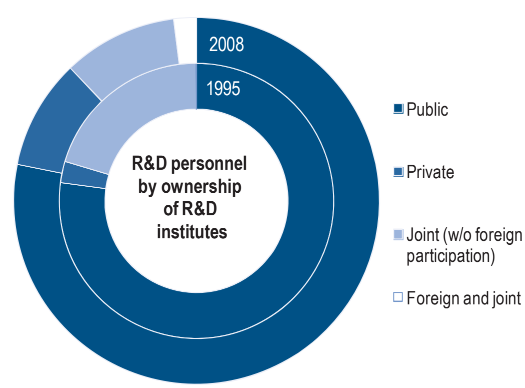
Source: OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

Figure 1.31. R&D personnel by sector of performance



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

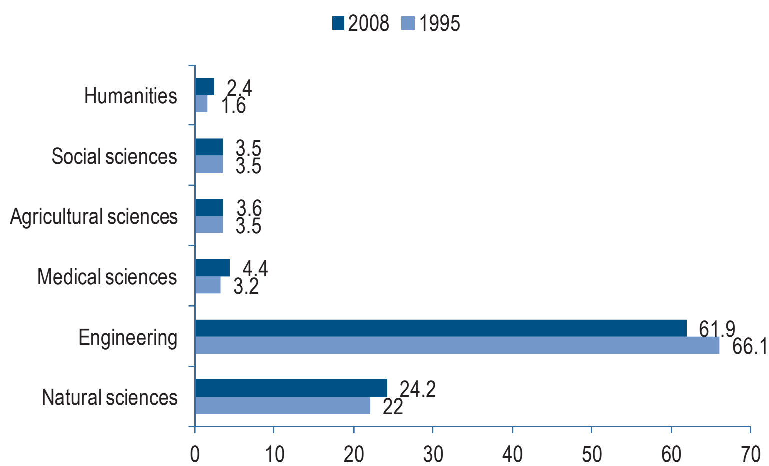
Figure 1.32. R&D personnel by ownership of R&D institutes



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

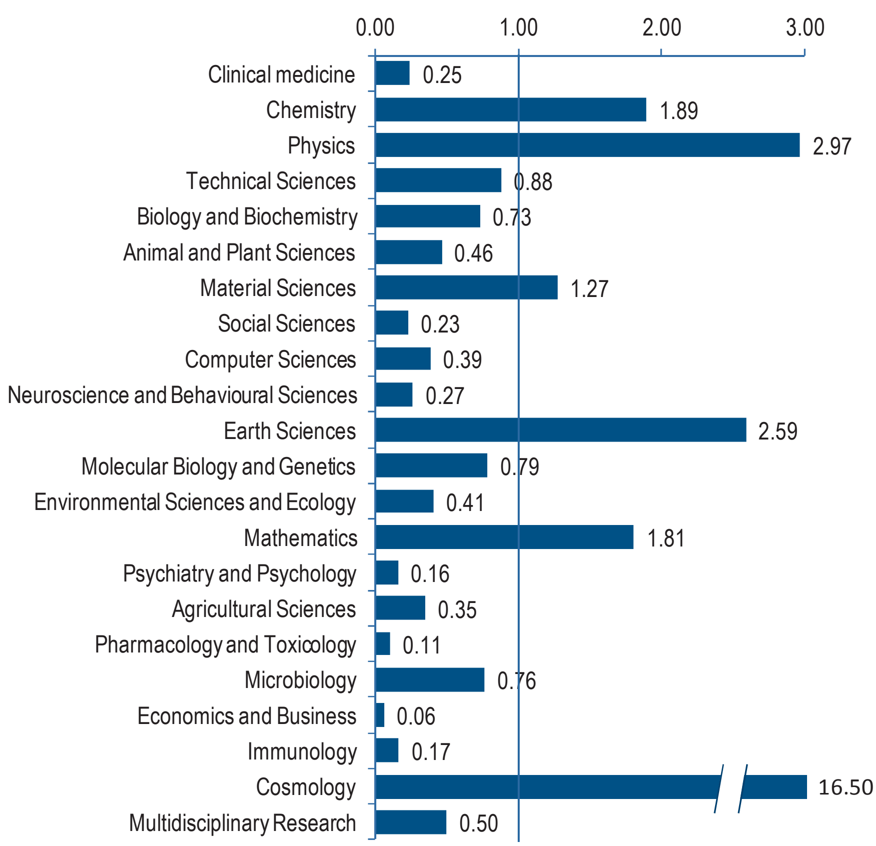
Around 62% of researchers in Russia worked in the engineering field in 2008, a slight drop since 1995 (Figure 1.33) on account of the relative decline of the industrial R&D institutes. Natural sciences account for about one-quarter of researchers, owing to a slight increase over the last 15 years. The dominance of engineering reflects the specialisation of the Russian economy and the Soviet legacy of a research system geared to the needs of the military-industrial complex. Scientific publication data by disciplinary field confirm a strong bias towards the physical sciences (physics, chemistry and Earth sciences) and mathematics and a relatively weak presence in biological, medical and social sciences (Figure 1.34).

Figure 1.33. Percentage of researchers by fields of study



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 1.34. Research specialisation index

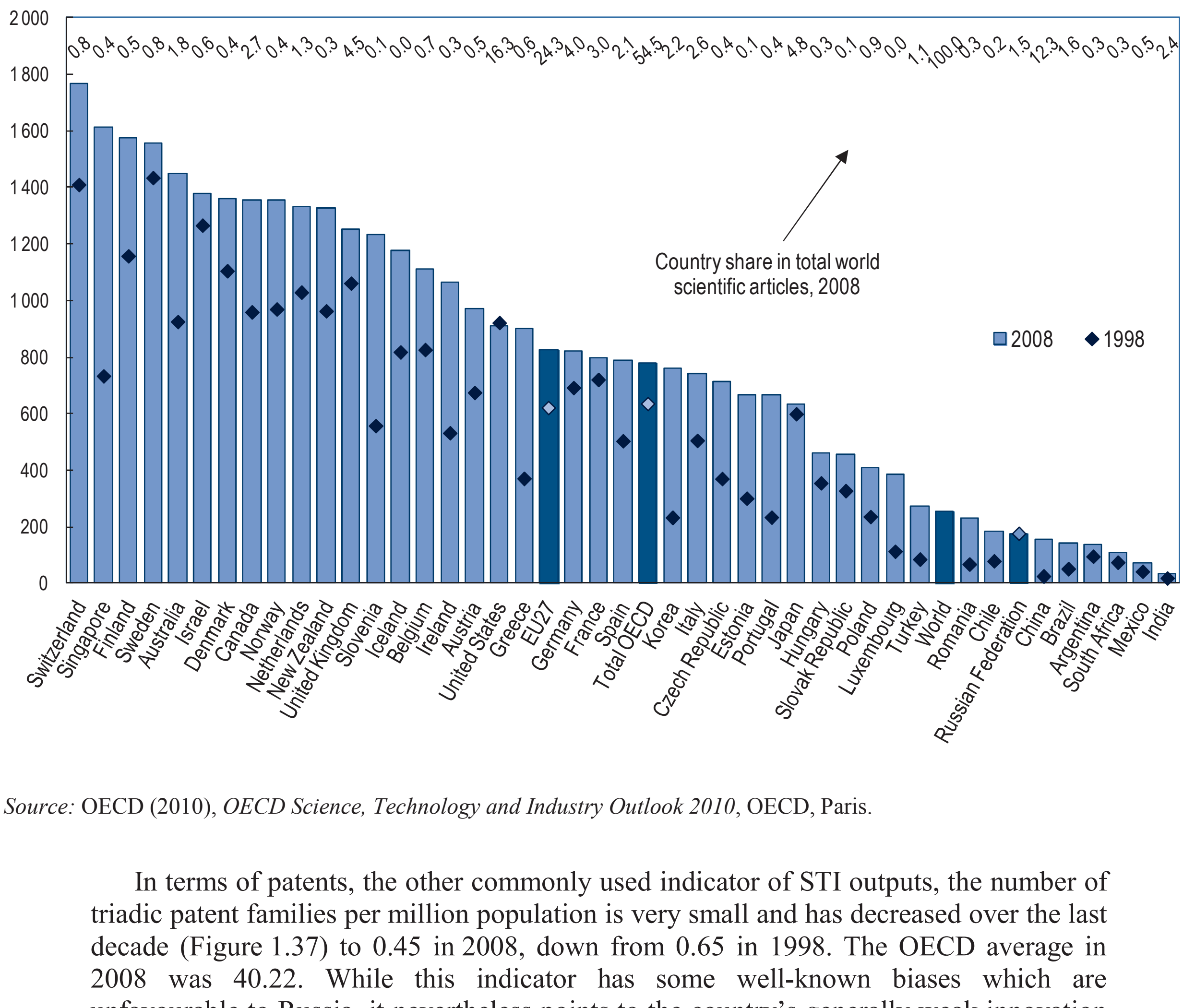


Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

1.6.3. Indicators of science, technology and innovation outputs

The outputs of science, technology and innovation activities are multiple and often difficult to capture quantitatively. A couple of commonly used, although limited, indicators focus on outputs of scientific articles and patents. Figure 1.35 shows that Russia published 176 articles per million population in 2008, a very slight increase on its 174 articles per million population in 1998. This figure is rather low by OECD standards and amounts to just 1.5% of world scientific articles. It also represents a relative decline. Figure 1.36 shows that the number of articles published by Russian researchers has stagnated over the last decade while almost all major scientific publishing countries have seen some, often significant, increases. The figure also shows that Russian researchers are less strongly networked internationally than their counterparts in most other countries, although the situation seems to have improved over the last decade.

Figure 1.35. Number of scientific articles per million population for selected countries

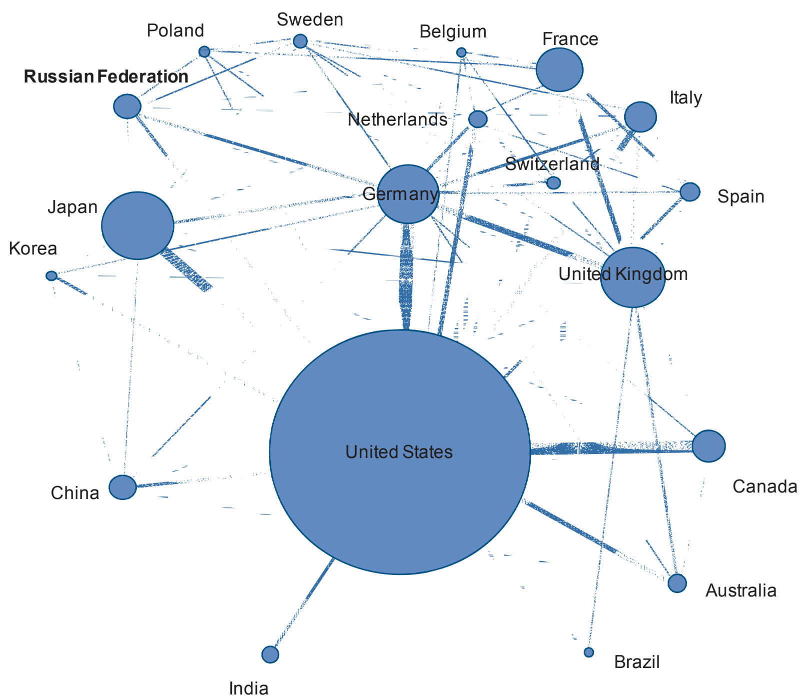


Source: OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

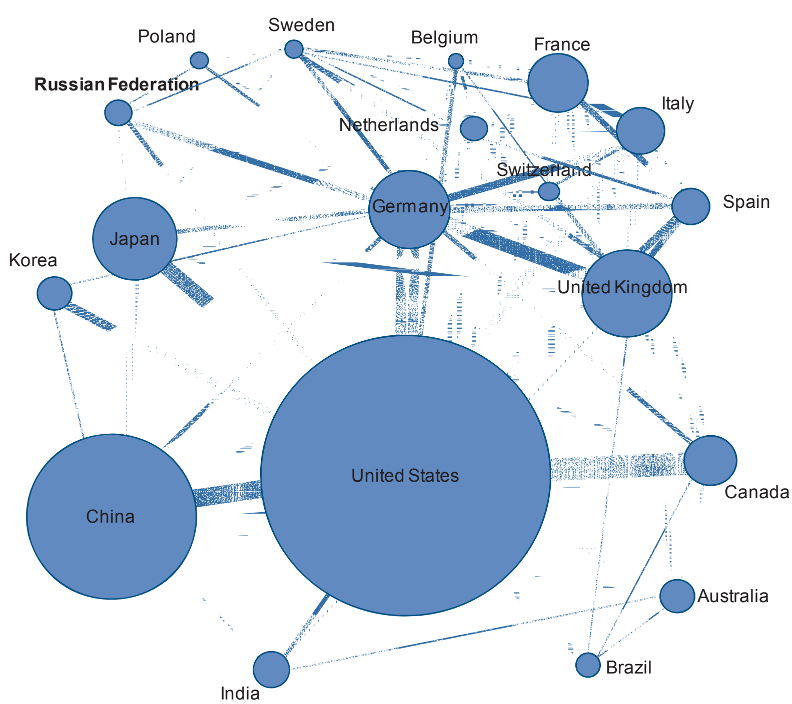
In terms of patents, the other commonly used indicator of STI outputs, the number of triadic patent families per million population is very small and has decreased over the last decade (Figure 1.37) to 0.45 in 2008, down from 0.65 in 1998. The OECD average in 2008 was 40.22. While this indicator has some well-known biases which are unfavourable to Russia, it nevertheless points to the country's generally weak innovation performance.

Figure 1.36. Scientific publications and co-authored articles, 1998 and 2008

1998

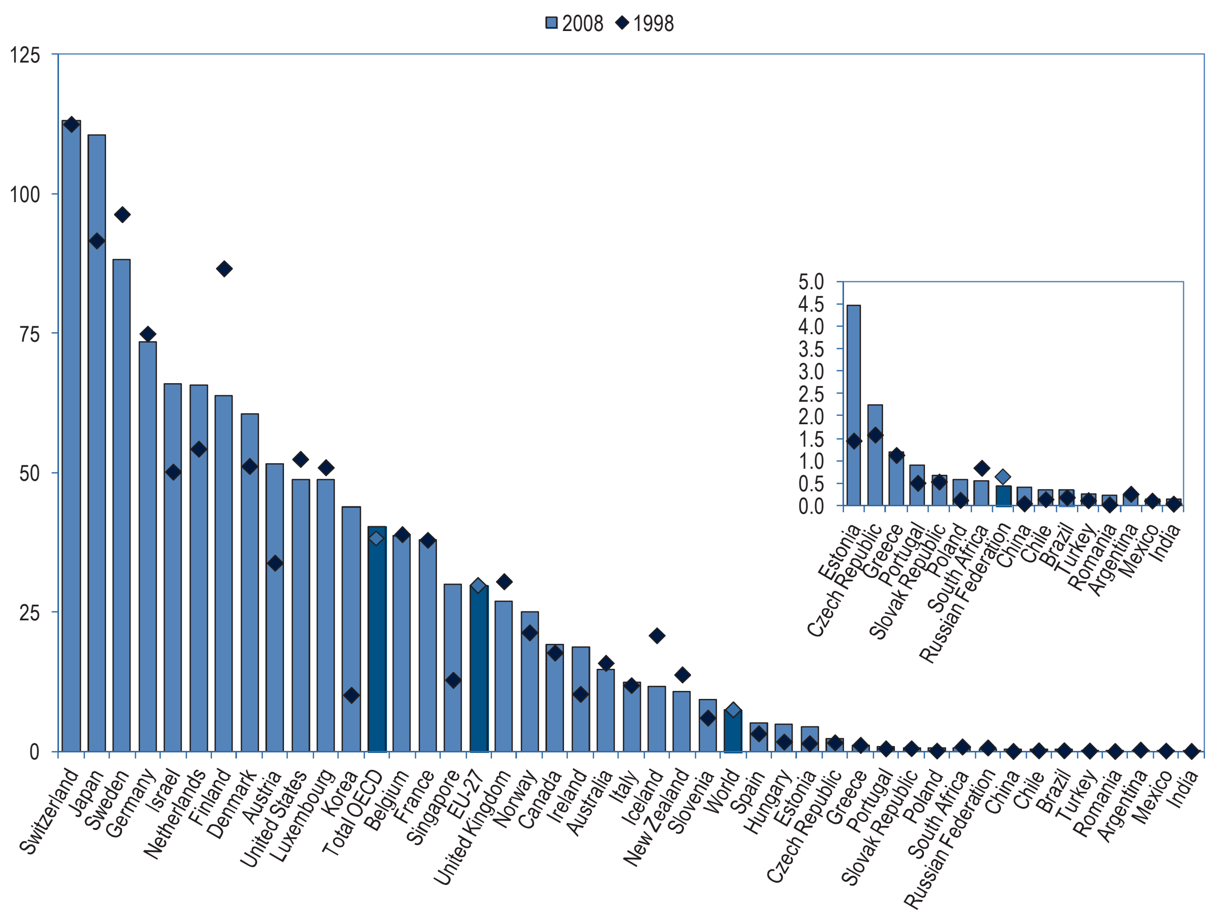


2008



Source: OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

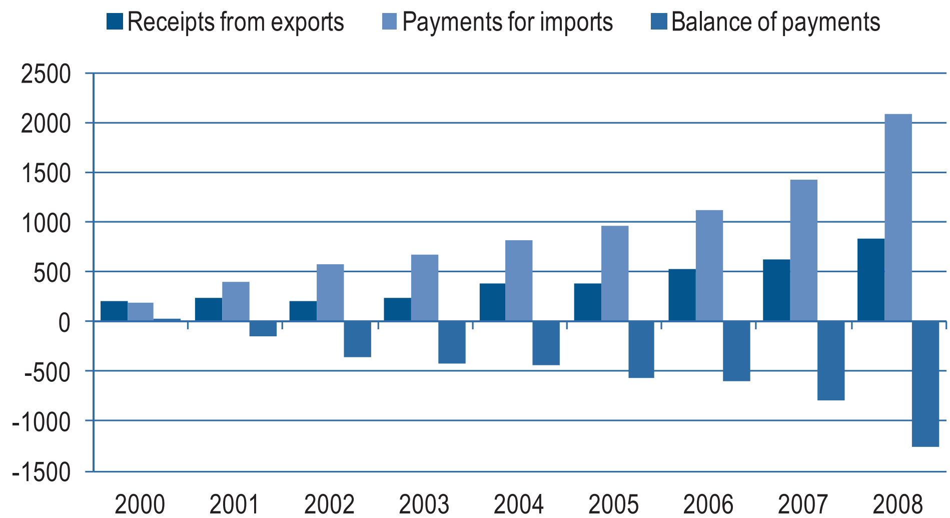
Figure 1.37. Triadic patent families per million population



Source: OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

Technology balance of payments (TBP) data, which register the international flow of industrial property and know-how (*e.g.* through patent purchases and licensing, trademarks, technical services, etc.), show a rapid increase in payments and receipts in recent years, an indication of the growing internationalisation of Russian industry (Figure 1.38). Russia runs a sizeable TBP deficit with the rest of the world and payments were about 2.5 times receipts in 2008 (Table 1.5). Engineering services are the most traded, representing 59% of receipts and 55% of payments and accounting for 53% of the TBP deficit. Transactions involving trademarks represented 19% of payments in 2008 and accounted for 31% of the TBP deficit. Figure 1.39 shows that almost 80% of payments were made to OECD countries. By contrast, OECD countries accounted for just over 40% of receipts, with the majority coming from other CIS and middle-income/emerging economies. This would seem to confirm Russia's intermediate technological position: most of its technology imports arrive from more technologically advanced countries and most of its technology exports go to those that are less technologically advanced. The main exception is R&D, which represented 18% of receipts and ran a surplus of more than USD 120 million in 2008 as a result of the off-shoring of R&D services to Russia by multinational enterprises. It indicates Russia's strong comparative advantage in R&D.

Figure 1.38. Technology balance of payments



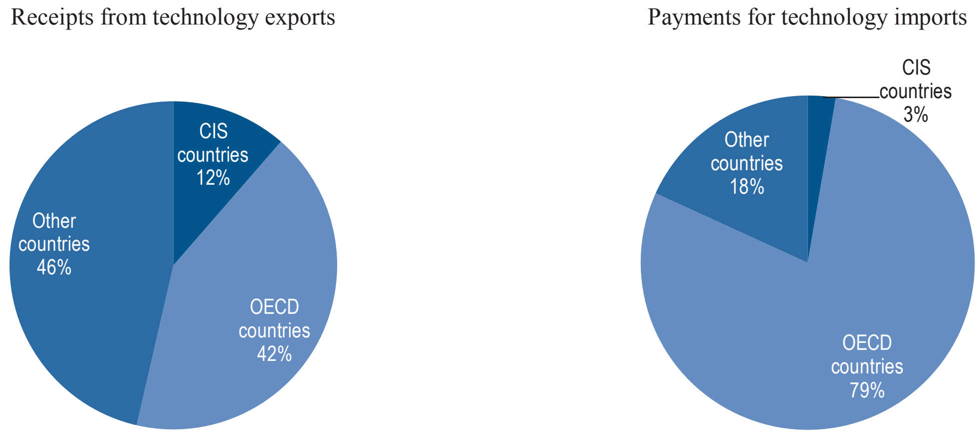
Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Table 1.5. Technology balance of payments by category of contracts, 2008 (million USD)

Category of contract	Receipts from exports	Payments for imports	Balance of payments
Patents	0.1	10.7	-10.6
Non-patent inventions	–	0.02	-0.02
Patent licences	5.2	63.0	-57.9
Utility models	3.8	0.7	3.1
Know-how	9.7	43.3	-33.6
Trademarks	17.7	408.3	-390.7
Industrial designs	3.8	–	3.8
Engineering services	491.7	1156.8	-665.2
R&D	151.5	31.0	120.4
Others	149.8	373.1	-223.3
Total	**833.2**	**2087.1**	**-1253.9**

Source: CSRS (2010), *Russian Science and Technology at a Glance*, Centre for Science Research and Statistics, Moscow.

Figure 1.39. Percentage distribution of technology exports and imports in Russia by country groups, 2008



Source: HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

1.6.4. The regional dimension of R&D

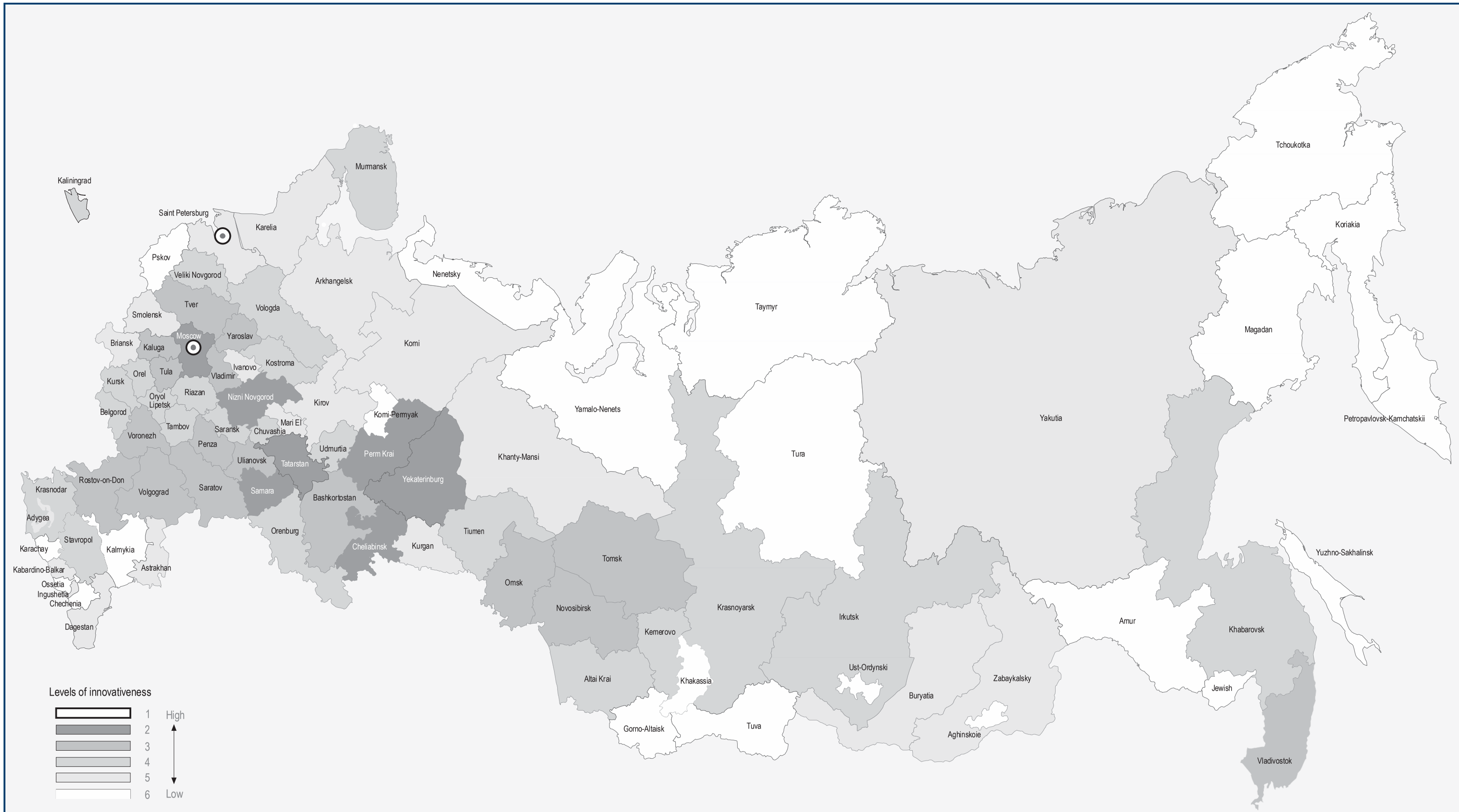
Russian innovation and research activities are geographically concentrated around the main population centres of Moscow, Saint Petersburg and the Volga District, which account for 57.4% of Russia's population and perform 82.3% of its GERD (Figure 1.40). The dominant position of the Central District, which includes Moscow, explains much of this disparity. This region alone accounts for more than half of Russia's GERD and R&D personnel and almost half of its patent applications. There are 208 R&D personnel per 10 000 population in this region, a much higher proportion than anywhere else, particularly in the less developed Southern and Far Eastern Districts, where proportions are less than one-fifth of that in the Central District. Figure 1.41 provides both a more aggregate and finer picture of innovation in the 80 regions of Russia using a composite 'innovation index'.[43]

Figure 1.40. Regional innovation statistics

Federal districts	Higher education				R&D				Patents
	Population (% of total, 2002)	Enrolments (thousands, 2008-09)	Graduates (thousands, 2008)	Enrolments in doctoral studies (2008)	Number of R&D institutions (2008)	R&D personnel (2008)	R&D personnel per 10 000 employment (2008)	Gross domestic R&D expenditures (million roubles, 2008)	N° of applications by residents (2008)
1. Central	26.2	2 380	432	1 486	1 445	396 272	208	238 762	13 377
(of which Moscow)	*n.a.*	*(1 313)*	*(243)*	*(996)*	*(787)*	*(246 612)*	*(n.a.)*	*(165 775)*	*(8 700)*
2. North-Western	9.7	761	139	669	533	99 556	146	58 586	2 420
(of which St. Petersburg)	*n.a.*	*(459)*	*(85)*	*(595)*	*(361)*	*(81 654)*	*(n.a.)*	*(48 686)*	*(1 895)*
3. Southern	15.7	993	187	506	321	33 633	36	13 582	2 904
4. Volga	21.5	1 488	271	666	549	120 644	82	57 149	4 279
5. Ural	8.6	622	107	199	220	43 695	72	24 654	1 537
6. Siberian	13.7	953	168	625	429	53 956	59	28 690	2 647
7. Far-Eastern	4.6	316	55	91	169	13 496	41	9 650	539
Total Russia	100.0	7 513	1 359	4 242	3 666	761252	n.a.	431 073	27 712

Source: CSRS (2010), *Russian Science and Technology at a Glance*, Centre for Science Research and Statistics, Moscow.

Figure 1.41. Levels of innovativeness of the regions of the Russian Federation



Source: Ministry of Education and Science of the Russian Federation (2009), “Background Report prepared for the OECD Review of the Russian Innovation System and Policy”, Moscow.

1.7. Conclusion

Over the past two decades, Russia has made significant progress along various dimensions of socio-economic development. Most importantly, it has succeeded in making the transition towards a market-based economy and has made important progress in managing and stabilising the macroeconomy. In the years before the recent economic crisis, Russia enjoyed high and sustained growth. The recession that followed has exposed the weaknesses of Russia's growth model – notably its continued dependence on natural resources – and the need to shift towards a more innovation-driven growth trajectory. Important shortcomings need to be addressed if Russia wants to effect such a transition. These shortcomings include, among others, exceptions to the rule of law, corruption, overly restrictive regulations, a lack of competition in many parts of the economy, underdeveloped supporting institutions, for example for financing innovation. Taken together, adverse framework conditions create an environment in which incentive structures do not encourage long-term and inherently risky productive activities such as business investment in R&D and innovation.

Although the country has a substantial science base and a well developed education system in science and technology, indicators of actual innovation activity indicate modest performance. Russia performs best on international comparative innovation indices when they are weighted towards inputs into R&D; it performs less well on indices that emphasise revealed technical achievement; and it ranks worst of all on indices emphasising economic incentives.[44] Overall, there is an imbalance between the public resources devoted to knowledge creation and outputs in terms of innovation. Closing this gap constitutes one of the primary challenges for Russian innovation policy. The other is to stimulate greater private-sector involvement in R&D.[45]

In this context, the emphasis on spurring innovation that has been evident in Russia over the last couple of years is to be welcomed. The country's innovation potential is unusually great for a country at its level of per capita GDP but it needs to be developed to become a significant source of growth. Achieving this potential should undoubtedly be a major emphasis of government policy. Innovation can act as a driver of productivity and economic growth, and an improvement in Russia's innovation performance can also help to meet the need to diversify the structure of production and exports, the demographic challenges that confront the country, and the need for cleaner, more energy-efficient growth.

In order to boost innovation, the government will have to ensure macroeconomic stability and, more broadly, strengthen framework conditions for innovation through policies that facilitate innovation and enhance overall economic performance. Indeed, sound framework conditions should be seen as the *sine qua non* condition for success, since innovation promotion efforts will almost certainly fail if the overall business environment is not conducive to long-term investment in new activities. The potential gains from improvements in framework conditions appear to be high, exceeding those of most OECD countries.

At the same time, creating favourable framework conditions will not suffice to turn Russia into a leading innovator. There is a clear need and scope for policies to address market and systemic failures that hamper innovation. The following chapters – focusing on the main actors of the Russian innovation system, their interlinkages and the role of government in fostering innovation – will discuss, among others, current capabilities, policy orientations, and the mix of policies and instruments in place. They will shed light on areas in which specific innovation policy initiatives may be warranted and existing policy could be improved.

Notes

1. It is important to note that this partly reflected differences in the evolution of various price deflators: OECD (2009a) notes that investment grew by 12% a year in real terms from 1999 through 2008, far faster than GDP, but the relatively slow increase in the investment deflator compared to the deflators for other components of GDP (especially export prices) left the investment-to-GDP ratio little changed.
2. The forecasts included those of the OECD, the EBRD, the IMF, UBS, Citigroup, Renaissance Capital, Merrill Lynch, the Vienna Institute WIIW, HIS Global Insight, Troika Dialog, the Economist Intelligence Unit, Kopint-Tarki, UniCredit MIB, Dresdner Bank, Raffeisen Zentralbank, JP Morgan and Goldman Sachs; in December 2008, all but JP Morgan (with a 0.0 forecast) anticipated growth in 2009.
3. Measures aimed at bolstering trust in banks included raising deposit insurance ceilings, guaranteeing interbank loans to smaller banks and bringing several small banks into state ownership.
4. Such concerns are reinforced, among other things, by the presidential commission's consideration of mandatory R&D expenditure targets for state companies and its emphasis on further expansion of innovation infrastructure (more business incubators, more R&D centres, etc).
5. The data are available on the KOF (Swiss Economic Institute) Index of Globalization website: *http://globalization.kof.ethz.ch*. For a more detailed description, see Dreher *et al.* (2008).
6. It should be recognised however, that it is increasingly difficult to distinguish between "foreign" and "local" investment in the context of global capital markets and given the existence of Russia's large round-tripping flows (OECD, 2008a). Round-tripping refers to the channelling of funds abroad, with the purpose of subsequently returning them as FDI to the domestic economy (Filippov, 2008). Russian companies, seeking to circumvent domestic regulatory restrictions, often use offshore locations in Europe or other regions as a base for re-investment to Russia. The position of some major partner countries reflects their role as a source of round-tripping flows (OECD, 2008a).
7. Several studies have emphasised the positive impact of foreign-performed R&D and FDI on domestic total factor productivity (Guellec and van Pottelsberghe, 2001; EBRD, 2005; Hemmings, 2005), and FDI restrictions are found to have a negative impact on patenting (OECD, 2006b). See also the survey on FDI spillovers by Crespo and Fontoura (2007).
8. Values of the RCA index above 1 indicate a comparative advantage, values below 1 a comparative disadvantage. When the RCA index is above 1 the country is said to be specialised in the industry concerned.
9. For example, improved patent protection only works in the official economy. While strengthening such protection may, at the margin, increase incentives for firms to operate in the formal sector, it is likely to achieve little if the state is otherwise acting in ways that encourage businesses to retreat into the shadow economy. Likewise, the impact of policies aimed at assisting innovation-oriented start-ups will depend in part on the conditions for establishing new businesses in any sphere.
10. As noted by the World Bank (2011a), the Doing Business methodology has some limitations. Among others, these are the scope of factors that are important to business and covered in the survey. For reasons of international comparability, the indicators refer to a specific type of business, generally a local limited liability company operating in the largest business city.
11. The degree of concentration usually serves as a proxy for competition. See Nickell (1996) and Blundell *et al.* (1999).

12. Interestingly, the survey also highlights huge variance in firm productivity. This gap reflects in particular different attitudes towards innovation and the restructuring of production.
13. Import-competing industries are defined as industries in which the share of imports exceeds 30%.
14. Calculated on the basis of 119 markets, for which data from Rosstat are available for both 2001 and 2007. Concentration ratios are calculated using the HHI and CR3 methodologies. A highly concentrated industry is defined as one in which the Herfindahl-Hirschmann Index (HHI) is greater than 2000.
15. See CEFIR (2007) for details of the sixth round of the joint World Bank/CEFIR monitoring of the administrative burden on small business.
16. Discriminatory procedures for procurement/tenders are especially common. Given the potential role of public procurement in stimulating demand for innovation, this must be viewed as a problem.
17. Russia is hardly unique in this respect: Jaumotte and Pain (2005a) confirm the adverse effect of rigid regulations on business sector R&D expenditure and on the level of patenting in OECD countries.
18. This section was prepared in consultation with the OECD Trade and Agriculture Directorate.
19. More information on the structure and function of Rospatent can be found at (as of 21 March 2011): *www1.fips.ru/wps/wcm/connect/content_en/en/about_rospatent/*.
20. These include the Berne Convention and the Geneva Convention in 1995, the Madrid Protocol in 1997, the Trademark Law Treaty in 1998 and the Rome Convention in 2003. In February 2009, Russian membership in the so called WIPO Internet Treaties, the WIPO Copyright Treaty and the WIPO Performances and Phonograms Treaty, which a number of OECD members have ratified, entered into force. Russia also ratified the Singapore Treaty on the Law of Trademarks in 2009.
21. However, implementation of some of the commitments has been slow, and discussions between the US and Russian governments to ensure the full implementation of this agreement are still under way.
22. Estimates put the piracy rate in business software in Russia at 73% in 2007 (BSA, 2007).
23. These include: a law on data exclusivity to bring domestic legislation in line with international practice under the WTO TRIPS Agreement concerning the protection of pharmaceutical data; a law on business licences establishing the right of ownership over optical disc manufacturing equipment, which makes it possible for a court decision to revoke such a licence; amendments to Part IV of the Civil Code to bring it into conformity with the TRIPS Agreement and the Singapore Treaty, which for example addresses an issue relating to registered domain names blocking registration of trademarks; and amendments to the Customs Code providing *ex officio* authority to the customs.
24. Part IV of the Civil Code has a number of deficiencies which may hamper the ability of enterprises to protect trademarks even on paper. These deficiencies may have also enabled various forms of registration piracy. Amendments to the legislation on trademarks remain necessary to bring Russia into conformity with the TRIPS Agreement and the Singapore Treaty. These amendments include both those already proposed and in the legislative process and those suggested by international organisations.
25. It is worth noting that this was one of the priority tasks set out in the programme of Russia's first post-Soviet government in 1992.
26. For recent discussions of this issue, and Russia's limited progress in moving away from resource-dependent growth, see OECD (2006a, 2009a) and Kuboniwa (2009).

27. In fact, the overall capacity utilisation rate is almost certainly higher, perhaps by as much as 20 percentage points (OECD, 2006a; Åslund *et al*., 2010), than that usually presented (*e.g.* OECD, 2009a), as enterprises in many sectors retain on their books fixed assets inherited from the Soviet era that it will probably never again be profitable to employ.

28. See the classic statement of the resource curse hypothesis by Sachs and Warner (2001); on the paradox of plenty, see Karl (1999).

29. For an overview of these explanations, with particular emphasis on the issue of weak financial markets, see Hausmann and Rigobon (2003).

30. Oil and gas revenues include the natural resource extraction tax and export duties for oil, oil products and natural gas, as well as corporate income taxes, value added tax (VAT), excise fees and other charges paid by companies in the sector.

31. Baffes and Haniotis (2010) estimate that international energy prices in early 2010 were somewhat more than 250% of the levels in 2000, despite the impact of the global downturn.

32. Birth rates have been somewhat more volatile and have attracted far more attention in public discussions. However, birth rates are extremely sensitive to cohort effects; it is the total fertility ratio that really matters.

33. The population is ageing, which implies, *ceteris paribus*, a rise in the mortality rates.

34. Even on the "high-growth" scenario, the natural rate of change (via births and deaths) is expected to remain negative; it is higher immigration that might allow for overall population growth.

35. Healthy life expectancy for Russian women is actually *lower* at age 65 than it is for men, even though their life expectancy at that age is almost four years longer.

36. Although life expectancy at birth is much lower in Russia than in most European countries, this reflects higher mortality rates in every decade of life. The gap thus shrinks with age, and life expectancy at retirement is not much lower than in central Europe.

37. Phasing out implicit energy subsidies is a only a first, albeit critical, step; there may still be scope for interventions to tackle environmental externalities associated with industrial production directly.

38. Such high ratios of energy consumption to output are also in part the product of factors such as geography, climate and the structure of industrial production. These factors were compounded by the sharp drop in GDP during the 1990s: output fell far faster than energy consumption. Consequently, the growth of recent years has tended to reduce the energy intensity of GDP.

39. The OECD average of 2.33% is pulled up by the high R&D intensities of the few top countries; many countries have intensities below the OECD average. The median R&D intensity for OECD countries is approximately 1.76% of GDP (a value between that of the Netherlands and the United Kingdom).

40. This proportion has changed little since the mid-1990s, although the proportion of wholly privately owned R&D institutes has increased from around 2% of the total in 1995 to around 15% in 2008. This is on account of the full privatisation of around half of the R&D institutes that were still jointly owned by the public and private sectors in 1995 (Figure 1.20).

41. Unlike in many OECD countries, higher education institutions performed little R&D and focused mostly on education.

42. The level of GERD invested in instruments and equipment by many other former communist countries, perhaps benefiting from EC funds, is considerably higher, *e.g.* Slovak Republic, 7.3%; Romania, 18.2%; Poland, 15.3%; and Czech Republic, 8.7%.

The level of GERD invested in instruments and equipment by China in 2007 was higher still, at 22.8% (Figure 1.25).

43. The innovation index was compiled by the Center for Strategic Research "North-West" and reported in the background report prepared in support of this review. It is a composite index combining indicators of human resources for science and technology, new knowledge creation, knowledge diffusion and application, and marketing of innovative products.

44. This observation is borne out by a comparison of different innovation indices in the annex to World Bank (2006) and by the findings of the Executive Opinion Survey reported in WEF (2009). Russia scores well on indicators of innovation potential (R&D spending, quality and quantity of research institutions) but rather less well on indicators of outcomes. The World Economic Forum (WEF, 2010), using the Global Competitiveness Index (GCI), ranked Russia 63rd among 139 countries. Russia occupies rank 69 for its technological readiness and 57 for innovation. The Global Competitiveness Index used by the World Economic Forum (*www.weforum.org*) attempts to provide an overview of factors considered as critical drivers of productivity and competitiveness (institutions, infrastructure, macroeconomy, health and primary education, higher education and training, market efficiency, technological readiness, business sophistication, innovation).

45. There would appear to be potential spillovers with respect to human capital accumulation, since incentives to train workers and incentives to innovate are related. Enterprise surveys suggest that innovative firms train workers more than non-innovators (Goldberg, 2006).

References

Abramovitz, M. (1956), "Resource and Output Trends in the United States Since 1870", *American Economic Review Papers and Proceedings,* Vol. 46, pp. 5-23.

Aghion, P. and E. Bessonova (2006), "On Entry and Growth: Theory and Evidence", *Revue de l'OFCE,* 97 bis 2006, No. 3.

Aghion, P., W. Carlin and M. Schaffer (2002), "Competition, Innovation and Growth in Transition: Exploring the Interactions between Policies", *William Davidson Institute Working Papers Series 501*, William Davidson Institute at the University of Michigan, *http://wdi.umich.edu/files/Publications/WorkingPapers/wp501.pdf*.

Aghion, P., N. Bloom, R. Blundell, R. Griffith and P. Howitt (2005), "Competition and Innovation: An Inverted-U Relationship", *Quarterly Journal of Economics*, May, pp. 701-728.

Aghion, P. and P. Howitt (1998), *Endogenous Growth Theory*, The MIT Press, Cambridge, MA.

Ahrend, R. and W. Tompson (2005), "Fifteen Years of Economic Reform in Russia: What Has Been Achieved? What Remains to Be Done?", *OECD Economics Department Working Paper,* No. 430.

Ahrend, R. and W. Tompson (2006), "Realising the Oil Supply Potential of the CIS: The Impact of Institutions and Policies", *OECD Economics Department Working Paper,* No. 484.

Åslund, A., S. Guriev and A. Kuchins (eds.) (2010), *Russia after the Global Economic Crisis*, Peterson Institute for International Economics, Washington, DC.

Baffes, J. and T. Haniotis (2010), "Placing the 2006/08 Commodity Price Boom into Perspective", *Policy Research Working Paper 5371*, The World Bank, Washington, DC, July.

Baumol, W. (2002), *The Free-Market Innovation Machine*, Princeton and Oxford.

Bessonova, E. (2009), "Competition, Foreign Investment, and the Efficiency of Russian Industrial Firms", mimeo.

Bessonova, E., K. Kozlov and K. Yudaeva (2003), "Trade Liberalization, Foreign Direct Investment, and Productivity of Russian Firms", paper prepared for a CEFIR conference on Negotiating Russia's WTO accession: strategic lessons from multilateral trade liberalization and club enlargement, *www.cefir.ru/papers/WP39.pdf*.

Blundell, R., R. Griffith and J. Van Reenen (1999), "Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms", *Review of Economic Studies*, Vol. 66, No. 3.

Business Software Alliance (BSA) (2007), Fifth Annual BSA and IDC Global Software Piracy Study, Business Software Alliance, *http://global.bsa.org/idcglobalstudy2007/studies/2007_global_piracy_study.pdf*.

CEFIR (2007), *Monitoring the Administrative Barriers to the Development of Small Business in Russia*, Round 6, http://www.cefir.org.

Charap, S. and G. Safonov (2010), "Climate Change and Role of Energy Efficiency", in A. Åslund, S. Guriev and A. Kuchins (eds.), *Russia after the Global Economic Crisis*, Peterson Institute for International Economics, Washington, DC, June.

Coe, D., E. Helpman and A. Hoffmaister (1997), "North-South R&D Spillovers", *Economic Journal*, Vol. 107, pp. 134-49.

Conway, P. *et al.* (2006), "Product Market Regulation and Productivity Convergence", *Economic Studies*, No. 43, pp. 39 76, OECD, Paris, *www.oecd.org/dataoecd/62/31/40505949.pdf*.

Crespo, N. and M.P. Fontoura (2007), "Determinant Factors of FDI Spillovers – What Do We Really Know?", *World Development*, Vol. 35, No. 3, pp. 410-425.

CSRS (2010), *Russian Science and Technology at a Glance*, Centre for Science Research and Statistics, Moscow.

Donselaar P., H.P.G. Erken and L. Klomp (2004), "R&D and Innovation: Drivers of Productivity Growth", in G.M. Gelauff, L. Klomp, S.E.P. Raes and T.J.A. Roelandt (eds.), *Fostering Productivity. Patterns, Determinants and Policy Implications*, Elsevier, Boston.

Dreher, A., G. Noel and P. Martens (2008), *Measuring Globalization – Gauging its Consequences*, Springer, New York.

Easterly, W. and S. Fischer (1994), "The Soviet Economic Decline: Historical and Republican Data", *NBER Working Paper* No. 4735.

EBRD (2005), *Transition Report 2005*, European Bank for Reconstruction and Development, London.

"Energeticheskaya strategiya" (2003), *Energeticheskaya strategiya Rossii na period do 2020 goda* (*Energy Strategy of Russia for the Period to 2020*), RIA TEK, Moscow.

Erken, H., M. Kleijn and F. Lantzendörffer (2005), "Improving the R&D Investment Climate: Sharpening a Double-Edged Sword", *Ministry of Economic Affairs Research Series*, The Hague, *http://appz.ez.nl/publicaties/pdfs/05OI21.pdf*.

Federal Antimonopoly Service (2008), Доклад "О состоянии конкуренции в Российской Федерации" за 2007 год (*Report on the State of Competition in the Russian Federation in 2007*), Moscow, www.fas.gov.ru/competition/goods/20916.shtml.

Filippov, S. (2008), "Russia's Emerging Multinationals: Trends and Issues", *UNU-MERIT Working Paper Series*, No. 62, UNU-MERIT, Maastricht.

Frantzen, D. (2000), "R&D, Human Capital and International Technology Spillovers: A Cross-Country Analysis", *Scandinavian Journal of Economics* ,Vol. 102, No. 1.

Frye, T. (2010), "Corruption and Rule of Law", in A. Åslund, S. Guriev and A. Kuchins (eds.), *Russia after the Global Economic Crisis*, Peterson Institute for International Economics, Washington, DC.

Gianella, C. and W. Tompson (2007), "Stimulating Innovation in Russia: The Role of Institutions and Policies", *OECD Economics Department Working Paper*, No. 539.

Goldberg, I. (2006), "Competitiveness and the Investment Climate in Russia: An Assessment by the World Bank and the Higher School of Economics, Moscow", presented to the 10th Annual St Petersburg International Economic Forum, 12–14 June.

Griffith, R., S. Redding and J. Van Reenen (2004), "Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries", *Review of Economics and Statistics*, Vol. 86, No. 4, pp. 883-895.

Griliches, Z. and F. Lichtenberg (1984), "Interindustry Technology Flows and Productivity Growth: A Reexamination", *Review of Economics and Statistics* ,Vol. 66, pp. 324-29.

Guellec, D. and B. van Pottelsberghe de la Potterie (2001) "R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries", *OECD STI Working Paper*, 2000/4, *www.oecd.org/findDocument/0,2350,en_2649_33703_1_119684_1_7_1,00.html*.

Guriev, S. and E. Zhuravskaya (2010), "Why Russia is Not South Korea", *Journal of International Affairs*, Vol. 63, No. 2.

Hausmann, R. and R. Rigobon (2003), "An Alternative Interpretation of the 'Resource Curse': Theory and Policy Implications", *NBER Working Paper* No. 9424.

Havlik, P. (2010), "European Energy Security in View of Russian Economic and Integration Prospects", *Research Reports*, 362, Vienna Institute for International Economic Studies, Vienna.

Hemmings, P. (2005), "Hungarian Innovation Policy: What is the Best Way Forward?", *Economics Department Working Papers*, No. 445.

Hempell, T. (2002), "Does Experience Matter? Innovation and Productivity of ICT in German Services", *ZEW Discussion Pape*r, 02-43, Centre for European Economic Research.

HSE (2010), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

IEA (2009), *IEA World Energy Statistics and Balances – Energy Balances of Non-OECD Countries – Economic Indicators*, International Energy Agency, Paris.

Gaidar Institute (2010), *Rossiiskaya ekonomika v 2009 godu*, Gaidar Institute, Moscow.

IPRAN (2009), *Nauka, tekhnologii i innovatsii Rossii: 2009*, Institute for the Problems of Science Development of the Russian Academy of Sciences (IPRAN RAN), Moscow.

Jaumotte, F. and N. Pain (2005a) "Innovation in the Business Sector", *Economics Department Working Papers,* No. 459, OECD, Paris, www.oecd.org/dataoecd/49/29/20686301.HTM.

Jaumotte, F. and N. Pain (2005b) "From Ideas to Development: The Determinants of R&D and Patenting", *Economics Department Working Papers*, No. 457, OECD, Paris, www.oecd.org/dataoecd/49/29/20686301.HTM.

Jaumotte, F. and N. Pain (2005c), "An Overview of Public Policies to Support Innovation", *Economics Department Working Paper*s, No. 456, OECD, Paris, www.oecd.org/dataoecd/49/29/20686301.HTM.

Jaumotte, F. and N. Pain (2005d), "From Development to Implementation: Evidence on Innovation Determinants from the Community Survey", *Economics Department Working Papers,* No. 458, www.oecd.org/dataoecd/49/29/20686301.HTM.

Karl, Terry-Lynn (1999), "The Perils of the Petro-State: Reflections on the Paradox of Plenty", *Journal of International Affairs*, Vol. 53, pp. 31-48.

Keller, W. (2004), “International Technology Diffusion”, *Journal of Economic Literature*, Vol. 42, No. 3.

Kendrick, J. (1962), *Productivity Trends in the United States*, Princeton University Press, Princeton, NJ.

Kozlov, K. and K. Yudaeva (2004), “Imitations and Innovations in a Transition Economy”, mimeo, Bank of Finland Institute for Economies in Transition (BOFIT), October, www.bof.fi/bofit/seminar/bofcef05/innovations.pdf.

Krugman, P. (1994), “The Myth of Asia’s Miracle”, *Foreign Affairs* ,Vol. 73, No. 6.

Kuboniwa, M. (2009), “Growth and Diversification of the Russian Economy in Light of Input-Output Tables”, Hermes-IR Technical Report, Tokyo, June, *http://hdl.handle.net/10086/17477*.

Mel’nik, I. (2008), “V nadezhdakh na gospodderzhku”, *Ekspert Sibir*’, 22 December, *http://inno.ru/press/news/document33157/*.

Ministry of Education and Science of the Russian Federation (2009), “Background Report prepared for the OECD Review of the Russian Innovation System and Policy”, Moscow.

Ministry of Economic Development of the Russian Federation (2009), Comments of the Ministry of Economic Development of the Russian Federation on 2009 Special 301 Report on Copyright Protection and Enforcement: *www.regulations.gov/fdmspublic/ContentViewer?objectId=09000064808e5c8c&disposition=attachment&contentType=msw8*.

Mocan, N. (2004), “What Determines Corruption? International Evidence from Micro Data”, *NBER Working Papers*, No. 10460.

MON-Rosstat-HSE (2009), *Indikatory innovatsionnoi deyatil’nosti: 2009: statisticheskii sbornik*, Ministry of Education and Science, Rosstat and the Higher School of Economics, Moscow.

Nickell, S.J. (1996), “Competition and Corporate Performance”, *Journal of Political Economy*, Vol. 104, No. 4.

Nicoletti, G. *et al.* (2003), “The Influence of Policies on Trade and Foreign Direct Investment”, *Economic Studies*, No. 36, OECD, Paris, *www.oecd.org/dataoecd/22/2/33638319.pdf*.

NISSE – National Institute for System Studies of Entrepreneurship (2010), *Dynamics of Small Business Development in Russian Regions in January-June 2010*, NISSE, Moscow (in Russian).

OECD (2001), *The New Economy: Beyond the Hype*, OECD, Paris.

OECD (2003a), *The Sources of Economic Growth in OECD Countries*, OECD, Paris.

OECD (2003b), *ICT and Economic Growth, Evidence from OECD Countries, Industries and Firms*, OECD, Paris.

OECD (2004), *OECD Economic Surveys: Russian Federation*, OECD, Paris.

OECD (2006a), *OECD Economic Surveys: Russian Federation*, OECD, Paris.

OECD (2006b), *Economic Policy Reforms: Going for Growth 2006*, OECD, Paris.

OECD (2007a), “Product Market Regulation and Productivity Convergence”, Chapter 5 in OECD, *Going for Growth 2007*, OECD, Paris.

OECD (2007b), *OECD Reviews of Innovation Policy: Norway*, OECD, Paris.

OECD (2008a), *2008 Investment Policy Review of the Russian Federation: Strengthening the Policy Framework for Investment*, OECD, Paris.

OECD (2008b), *OECD Reviews of Innovation Policy: Hungary*, OECD, Paris.

OECD (2009a), *OECD Economic Surveys: Russian Federation*, OECD, Paris.

OECD (2009b), "Policy Responses to the Economic Crisis to Restore Long-Term Growth: Results of the OECD Questionnaire", Directorate for Science, Technology and Industry, OECD, Paris, February.

OECD (2010a), *The OECD Innovation Strategy – Getting a Head Start on Tomorrow*, OECD, Paris.

OECD (2010a), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

OECD (2010b), *OECD Factbook 2010*, OECD, Paris.

OECD/IEA (2009), "Progress with Implementing Energy Efficiency Policies in the G8", OECD and IEA, Paris, *www.iea.org/G8/docs/Efficiency_progress_g8july09.pdf*.

Ofer, G. (1987), "Soviet Economic Growth, 1928-1985", *Journal of Economic Literature*, Vol. 25, No. 1767-1833.

Olken, B. (2009), "Corruption Perceptions *vs.* Corruption Reality", *Journal of Public Economics*,Vol. 93, No. 7-8.

OPORA (2010), *Key Performance Indicators for Small and Medium-sized Enterprises in the Russian Federation*, OPORA, Moscow (in Russian).

Rosenberg, N. (2003), "Innovation and Economic Growth", Paper for the Conference on Innovation and Growth in Tourism hosted by the Swiss State Secretariat for Economic Affairs (SECO), Lugano, Switzerland, 18-19 September.

Sachs, J. and A.Warner (2001), "The Curse of Natural Resources", *European Economic Review*, Vol. 45, No. 4-6, pp. 827-838.

Safonov, G. (2008), "Russia: Environmental Outlook to 2030", *OECD Global Forum on Sustainable Development*, OECD, Paris, 3 June.

Sala-i-Martin, X., J. Blanke, M. Drzeniek Hanouz, T. Geiger and I. Mia (2010), "The Global Competitiveness Index, 2009-2010: Contributing to Long-Term Prosperity amid the Global Economic Crisis", *Global Competitiveness Report 2009–2010*, World Economic Forum, Davos.

Savvides, A. and M. Zachariadis (2005), "International Technology Diffusion and the Growth of TFP in the Manufacturing Sector of Developing Economies", *Review of Development Economics*, Vol. 9, No. 4.

Scherer, F. (1982), "Inter-Industry Technology Flows and Productivity Growth", *Review of Economics and Statistics*, Vol. 64, pp. 627-34.

Solow, R.M. (1957), "Technical Change and the Aggregate Production Function", *Review of Economics and Statistics* ,Vol. 39, 312-20.

Sutela, P. (2005), "The Political Economy of Putin's Russia", *BOFIT Russia Review* 3, March.

Tompson, W. (2006), "A Frozen Venezuela? The 'Resource Curse' and Russian Politics", in M. Ellman (ed.), *Russia's Oil: Bonanza or Curse?*, Anthem, London.

Tompson, W. (2010), "Back to the future? Thoughts on the Political Economy of Expanding State Ownership in Russia", in J. Newton and W. Tompson (eds.), *Institutions, Ideas and Leadership in Russian Politics*, Palgrave Macmillan, Basingstoke.

Ulku, H. (2004), "R&D, Innovation, and Economic Growth: An Empirical Analysis", *IMF Working Paper* WP/04/185, International Monetary Fund, Washington, DC.

UNCTAD (2010), *World Investment Report 2010*, United Nations Conference for Trade and Development, Geneva.

UNDP (2010), *National Human Development Report in the Russian Federation 2009: Energy Sector and Sustainable Development*, United Nations Development Programme, Moscow.

Van der Wiel, H. (2001), "Innovation and Productivity in Services", *CPB Report,* 2001/1, CPB Netherlands Bureau for Economic Policy Analysis, The Hague.

Verkhovskaya, O. and M. Dorokhina (2009), *Global Entrepreneurship Monitor (GEM): Russia 2008 Report*, Graduate School of Management, Saint Petersburg State University, Saint Petersburg.

WEF (2009), *Global Competitiveness Report 2009–2010*, World Economic Forum, Davos.

WEF (2010), *Global Competitiveness Report 2010–2011*, World Economic Forum, Davos.

World Bank (2006), *Public Financial Support for Commercial Innovation: Europe and Central Asia Knowledge Economy Study, Part I*, The World Bank, Washington, DC.

World Bank (2008), *Energy Efficiency in Russia: Untapped Reserves*, The World Bank Group, Washington, DC, *www.ifc.org/ifcext/rsefp.nsf/AttachmentsByTitle/FINAL_EE_report_Engl.pdf/$FILE/Final_EE_report_engl.pdf*.

World Bank (2011a), *Doing Business in 2011*, International Bank for Reconstruction and Development and World Bank, Washington, DC.

World Bank (2011b), *Russian Economic Report*, No. 24, The World Bank in Russia, March.

Zachariadis, M. (2003), "R&D, Innovation, and Technological Progress: A Test of the Schumpeterian Framework without Scale Effects", *Canadian Journal of Economics*,Vol. 36, No. 3.

Chapter 2

Innovation actors

The definition of a country's innovation system has major implications for the balance and mix of policies needed to improve innovation system performance and for the amount of communication and co-ordination required to create holistic innovation policies. To the extent that countries operate within the confines of a narrow "innovation system map" focused on science and technology and the formal research and development (R&D) system, they are likely to be guided towards policy choices that optimise the formal part of the system at the expense of the whole. However, with the emergence of a broader perspective on innovation systems over the last decade or so, governments increasingly tend to develop more holistic innovation and research policies.

With this broader perspective in mind, this chapter provides an overall assessment of the innovation and research activities of the business sector and of the public science and education systems, and of the stock and flow of human resources. It begins with business firms, the central actors in any well-functioning innovation system. It explores the explanations of low levels of R&D spending and broadens the perspective on innovation by firms to take account of non-R&D and non-technological innovation. It then considers the public sector research system, with particular attention to the academies of science and the higher education sector. A final section covers the human resource dimension of innovation.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Note by Turkey:

The information in this document with reference to "Cyprus" relates to the southern part of the island. There is no single authority representing both Turkish and Greek Cypriot people on the island. Turkey recognizes the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Commission:

The Republic of Cyprus is recognized by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

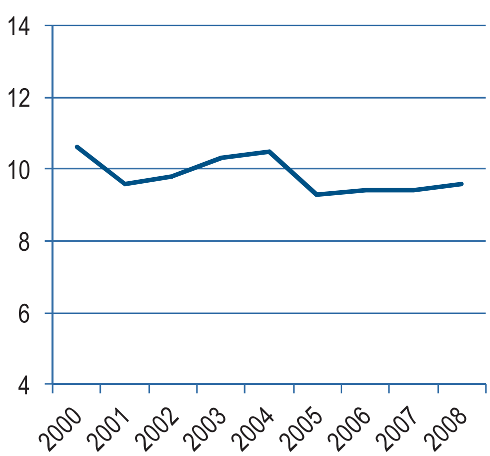
2.1. Business sector

This section explores the performance and organisation of innovation in the Russian business sector. It first reports on the results of innovation surveys of firms, which show, among other things, firms' innovation performance levels and the barriers they face for innovating. Attention then turns to the performance of R&D in the business sector, with a focus on its post-Soviet organisation and funding and its linkages to productive enterprises. It is argued that these, together with the specialisation and structure of the Russian economy, partly explain the relatively weak innovation performance of Russian business. The section ends with a brief discussion of the benefits of closer linkages with foreign businesses as a way to access international sources of knowledge.

2.1.1. Business innovation performance

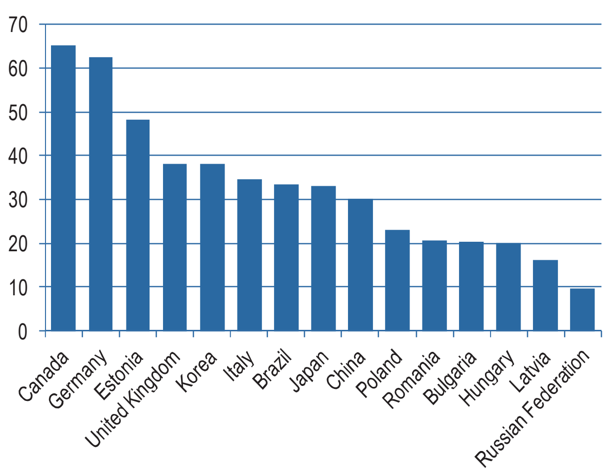
Annual innovation surveys suggest that the level of innovation among Russian business enterprises is low by OECD standards. Around 10% of surveyed enterprises reported technological innovation activity in 2008, a proportion that has remained more or less the same over the last decade (Figure 2.1). Similar surveys in other countries report much higher proportions of innovative enterprises, sometimes in excess of 60% of those surveyed, though more typically 30-40% (Figure 2.2). Other measures suggest weak innovation performance: for example, the level of innovative products as a percentage of total sales, while climbing a little over the last decade (Figure 2.3), remains low at around 5% (the EU27 average stands at around 10%, as reported in CIS-2006); and expenditure on technological innovation as a percentage of total sales remains stubbornly low at 1.4% in 2008, a figure that has changed little over the last decade (Figure 2.4). While the results of national surveys are never fully comparable with one another (see Box 2.1), the data nevertheless suggest weak innovation performance by Russian enterprises compared to their counterparts in Europe and other parts of the world.

Figure 2.1. Enterprises engaged in technological innovation as a percentage of all industrial enterprises (2008)



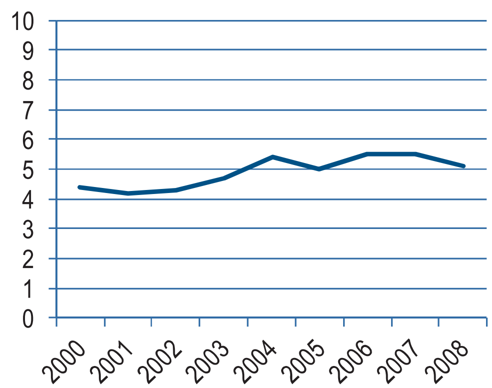
Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Figure 2.2. Enterprises engaged in technological innovation as a percentage of all industrial enterprises, by country (2008 or nearest year)



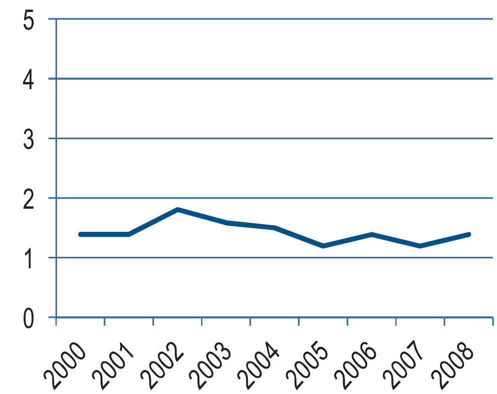
Source: EU country data from CIS-2006 (Eurostat, 2010); non-EU data from HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Figure 2.3. Innovative products as a percentage of total sales (2008)



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Figure 2.4. Expenditure on technological innovation as a percentage of total sales (2008)



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Box 2.1. Annual Russian innovation surveys

Innovation surveys ask enterprises to provide information about inputs, outputs and the behavioural and organisational dimensions of their innovative activities, using *Oslo Manual* definitions. On the input side, innovation surveys measure an enterprise's intangible assets, which include, beyond R&D expenditure, spending on training, acquisition of patents and licences, product design, trial production, and market analysis. On the output side, data are collected on whether an enterprise has introduced a new product or process, the share of sales due to significantly changed or new products ("new" can mean new to the enterprise, new to the market or new to the world). Other indicators capture the nature of innovative activities, whether R&D is done on a continuous basis and/or in co-operation with others, as well as categorical data on the sources of knowledge, the reasons for innovating, the perceived obstacles to innovation, and the perceived strength of various appropriability mechanisms.

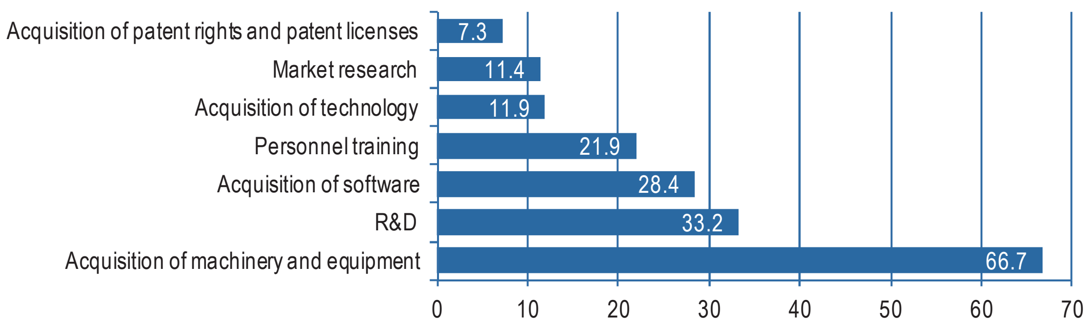
Russia began carrying out annual statistical surveys of business innovation activity in 1994, closely aligning its approach on the European Union's Community Innovation Survey (CIS). For instance, the latest surveys have been undertaken in accordance with the requirements of CIS-2008 and use the definitions outlined in the third edition of the Oslo Manual (OECD and Eurostat, 2005). The survey methodology has been developed by the Institute for Statistical Studies and Economics of Knowledge (ISSEK) of the National Research University – Higher School of Economics (HSE). The Russian Federal State Statistics Service (Rosstat) provides for data collection, which is mandatory for enterprises.

The survey covers large and medium-sized industrial enterprises (in resource extraction, manufacturing, distribution of electricity, gas and water), a number of industries in the services sector such as communications, computing and information technology (IT) and others (technical testing, research and certification, market analysis, business and management consulting, etc.). Moreover, biennial business innovation surveys are carried out for small enterprises (using a shorter list of indicators).

The comparability of Russian innovation survey data with the EU's CIS is mixed. While the structure of the survey and questions asked are closely aligned, sampling issues need to be taken into account when comparing survey data. For example, the Russian survey is a mandatory census, unlike those of most of the countries participating in the EU's CIS. This might explain in part the low levels of innovation reported by Russian enterprises. There are also differences in sector coverage and the size of participating enterprises. The international benchmarking carried out in this review utilises CIS 2006 data (Eurostat, 2010), which covers the year 2006, while the Russian data refer to 2008 (HSE, 2010a).

Activities in support of innovation are much broader than R&D (Box 2.2) and include, for example, the acquisition of machinery and software, market research and even employee training. Innovation surveys ask about the types of innovation-supporting activities carried out by innovating enterprises, and the results from the latest Russian survey are shown in Figure 2.5. As in similar surveys carried out in almost all other countries, the acquisition of machinery and equipment is the number one activity,[1] carried out by two-thirds of innovating firms, a figure broadly comparable to levels reported by EU countries' enterprises in CIS-2006. This activity has increased slightly over the years from 61% in 2001. Levels of most other forms of innovative activity have changed little or have decreased slightly.

Figure 2.5. Percentage of innovative industrial enterprises engaged in selected types of innovation-supporting activity (2008)



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Box 2.2. Non-R&D-performing innovators

How do firms that do not perform R&D innovate? The innovation literature points to four main approaches:

Technology adoption: Firms can acquire innovative products and processes from sources external to the firm, with little or no further work required. For example, a computer assembler can purchase faster hard drives or wireless cards from specialist firms to include in a notebook computer or a food processing firm can purchase improved packaging equipment. CIS data used by Evangelista and Mastrostefano (2006) show that the acquisition of new machinery and equipment is one of the most common innovation activities across firms. Similarly, firms can acquire ideas for organisational innovations from other firms.

Minor modifications or incremental changes to products and processes, including the use of engineering knowledge (Kline and Rosenberg, 1986). Modifications can be made to both purchased products and processes or to technologies previously developed by the firm itself. These innovation activities are particularly common for process innovation (Evangelista *et al*., 2002; Nascia and Perani, 2002). Lhuillery and Bogers (2006) estimate that 15% of overall cost reductions are due to incremental innovations made by employees to production processes. Incremental change can depend on learning by doing, as a firm gets better at what it already does (Cohen and Levinthal, 1989).

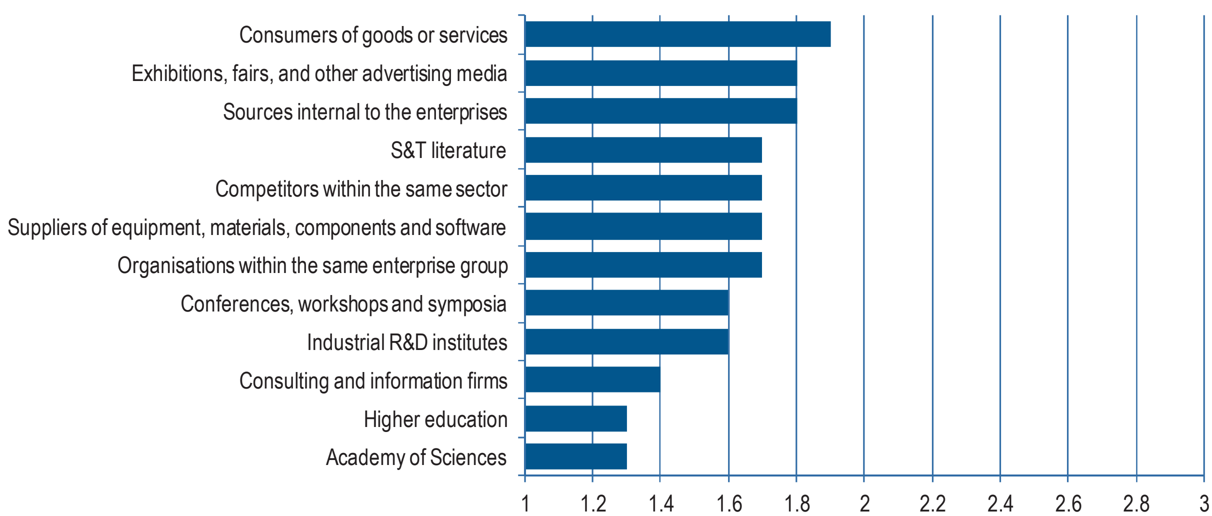
Imitation, including reverse engineering: Many activities to replicate products or processes that are already available, including solutions to circumvent a patent (Kim and Nelson, 2000), do not require R&D. This method of innovating may be especially common in less developed countries or for innovations that are not patentable.

Combining existing knowledge in new ways: This can include some types of industrial design and engineering projects (Grimpe and Sofka, 2007; Huston and Sakkab, 2006). The Italian "informal learning systems" of SMEs in traditional industries and mechanical and electrical/electronics sectors, use these methods to create new products (Evangelista *et al*., 2002). These systems build on tacit knowledge, engineering skills and cumulative learning processes, with the necessary knowledge located in the system, rather than in a specific firm (Gottardi, 1996). Informal contacts and mobility of highly skilled personnel move tacit knowledge from firm to firm.

Source: Arundel *et al*. (2008).

Again emphasising that R&D is but one input into innovation, Figure 2.6 ranks by order of importance several different sources of information used by Russian industrial enterprises in support of technological innovation. Consumers, exhibitions, internal sources, science and technology (S&T) literature, competitors, and suppliers were ranked as the most important sources of information; the Academies of Science, higher education institutes (HEIs), consulting firms and industrial (former branch) institutes were ranked as the least important. This could be taken as evidence of weak links between the public science base and technological innovation in firms. While this is almost certainly the case, it should also be noted that innovation surveys carried out elsewhere (*e.g.* the EU's CIS-2006) show very similar patterns. It may of course be concluded from this that EU countries also face similar problems of weak linkages between the public science base and innovating firms – again, almost certainly true. But another plausible explanation is that technological innovation activities in enterprises, by their very nature, require a mix of inputs, with R&D just one of these and often not used at all. This has important implications for supply-side innovation policy that seeks to build up the public research base in the hope that it will create a kind of domino effect on the enterprise sector. While this may be helpful, it should be complemented by other more demand-side measures that address relationships with consumers and even competitors. This issue is discussed further in Chapter 3.

Figure 2.6. Sources of information for technological innovation at industrial enterprises, by rank of importance (2008)



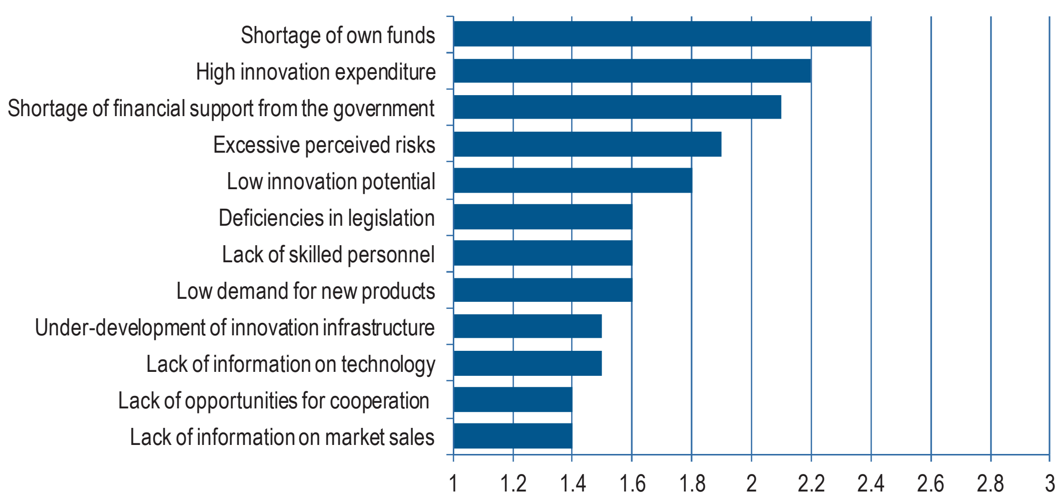
Note: Values are a weighted average of enterprises' assessment, on a three point scale, of significance of sources of information and range between 1 and 3.

Source: HSE (2010c), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Non-technological innovation is increasingly recognised as an important driver of transformative change in enterprises. According to the *Oslo Manual*, it can be broken down into two main components, *i.e.* organisational innovation, which refers to important changes in the organisational structure or the administration of an enterprise; and marketing innovation, which covers important changes in the design or the packaging of products or important changes in sales or distribution methods. It is interesting that non-technological innovation is most commonly reported by high-technology sectors (*e.g.* technical testing and analysis; computer and related activities) and knowledge-intensive business services (*e.g.* architectural and engineering activities; financial intermediation). This points to the often close relationship between the two types of innovation.

Innovation surveys also ask about the factors that hamper firms in their innovation activities. The Russian survey uses a categorisation of factors similar to that used by the EU's Community Innovation Surveys. A ranking of hampering factors is shown in Figure 2.7. Cost factors are considered the most important barriers. This is in line with the findings of innovation surveys carried out elsewhere, *e.g.* the EU's CIS-2006, which shows the same cost factors to be the most significant obstacles to firms' innovation activities in EU countries. Market factors are also regarded as major barriers; these include excessive perceived risk, low demand for new products, and deficiencies in legislation. The hampering factors rated least important are knowledge factors. A lack of skilled personnel is the most highly ranked knowledge factor. Lack of information on markets and technologies and lack of opportunities for co-operation are considered the least important factors. Again, these results are broadly in line with the findings of the EU's CIS-2006 (Eurostat, 2010).

Figure 2.7. Factors hampering technological innovation by industrial enterprises by rank of importance (2008)

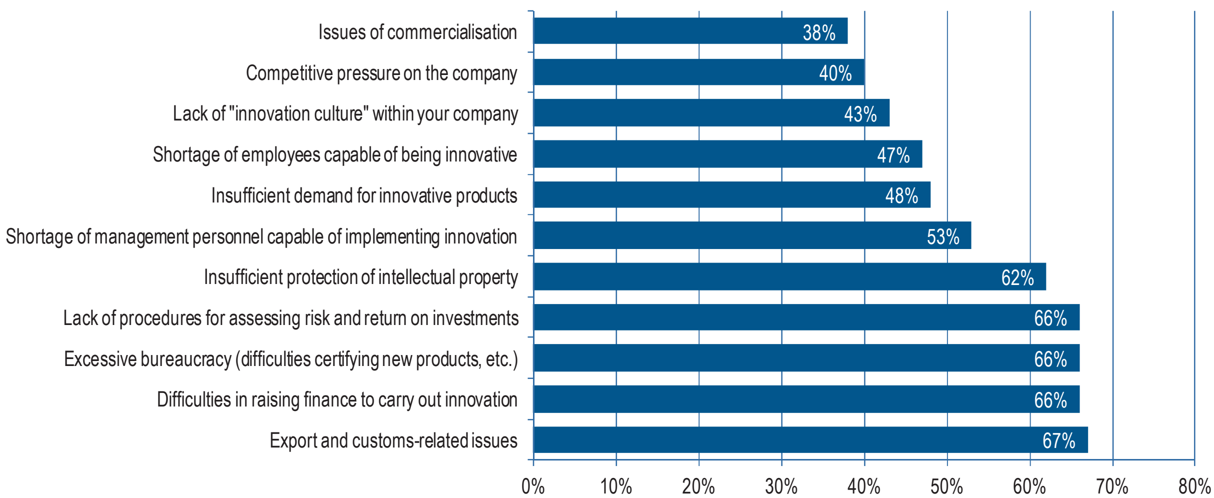


Note: Values are a weighted average of enterprises' assessment, on a three point scale, of significance of hampering factors and range between 1 and 3.

Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

PricewaterhouseCoopers (2010) has recently carried out a more targeted innovation survey of 100 of the largest firms operating in Russia which also reports on the barriers to innovation activity. The results are shown in Figure 2.8. While two-thirds of surveyed firms identified difficulties in raising finance for innovation as a barrier, most of the top-rated factors are concerned with regulatory issues. These include export- and customs-related issues (the top-rated barrier), excessive bureaucracy and insufficient protection of intellectual property. Factors related to organisational capabilities followed; these included lack of procedures for assessing risk and return on investments, shortage of innovation capabilities among management personnel and employees, and a lack of innovation culture within the firm. Interestingly, market factors are the lowest-rated barrier; these include insufficient demand for innovative products, competitive pressures on firms and issues of commercialisation. These findings should are not surprising, given the market domination enjoyed by many of Russia's largest firms. The main barriers relate to the regulatory environment and to firm-level organisational capabilities to carry out innovation.

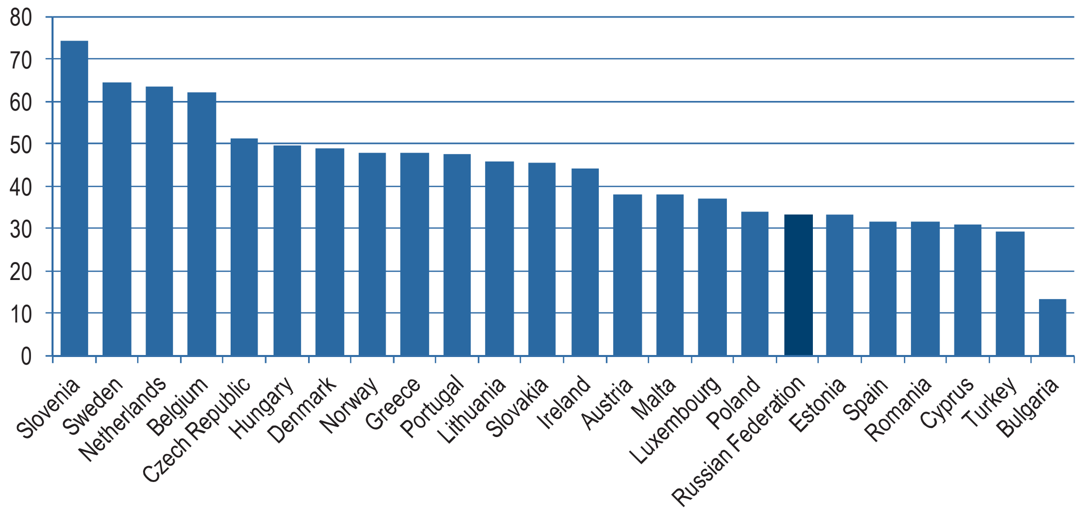
Figure 2.8. Barriers to innovation: A viewpoint from large firms (2010)



Source: PricewaterhouseCoopers (2010), *Innovation by Large Companies in Russia*, Moscow.

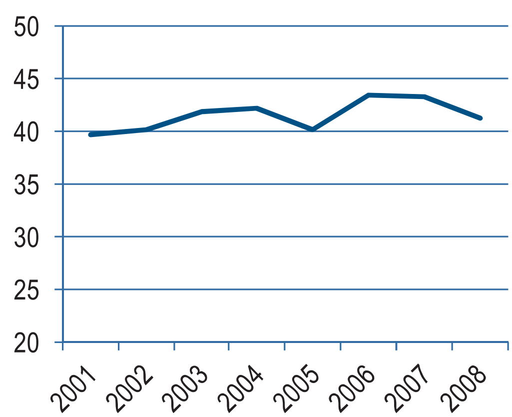
While the importance of non-R&D performing innovators and of non-technological innovation needs to be emphasised, the proportion of innovative enterprises carrying out R&D is of particular interest to this review. Figure 2.9 shows this to be around one-third of innovating firms; this is rather low in comparison to other European countries. However, more than 40% of innovative industrial enterprises reported having in-house R&D, project and design units, a proportion that has increased marginally over the last few years (Figure 2.10). In the 2007 survey, 2 360 R&D units employing more than 94 000 personnel were reported by innovative industrial enterprises, but these figures fell sharply in 2008 to 2 117 R&D units employing around 80 000 personnel (Figures 2.11 and 2.12), possibly owing to the impact of the financial crisis. A similar sharp decline can be seen in the 2008 figures for business enterprise expenditure on R&D (BERD) as a percentage of GDP (Figure 2.13).[2] Whether this decline will continue, albeit at a slower pace, will depend upon Russia's success in moving to an innovation-driven economy.

Figure 2.9. Percentage of innovative enterprises engaged in intramural R&D



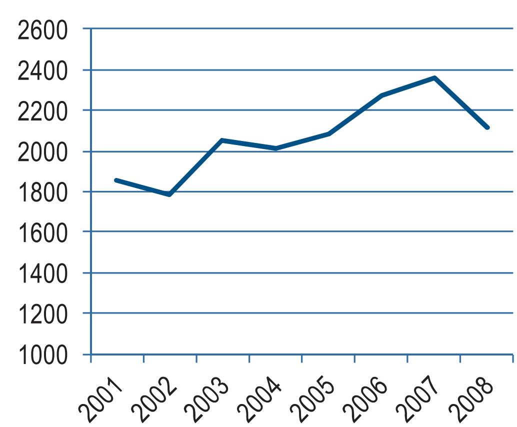
Source: EU country data from CIS-2006 (Eurostat, 2010); Russia data from HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Figure 2.10. Enterprises with in-house R&D, project and design units as a percentage of all industrial enterprises engaged in technological innovation



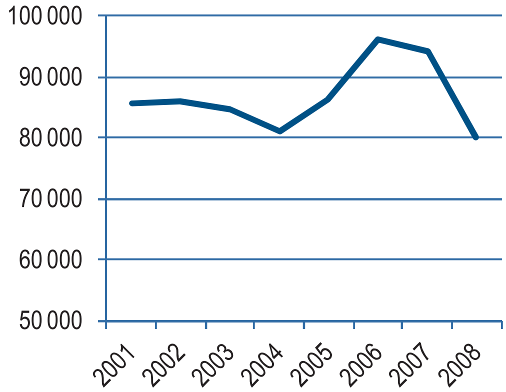
Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Figure 2.11. Number of R&D units at industrial enterprises engaged in technological innovation



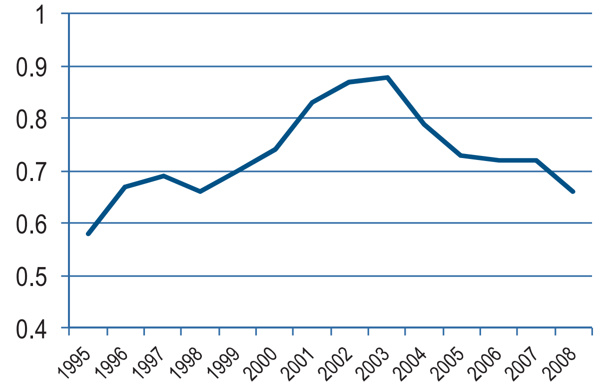
Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Figure 2.12. Employment in R&D units at industrial enterprises engaged in technological innovation (head count)



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

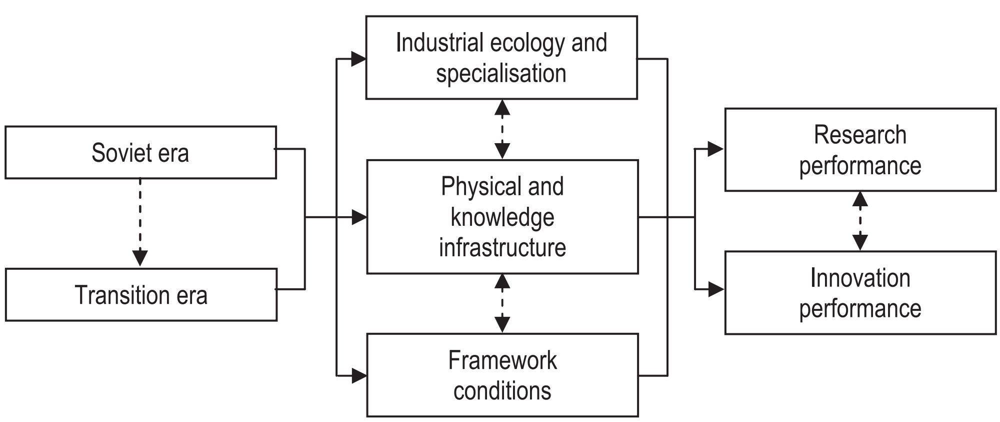
Figure 2.13. Trend in business enterprise expenditure on R&D as a proportion of GDP



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

To improve the innovation and research performance of Russian enterprises, it is important to understand the factors that shape enterprises' innovative activities. Some of the major factors are shown diagrammatically in Figure 2.14. To begin with, certain legacy factors from both the Soviet and transition eras[3] still heavily influence the location, organisation and levels of innovation and research performed in Russia. This influence is felt in contemporary patterns of specialisation and the structure of Russian industry, Russia's physical and knowledge infrastructure, and a variety of prevailing framework conditions that have often proven less than conducive to enterprises' efforts to innovate. The latter are discussed extensively in Chapter 1 and will not be covered here. Rather, the following analysis focuses on the way Russia's knowledge infrastructure for industrial innovation and its patterns of industrial specialisation and firm ecology shape firms' innovation performance.

Figure 2.14. Path dependency and institutional-structural conditions shaping research and innovation performance in Russian enterprises



2.1.2. Knowledge infrastructure

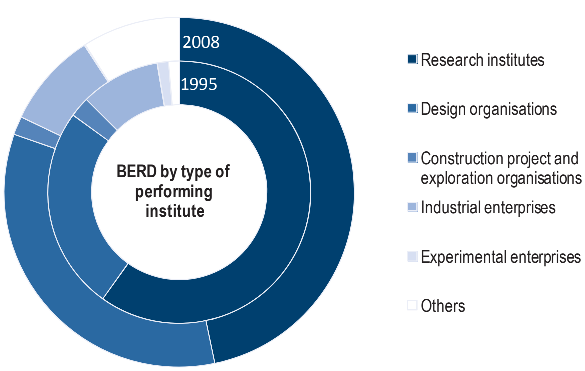
A striking feature of the industry breakdown of business enterprise expenditure on R&D is the apparent dominance of services as research performers, as they account for more than three-quarters of the total. Manufacturing, by contrast, accounts for only about one-fifth of the total research performed by business enterprises, a remarkably low proportion by OECD standards (Table 2.1). Closer inspection of the composition of services, however, reveals that virtually all of the research is performed by a dedicated R&D services sector, most of which purports to serve manufacturing firms. This R&D sector represents a mix of largely government-owned research institutes and design bureaus established during the Soviet era. Figure 2.15 shows that these account for the vast majority (more than 80%) of Russian BERD; industrial enterprises performed just 9% of BERD in 2008, a slight decrease from 1995. This section describes the R&D services infrastructure, its evolution since Soviet times and its performance in contemporary Russia.

Table 2.1. Business enterprise R&D expenditure by industry, 2007 (percentage)

Agriculture, hunting and forestry	0.6%
Mining and quarrying	1.8%
Manufacturing (total)	21.1%
=> Machinery and equipment, n.e.c.	3.9%
=> Radio, TV and communications equipment and apparatus	5.1%
=> Motor vehicles, trailers and semi-trailers	0.7%
=> Aircraft and spacecraft	6.0%
=> Ships and boats	2.1%
Electricity, gas and water supply	0.5%
Construction	0.1%
Services sector (total)	75.9%
=> Research and development	71.3%
Total	100.0%

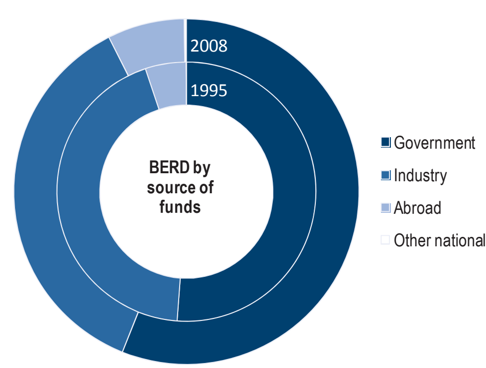
Source: OECD *Main Science and Technology Indicators* 2010/1.

Figure 2.15. Business enterprise expenditure on R&D by type of performing institute



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.16. Business enterprise expenditure on R&D by source of funds



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

To understand why R&D and production are largely carried out in different organisations, a little history is in order. The Soviet R&D system followed an ambitious strategy in all fields of science and technology. It was very large (employing more than 2.5 million R&D personnel by the late 1980s), centrally directed, and government-financed (Gokhberg, 1997). Industrial research institutes and other units specialising in development (such as design, construction projects and experimental work) were the principal organisational form and operated largely independently of both industrial enterprises and universities. These "branch" institutes and design bureaus were attached to specific branch ministries, each of which supervised an industry or sector of the economy. Each branch ministry established its own network of these units and determined the research topics and the allocation of R&D resources. R&D units served the sector as a whole rather than a specific enterprise. This arrangement reflected a linear logic – from research institute to design bureau, to experimental production, and finally to mass production – which was similar in all sectors of manufacturing. R&D was viewed as the main driver of technological innovation; production was considered a less important driver. In this view, technology was viewed as a commodity (Hanson and Pavitt, 1987, cited in Radosevic, 2003) which, once developed, could be introduced into production without the need for adaptation and improvement.

Already by the late 1970s, it was clear that these arrangements were too inflexible and that Russia was falling behind. They were ill-suited to the requirements of economic growth, which depended less on standard commodities like steel and more on sophisticated, fast-changing, manufactured products, such as integrated circuits (Alimpiev and Sokolov, 1997). The main failure was the lack of opportunity to accommodate feedback from users, who were considered largely irrelevant to technological advance. As a result, R&D units often pursued research work for which little application could be found and delivered finished technologies that failed to meet production requirements (Fortescue, 1986). But the arrangements had other critical failings arising from the central planning system itself. First, the horizontal diffusion of technologies was hampered by the branch principle, which confined the activities of research institutes and design bureaus to the needs of specific industrial sectors. This created monopolies in the development of particular technologies and made inter-sectoral technology diffusion difficult. Second, there were too few incentives for enterprises to introduce new products and processes through innovation. With prices based in part on costs, enterprises had little incentive to introduce new processes to lower costs. Furthermore, as almost all output was guaranteed to be sold, there was little incentive to introduce new products to gain sales volume. Instead, the planning system emphasised volume output rather than quality or cost (Gokhberg, 1997). Under these conditions, obligatory R&D programmes in state plans had second-class status, since the most important performance indicator, volume of output, could not be jeopardised.

A further important characteristic of the Soviet branch system was its focus on national security. Around 700 R&D institutes of various types contributed to the defence industry, mostly in the form of applied research. As the most advanced part of Russia's industrial research capacity, these R&D institutes also made notable contributions in strategic, mission-oriented, basic research in important fields such as nuclear and high-energy physics, mechanics, space exploration, new materials, computer science, and electronics (Gokhberg, 1997).

In attempts to offset some of the problems faced by the branch system, particularly as regarded its inflexibility, the early 1980s saw the introduction of new, cross-branch S&T programmes. These programmes overlaid, rather than replaced, the existing branch arrangements. As the R&D institutes responsible for the fulfilment of S&T programmes had no authority to provide financing to research institutes in adjacent branches, there was little incentive to implement projects that crossed branch boundaries. In the *perestroika* period of the late 1980s, new organisational forms, including research and production associations (RPAs) and inter-sectoral S&T complexes, were introduced or enhanced to overcome the rigidities of the branch structure and to encourage enterprises to utilise research results. RPAs brought institutes and enterprises together to carry out, within one organisation, the whole cycle from research to mass production of an industry sector. Inter-sectoral S&T complexes included research institutes, design bureaus and industrial enterprises from different sectors of the economy. Their main task was to organise applied interdisciplinary research and to implement the results in production. These new arrangements met with some success and the process of innovation accelerated as R&D institutes became engaged in the immediate supervision of the downstream introduction of their developments into production technologies. On the downside, a focus on solving enterprises' current problems meant too little attention was given to strengthening the long-term research capacities of R&D institutes (Alimpiev and Sokolov, 1997).

Any gains made in the late 1980s were swept away by the tumultuous changes of the early 1990s. The shift to a market economy was accompanied by macroeconomic instability, uncertainty over property rights and a general breakdown in the rule of law. Capital was scarce and domestic demand collapsed in many parts of the economy. Industrial enterprises adopted short-term and survivalist strategies and many exploited market imperfections and rent-seeking opportunities, which were more rewarding than innovation (Gokhberg *et al*., 1997). The government was short of capital and sought to privatise much of the former state economy as quickly as possible. This resulted in the severance of many links between R&D institutes and productive enterprises and a drastic decline in the demand for R&D and innovation services. It also saw a steep fall in state contracts for R&D institutes, as branch ministries no longer co-ordinated the work of research and production units. R&D institutes responded to the decrease in their budgets by shifting to part-time work and by sharply reducing the salaries of researchers. This resulted in a fall in the prestige of R&D employment and led to an exodus of researchers, with the numbers falling by around half in the first five years of the transition period. Many of the best and younger researchers moved to more lucrative sectors of the economy or went abroad, leaving R&D institutes with a significant proportion of more senior employees who were much less disposed to innovate than those who had departed (Glaziev *et al*., 1997).

To survive, many institutes initiated activities unrelated to R&D, such as leasing their buildings or retailing. Staff members often took additional jobs to supplement their increasingly meagre salaries (Gokhberg *et al.*, 1997). The branch ministries made allowances for these developments, since they sought to preserve the potential of the R&D institutes still under their control. But their preservation strategies almost entirely redistributed budgetary funds to salaries and overheads, which left very little room for purchase of equipment or materials. Even so, they were unable to prevent many R&D institutes from folding, particularly those nearer the end of the "innovation pipeline". Institutes that had directly served industrial enterprises, such as design bureaus, were especially hard hit. During the 1990s, the number of design bureaus decreased by two-thirds, construction project and exploration organisations by 85%, and R&D institutes in industrial enterprises by almost one-third. During this period, a small selection of R&D institutes was granted special status, either as a state science centre or as a federal research and production centre, to protect their capabilities in priority areas, particularly in the defence industry. They are still in existence today (see Chapter 3) and benefit from extra budgetary resources and tax breaks, among other privileges.

Many R&D institutes were nominally privatised while remaining government-owned. The aim was to accelerate their adaptation to market conditions, yet the sector remains highly reliant upon government funding to this day (Figure 2.16) and benefits from a mix of block grants and state contracts. Their privatisation took several forms (Box 2.3). There has been a recent tendency to decrease the number of state unitary enterprises by converting them into joint stock companies (Gijsbers and Roseboom, 2006). This reduces some of the impediments to commercial exploitation of R&D associated with state unitary enterprises' lack of property ownership rights. A small minority of R&D institutes have been integrated into industrial enterprises. The industrial R&D system therefore remains largely "externalised", with the bulk of R&D activity still taking place in a privatised state-owned R&D services sector.

Box 2.3. Organisational forms of public R&D institutes

State unitary enterprise: This is the most widespread form of public research institute. The specific feature of a state unitary enterprise is a lack of ownership rights to assigned state property, which it may own only by the right of economic or operative management. Thus, state unitary enterprises have only limited rights regarding the use of their property, and many types of transaction have to be approved by the corresponding government agencies. They are generally not obliged to disclose financial information, but are audited by the Audit Chamber of the Russian Federation.

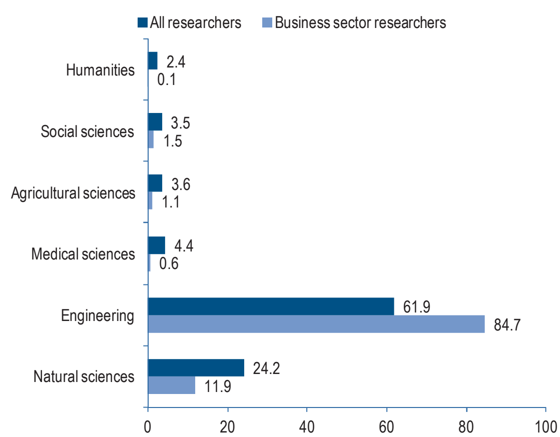
State establishment. This is another widespread form of public research institute that is non-commercial in nature and funded fully or partially by the state. The property recorded in favour of a state establishment is not in its ownership, just its operative management. The law forbids a state establishment to assign or dispose of property obtained from or funded by the state. However, if the property was obtained from or funded by others, for example from own income or from sponsors, then the state establishment has the right to use such property as it wishes, including the disposal of it.

Joint stock company. This is a type of corporation or partnership involving two or more individuals that own shares of stock in the company. It is closely analogous to the limited company / corporation found in Anglo-Saxon economies. Joint stock companies are obliged to publish quarterly and yearly financial reports, to be audited externally, and may go bankrupt if they do not fulfil their financial obligations. The legal form of the open joint stock company provides flexibility for the participation of private investors, and allows raising capital on the stock and bond markets.

Source: Gijsbers and Roseboom (2006); Sprenger (2010).

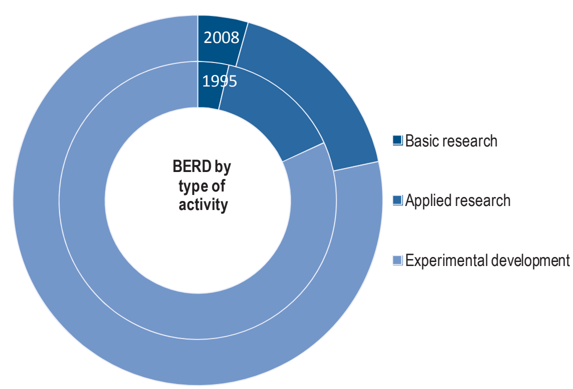
The continuing separation of R&D and production is perhaps the biggest legacy of the Soviet system today and still constitutes a weak spot. First, there is little demand from industrial production enterprises for R&D. Sectoral specialisation, discussed in the following section, together with unfavourable framework conditions for innovation (see Chapter 1), only partly explain this lack of demand. Another important factor is the separation of R&D from production, with very little R&D actually performed in industrial enterprises. If enterprises are not performing R&D themselves, they are unlikely to have the knowledge needed to buy R&D services efficiently from elsewhere or the absorptive capacity to use the results. In other words, if industrial enterprises performed more of their own R&D in house, their demand for contractual R&D would very likely increase. It is interesting that nearly 85% of researchers performing business R&D are engineers (Figure 2.17) and are engaged, for the most part, in experimental development work (Figure 2.18). Yet, this type of activity tends to be best performed in production enterprises rather than in nominally independent R&D institutes. Second, the lack of demand from industrial enterprises leads R&D institutes to operate in a technology-push rather than a technology-pull mode. This frequently leads to the development of technologies for which there is no industrial enterprise client. A technology-push model works only if there is a guaranteed demand for the product, a situation that occurs only in highly regulated markets or when the government is the procurer. This explains Russia's continuing strengths in sectors such as nuclear reactors, space rockets and military aircraft. In a more open market economy, however, the innovation development chain is more complex and typically starts with an assessment of business opportunities rather than with R&D (Gijsbers and Roseboom, 2006).

Figure 2.17. Business sector researchers by field of science (2008)



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.18. Business enterprise expenditure on R&D by type of R&D activity

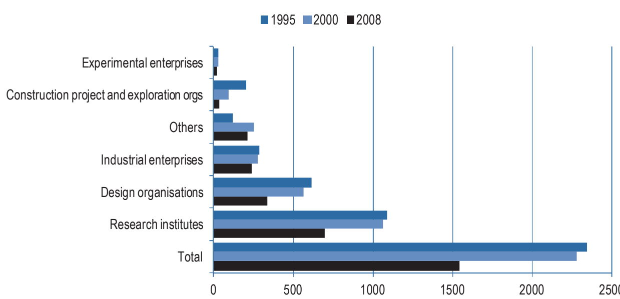


Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

An obvious solution to these problems would be to further integrate many of the nominally independent R&D institutes into industrial enterprises, but it is not clear that this is a widely applicable option. While some R&D institutes are strong, especially those granted special status (see above), many have been considerably weakened by the austerity of the transition years and continue to operate in survival mode. It is safe to assume that capabilities will have been eroded substantially in many cases, perhaps beyond recovery. Their integration with industrial enterprises could result in their closure, their property considered more valuable than their intangible assets. Even in less extreme cases, R&D institutes that have managed to remain productive have mostly fallen well behind knowledge frontiers. There is some evidence of this in the oil and gas industry, as Russian firms are much more likely to access foreign technologies to boost their productivity than to rely upon indigenous technological development (Filippov, 2008). Recent high-profile purchases of defence equipment from overseas suppliers by the Russian armed forces suggest there could be similar issues with some defence-related R&D institutes, which still constitute a large share of remaining industrial R&D institutes.

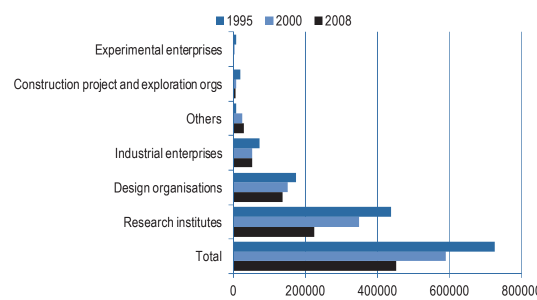
In summary, the industrial R&D system inherited from the Soviet period is only semi-reformed and consequently manifests many of its weaknesses, which have persisted during the transition, owing in part to a precipitous decline in demand for R&D institutes' research and technology development services from industrial enterprises. The picture is mixed, however. In some sectors, R&D institutes continue to perform world-leading research, particularly in the military-industrial complex and related industries, where the government remains the main customer. Elsewhere, the continuing dependence of significant parts of the extensive branch R&D infrastructure on public money has perhaps become more of a liability than an asset. Further consolidation and reorganisation would be useful and has, in fact, already begun. As Figure 2.19 shows, the number of R&D institutes has declined quite sharply since 2000, with virtually all of the reduction accounted for by former branch research institutes and design bureaus. It is also more than consolidation and reorganisation, since the number of R&D personnel working in the sector has also fallen significantly (Figure 2.20). This points to the continuing adjustment of the industrial R&D sector through contraction of both research institutes and R&D personnel.

Figure 2.19. Distribution of business sector R&D institutes by type



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.20. R&D personnel in the business enterprise sector by type of institute



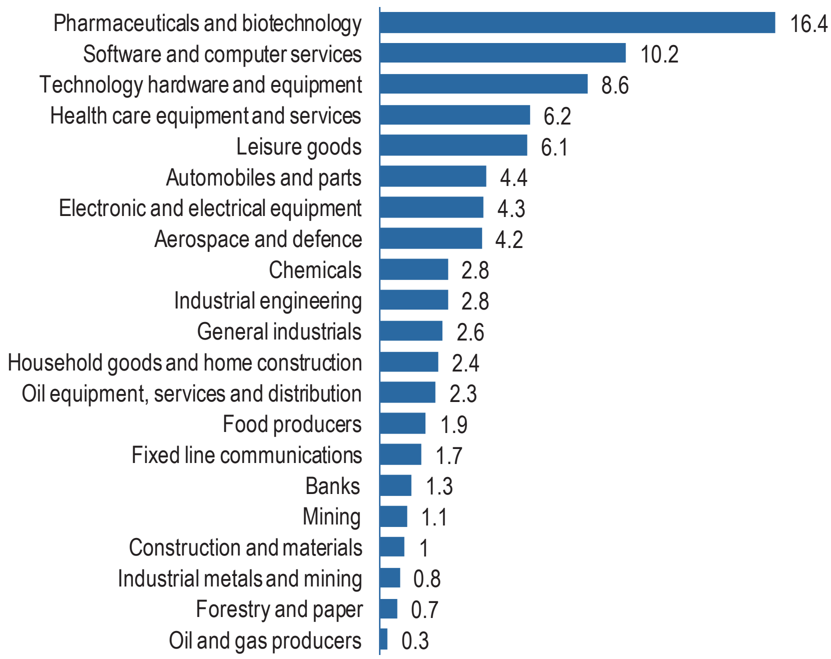
Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

2.1.3. Industrial specialisation

Another important factor shaping Russia's innovation and research performance is its industrial specialisation. Russia's economy is dominated by resource-based industries, such as oil and gas and metallurgy and mining. Of the 100 largest Russian enterprises, 12 are in the oil and gas sector and accounted for almost 40% of aggregate turnover and for more than 55% of the combined profits of the top 100 in 2007.[4] A further 13 are metal enterprises and account for around 15% of the combined turnover of Russia's top 100 (Liuhto and Vahtra, 2009). These are sectors that traditionally spend less on R&D than their manufacturing counterparts in all parts of the world (Figure 2.21). Russian innovation survey data suggest that firms in these sectors are also less innovative, as shown in Figure 2.22. Thus, part of the explanation for relatively low levels of R&D and innovation in enterprises can be traced to the industrial specialisation patterns of the Russian economy.

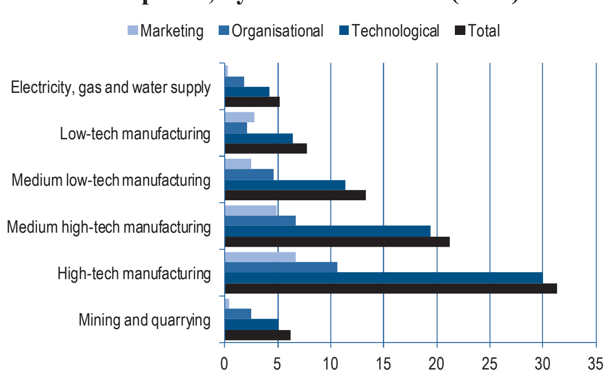
An obvious conclusion is the need to further diversify the economy towards more high-technology sectors that are less vulnerable to the vagaries of commodity markets. Russia already has world-class strengths in several sectors such as aerospace, nuclear reactors and advanced materials, in which it would do well to deepen its capabilities. But it also has notable weaknesses in other high-technology sectors, *e.g.* pharmaceuticals and consumer electronics, in which it will be difficult to compete internationally for the foreseeable future. An innovation policy focused solely on high-technology sectors would therefore be too narrow given the economy's specialisation in more low-technology and services sectors. Policy needs to avoid "high-tech myopia" and to acknowledge the central role of upgrading more low-technology and services sectors through innovation (Box 2.4). This policy orientation is discussed more extensively in Chapter 3.

Figure 2.21. Ranking of sectors by R&D expenditure as a percentage of sales in the top 1 000 R&D-performing firms worldwide (2008-09)



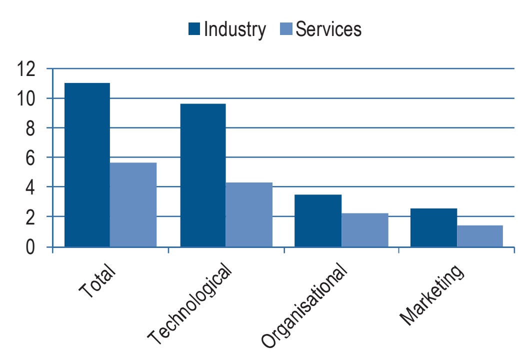
Source: OECD based on data from BIS (2010), *The 2009 R&D Scoreboard: The Top 1,000 UK and 1,000 global companies by R&D Investment*, Department for Business Innovation and Skills, London.

Figure 2.22. Industrial enterprises engaged in innovation as a percentage of all industrial enterprises, by industrial sector (2008)



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Figure 2.23. Comparison of innovative activity in industry and services: Enterprises engaged in innovation as a percentage of all enterprises (2008)



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

Box 2.4. Innovation in services

Boosting innovation in service industries is central to improving the performance of the services sector. The sector has traditionally been seen as less innovative than manufacturing (as Figure 2.25 would seem to confirm) and as playing only a supportive role in the innovation system. As a result, national innovation policies have paid scant attention to services, and service firms have not been active participants in government-sponsored innovation programmes. Recent work confirms, however, that services are more innovative than previously thought; indeed, in some areas, they are more innovative than the average manufacturing industry. For example, knowledge-intensive business services play an increasingly dynamic and pivotal role in the knowledge-based economy.

Innovation surveys suggest that service firms innovate for many of the same reasons as manufacturing firms: to increase market share, to improve service quality and to expand product or service range. However, how innovation occurs in the services sector is less well understood. Compared to manufacturing, most innovations in services appear to be non-technical and result from small, incremental changes in processes and procedures that do not require much formal R&D. Developing policy to support innovation in the services sector may therefore require new policies and programmes.

Source: Tamura *et al*. (2005).

2.1.4. Firm ecology: large domestic firms, SMEs and multinational enterprises

Sectoral specialisation is just one part of the explanation of Russia's low innovation intensity, of course. As already mentioned, there are several other factors, including unfavourable framework conditions and the continuing separation of R&D from production. Another is the nature and dynamics of the Russian industrial "ecosystem", which is dominated by a few very large players that have often, through their monopoly positions, stifled innovation-inducing competition.[5] The fact that the largest 100 enterprises accounted for close to 60% of Russia's GDP in 2007 is evidence of the strong concentration of economic power (Liuhto and Vahtra, 2009). A mix of private financial-industrial groups (FIGs) and state-owned enterprises/state corporations dominate the top 100. Among these are Gazprom, Lukoil, Alfa Group, Rosneft, Renova, Severstal, Norilsk Nickel, Evraz Group, Sistema, Rostechnologii, Mechel Steel Group, Tatneft and Basic Element.

The private sector FIGs, which may take the form of vertically integrated groups and/or diversified conglomerates, typically include a central holding company, a bank and numerous member enterprises with equity and/or cross-ownership relations with the central holding company/bank. They were mostly set up during the 1990s when Russia's financial capital institutions operated in imperfect and fragmented markets. FIGs offered an opportunity to combine financial and industrial capital for investments and to restructure enterprises (World Bank, 2001). They sought to create stable organisations in an otherwise turbulent environment, to compensate for links that had been broken during the privatisation process, and to facilitate internal financial flows in an economic system otherwise short of capital. Today, many have become powerful multinational corporations and have expanded in scale and scope through the further consolidation of Russian industry and the acquisition of strategic foreign assets.

Box 2.5. Theoretical pros and cons of conglomerates in innovation performance

Although there are many obstacles to the creation of efficient conglomerates, they can offer one way, at the current time at least, to concentrate capital on R&D and innovation. They can have several advantages from an innovation perspective:

- *Vertical integration*: This can facilitate the co-ordination of complementary investments through the sharing of investment plans, thereby reducing some of the uncertainties associated with innovation (Teece, 1996). This is particularly pertinent in Russia, where improved vertical integration of the technological cycle – uniting the R&D capacities of industrial research institutes, the production capacities of industrial enterprises, and the capital available from financial institutions – could bring about closer and more continuous communication (Alimpiev and Sokolov, 1997). This should improve their mutual adaptation and could help overcome fragmentation of the innovation system.
- *Internal capital market*: With underdeveloped financial markets, conglomerates can benefit from their access to internal finance. They can re-allocate cash from businesses that have positive cash flow to new businesses with negative cash flow (Teece, 1996).
- *Economies of scale*: Conglomerates can afford to undertake large-scale, expensive projects and are able to conduct multipurpose research uniting researchers and experts from various disciplines (Gijsbers and Roseboom, 2006).
- *Economies of scope*: Conglomerates afford opportunities for transferring technologies across product lines and melding them to create new products (Teece, 1996). They can also finance the parallel development of alternative innovations, with commercially successful projects compensating for those that fail (Gijsbers and Roseboom, 2006).
- *Substitute for weak institutions*: Although the situation shows definite signs of improving, Russia still suffers from institutional weaknesses which large conglomerates, with their large size and influence, are better placed to circumvent (Guriev and Rachinsky, 2004).

However, many risks and inefficiencies associated with conglomerates can limit their innovativeness:

- *Monopoly*: A lack of competition generally diminishes firms' proclivity to innovate.
- *Bureaucracy and inertia*: The hierarchies associated with conglomerates can accomplish complex organisational tasks, but they are also often associated with organisational properties inimical to innovation, such as slow, bureaucratic decision making (Teece, 1996) and inertia/inflexibility in the face of disruptive change in wider environments.
- *Lack of transparency and weak corporate governance*: Conglomerates can be less efficient than stand-alone firms, since they may suffer from multi-layered agency problems and redistribute capital inefficiently (Guriev and Rachinsky, 2004).
- *Lack of focus*: Diversification, if too great, can reduce synergies between business units and diminish potential economies of scope.
- *Political influence*: Because of their scale and power conglomerates may influence political decision making to protect their interests but this may weaken their drive to innovate and improve performance. Their influence can also hinder the emergence of more innovative competitor enterprises and therefore be detrimental to the wider national interest.

The other enterprises dominating the top 100 are a mix of majority state-owned enterprises (SOEs) and state corporations. Many of the largest SOEs are conglomerates that were often created by merging existing SOEs, *e.g.* United Aircraft Corporation, a holding with considerable stakes in all of the well-known Russian aircraft enterprises. These new corporations usually enjoy dominant market positions in their areas of activity, and the scope and modalities of private sector participation, including by foreign investors, are tightly controlled (OECD, 2008). A new breed of enterprise, the state corporation, was created more recently. Examples include: Rostechnologii, which operates mostly in the military-industrial complex; Rosnano, which is charged with leading developments in nanotechnology and related industries; Rosatom, which leads the federal programme on the development of the nuclear energy industrial complex; and Vnesheconombank, which is charged with enhancing innovation, competitiveness and diversification of the Russian economy through financing infrastructure, including special economic zones (SEZ), and supporting SME development. As an instrument of government policy, these state corporations are discussed more fully in Chapter 3.

Thus, recent years have seen intensified consolidation of ownership in Russia's leading industrial sectors, propelled by developments in both the private and public sectors. It gives large firms a critical role in driving innovation. In fact, it is this anticipated role that purportedly lies behind the government's policy to consolidate strategic industries into "national champions". The policy is not without its critics, who argue that it reduces competition, itself a major driver of innovation. However, competition is just one of many factors that shape the level (and nature) of a firm's innovativeness. Others include its organisational form, the scope of its product market activities, its vertical integration, its organisational culture and values, and its external linkages (Teece, 1996). Their influence on innovation can be as important as the prevailing level of competition. Box 2.5 sets out the relative pros and cons of conglomerates in innovation performance and highlights the role of some of these.

It will have to be seen whether large firms, public or private, will improve Russia's innovation performance and, ultimately, its levels of productivity over the medium to long term. With investments in R&D and innovation proving less lucrative than the short-term profits to be had through rent-seeking opportunities, the track record since the demise of the Soviet Union is hardly promising. This picture may now be slowly changing, as evidenced by considerable increases in R&D spending by some of Russia's leading conglomerates (Box 2.6). Many (*e.g.* Gazprom) have acquired former state-owned industrial R&D institutes, while others (*e.g.* Sistema) have created their own research divisions or institutes *de novo*. Some have developed collaborations with HEIs and institutes of the academies of science, although the practice is still not very widespread. Research activities are also being stepped up in public SOEs and state corporations, as discussed in Chapter 3. While these are promising signs, it must be borne in mind that R&D is but one contributor to innovation. Many of the barriers to innovation identified in innovation surveys remain, even for large firms, and are likely to continue to hamper the emergence of a more innovation-driven economy.

Box 2.6. R&D activities of leading Russian conglomerates

Gazprom is the world's largest gas producer. It produces 17% of global gas and has the world's largest natural gas reserves and the world's largest gas transmission system. Its activities include geological exploration, production, transport, storage, processing and marketing of gas and other hydrocarbons as well as electric power and heat energy production and distribution. The Russian state owns a 50.002% controlling stake in Gazprom. The company invested 1.6% of its operating profit in R&D in 2008-09. While this is low compared to the industry average of 2.3%, Gazprom's R&D budget grew by 29% over the previous year (BIS, 2010). Gazprom has its own research institute, Gazprom VNIIGAZ, which conducts R&D, testing and design work. Gazprom VNIIGAZ was established in 1948 and was incorporated into Gazprom after the fall of the Soviet Union. The organisational structure of GAZPROM VNIIGAZ includes research centres, an experimental and prototype base, and an R&D and design affiliation in Ukhta (Severnipigaz Ltd.). It employs over 1 300 research associates, experts and specialists (including over 50 doctors of sciences and 200 candidates of sciences), while Severnipigaz Ltd. employs a further 600 research associates, experts and specialists. Gazprom VNIIGAZ has more than 170 domestic patents (plus half a dozen in foreign countries). It also manages postgraduate courses and hosts dissertation councils in seven research areas which examine PhD and MPhil theses.

Lukoil is the largest producer of crude oil in Russia with total sales in 2009 of USD 81 billion. Its activities take place mostly in Russia and the CIS (Commonwealth of Independent States), though it has recently acquired refining capacity in the Netherlands and is active in exploration and field development in Latin America and the Middle East. Its main activity is exploration and production. In 2008-09, Lukoil spent around USD 100 million (0.7% of its operating profit) on R&D, a 58% increase on the previous year (BIS, 2010). This included expenditures on around 800 projects in support of its exploration and production activities for about 90% of the R&D budget. One of the company's most important technology development areas has been enhanced oil recovery (EOR), the method used for 20% of its total oil production in 2009. Also in 2009, the company drafted its first medium-term R&D plan for 2010-11 for more than USD 200 million. The company also entered into technical development partnerships with AvtoVaz and Novolipetsk Steel to develop lubricants that meet international standards and have the potential to substitute for currently imported products. It also collaborates with public science institutes in developing production technologies for oils, lubricants and additives suited to use in modern machinery. In 2009, Lukoil began co-operation with the state corporation, RUSNANO, on commercialisation of nanotechnologies and their applications in the oil and gas industry.

Norilsk Nickel is the world's largest producer of nickel and palladium and one of the leading producers of platinum and copper. It is involved in prospecting, exploration, extraction, refining and metallurgical processing of minerals, as well as in production, marketing and sale of base and precious metals. Norilsk Nickel's production facilities are located on three continents and in five countries: Russia, Australia, Botswana, Finland and South Africa. Its main shareholders are the conglomerate Interros and United Company Rusal. The company has a dedicated research and engineering business unit whose main objective is to provide a complete range of engineering services from blueprinting and design to project management, implementation and commissioning. A large part of its research activity is performed at the Gipronickel Institute in Saint Petersburg, which was established in 1934 and in 1990 became part of an integrated state concern that was subsequently privatised. Today, it has more than 500 employees. In 2007, other Russian R&D institutes were united with Gipronickel, including a former design bureau located in Norilsk (Norilskproject Institute, founded in 1938), an experimental research centre also in Norilsk (Mining and Metallurgical Research Centre, founded in 1938) and another design bureau located in Monchegorsk. The major goal of this reorganisation has been to increase the efficiency of in-house scientific research and technology development by improving asset management, reducing R&D costs, and introducing a contract basis for conducting research.

…/…

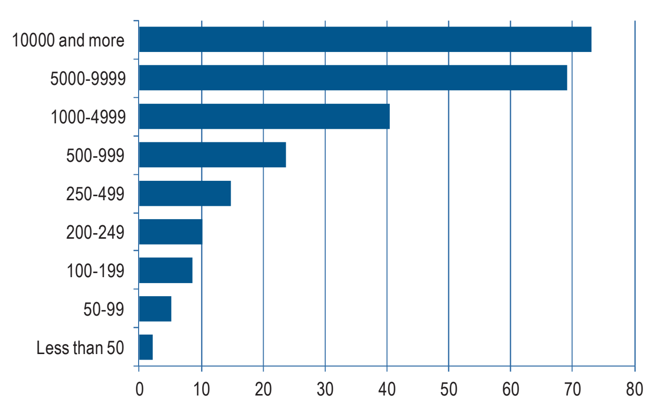
Box 2.6. R&D activities of leading Russian conglomerates *(continued)*

Sistema is the largest diversified public financial corporation in Russia and the CIS. It invests in and is a major shareholder of companies in the sectors of telecommunications, high technology, oil and energy, radars and aerospace, banking, retail, mass media, tourism and health-care services. Founded in 1993, the company has built its research base from scratch in several fields, *e.g.* telecommunications, rather than integrate former state-owned R&D institutes which tended not to possess the necessary competencies in the rapidly developing information and communication technologies (ICTs) (Filippov, 2008). In 2006, Sistema began establishing market-oriented R&D centres in each of its main businesses. It also created a Department for Innovation Projects to identify and co-ordinate priority R&D projects for each business area and the corporation as a whole. This department is also responsible for developing more systematic and efficient modes of collaboration with industrial research institutes and universities. For example, one of its member companies, Sitronics, has established a research institute jointly with the Institute for Information Transmission Problems of the Russian Academy of Sciences in Moscow. The centre will develop technology with future commercial potential for Sitronics and its main business divisions, and develop prototypes for data transmission systems, wireless networks and voice recognition systems, among other technologies. In Dubna, Sistema is building an engineering centre (Dubna Machine Building Factory) and a nanotechnology centre for use by Sitronics, Rosnano and the United Institute for Nuclear Research (OIYaI). In Zelenograd, there are plans to build a technology park for innovation around the National Research Institute for Precise Engineering (NIITM) and a centre for nanoelectronics, jointly with Rosnano. The company has also invested in the creation of the Sistema-Sarov Technopark near a large world-class scientific centre, the Russian Federal Nuclear Centre and All-Russian Research Institute of Experimental Physics (RFNC-VNIIEF), a notable defence industry centre. Finally, Sistema has established its own corporate university to train the specialists it needs.

Source: Relevant company websites and annual reports.

Russia's firm ecology also includes a growing population of small and medium-sized enterprises (SMEs). There is little available data on the R&D activities of SMEs, as they are mostly believed to be insufficient to warrant dedicated data collection. However, some data on innovation activity in SMEs are collected by the Russian innovation survey and show levels of innovativeness to be very low and to tail off dramatically at smaller firm sizes (Figure 2.24).[6] The barriers to innovation highlighted earlier, particularly for financing, are even greater for SMEs. Credit to SMEs is expensive and interest rates are higher in remote regions than in large cities. Other barriers, such as relatively weak intellectual property rights (IPR) arrangements and the dominance of large firms, are also likely to help explain the low levels of innovativeness among Russian SMEs.

Figure 2.24. Percentage of innovative enterprises, by firm size (2008)



Source: HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

In recent years, the interests of SMEs have been defended by OPORA, the All-Russian Non-Governmental Organisation of Small and Medium-Sized Business. This organisation continues to lobby hard for improvements in the framework conditions that would allow more SMEs to engage in innovation. It has recently carried out analysis and consultation on the measures needed (OPORA, 2010). These include measures to address unfavourable framework conditions and policy co-ordination failures. Some of these are taken up in Chapter 3.

Finally, many foreign firms have established operations in Russia, though to a far lesser degree than in more western former communist countries. Because the Soviet Union was an autarky, the presence of foreign firms is a relatively recent phenomenon. Investors have been drawn to Russia in search of three main things: natural resources, new markets and efficiency gains (Box 2.7). Resource-seeking investments are perhaps the largest and are concentrated in the oil and gas sectors. Market-seeking investments focus on food, beverages, tobacco and telecoms. Russia has also attracted some technology-based, efficiency-type investment (Gijsbers and Roseboom, 2006), which offers great potential for modernising the Russian economy.

Box 2.7. Multinational enterprises' rationales for foreign investment

In a widely used categorisation of the rationales for foreign direct investment (FDI) by multinational enterprises (MNEs), Dunning (1993) distinguished four main categories:

Natural resource seekers: Enterprises are prompted to invest abroad to acquire particular resources, perhaps of higher quality and/or of lower cost than can be obtained, if at all, in their home country. Most of the output of this type of production tends to be exported, typically to more developed industrialised countries.

Market seekers: Enterprises invest in a particular country or region to supply goods and services to them and/or to adjacent territories.

Efficiency seekers: Enterprises rationalise the structure of established resource-based or market-seeking investment by concentrating production in a limited number of locations to supply multiple markets. Such investments aim to take advantage of different factor endowments offered by different locations as part of their co-ordinated global operations.

Strategic asset seekers: Enterprises seek to promote their long-term strategic objectives, often by acquiring the assets of foreign firms. The motive is therefore less to exploit cost or marketing advantages than to augment portfolios of physical assets and human competences.

Many of the larger MNEs pursue multiple objectives that include two or more of the above categories. The motives for foreign investment may also change over time, shifting from natural resources and markets to efficiency and strategic assets. The categorisation obviously applies to both inward and outward FDI and can be used to explore the rationales of foreign firms investing in Russia and of Russian firms investing abroad.

Source: Based on Dunning (1993).

Box 2.8 gives examples of efficiency-seeking investment, while Table 2.2 shows that foreign firms dominate the list of Russian-based organisations receiving five or more US Patent and Trademark Office (USPTO) utility patents in the five years to 2009. With its highly educated workforce and sophisticated R&D infrastructure, Russia should be well placed to attract far more of this type of investment. Currently, 7% of Russian BERD is accounted for by funding from abroad, a proportion that puts Russia in a median position compared to OECD countries. It should probably be doing much better given its factor endowments in knowledge. Raising the level of investment will depend not only on improving the framework conditions for innovation, but also on the success of measures aimed at modernising the national research base.

Table 2.2. Rank-ordered listing of Russian-based organisations receiving five or more USPTO utility patents (2005-09)

First-named assignee	2005	2006	2007	2008	2009	Total
Individually owned patent	*37*	*38*	*48*	*30*	*44*	*197*
LSI Logic Corporation	8	10	7	10	3	38
Intel Corporation	2	2	7	13	11	35
Ajinomoto Company Incorporated	4	4	7	5	8	28
Kaspersky Lab, ZAO	**0**	**0**	**0**	**4**	**12**	**16**
Samsung Electronics Co., Ltd.	0	3	6	3	4	16
Clontech Laboratories, Inc.	1	1	5	7	1	15
Schlumberger Technology Corporation	1	4	3	2	5	15
LG Electronics Inc.	0	3	3	2	2	10
Nitto Denko Corporation	1	6	2	0	1	10
Corel Corporation	2	2	4	1	0	9
SWsoft Holdings, Ltd.	0	1	0	5	3	9
Acronis Inc.	**0**	**1**	**1**	**3**	**3**	**8**
ASML Netherlands B.V.	1	1	1	1	4	8
ExxonMobil Chemical Patents Inc.	0	0	4	1	3	8
Quintura, Inc.	**0**	**0**	**0**	**1**	**7**	**8**
Topcon GPS LLC	3	1	1	1	2	8
Airgain, Inc	0	1	3	1	2	7
InnaLabs Technologies, Inc.	**0**	**3**	**3**	**0**	**0**	**6**
Airbus S.A.S.	0	0	0	3	2	5
Basell Polyolefine GMBH	1	1	1	0	2	5
Corning Incorporated	1	3	0	1	0	5
D Data Inc.	0	2	1	2	0	5
Elbrus International Ltd.	**1**	**4**	**0**	**0**	**0**	**5**
Ferrolabs, Inc.	0	2	1	2	0	5
General Electric Company	3	1	0	1	0	5
Scantech Holdings, LLC	0	1	3	0	1	5
XVD Corporation	4	0	1	0	0	5

Note: Companies in **bold** are Russian-owned.

Source: USPTO website, accessed September 2010.

Box 2.8. Examples of foreign firms' R&D activities in Russia

Schlumberger established its Schlumberger Moscow Research Centre (SMR) in 1998 and operated initially through collaborative projects with universities. The first dedicated research facility was officially opened in 2003, and at the end of 2010, SMR moved to a new state-of-the-art facility next to the campus of Moscow State University, a major research and educational hub. The new SMR facility, which comprises office space, an experimental laboratory, and a supercomputer, houses approximately 100 researchers. SMR is a centre of excellence in borehole seismics and acoustics, reservoir physics, and well-testing research. Its research programmes capitalise on a collaborative network with the Russian academic community and customers that enables the production of world-class products and services. Research at SMR focuses on specific challenges in hydrocarbon exploration and production in Russia, including gas condensates, mature oil and gas fields, heavy oil, and operations in arctic and permafrost conditions. .../…

Box 2.8. Examples of foreign firms' R&D activities in Russia *(continued)*

Airbus signed an extensive long-term agreement with the Russian Aerospace Agency in 2001 on a programme of work that covers research and technology projects, design work, material procurement, product manufacturing and component delivery, as well as co-operation in the certification field. In the wake of this agreement, Airbus and the Kaskol Group jointly created an Airbus engineering centre in Moscow in 2002, the first Airbus engineering facility to open in Europe outside the company's home countries. Equipped with state-of-the-art communication equipment and linked with Airbus engineering sites in France and Germany, the centre performs extensive work in disciplines such as fuselage structure, stress, systems installation and design. The centre employs 190 engineers working across several Airbus product lines. Airbus continues to actively explore opportunities with the Russian aviation industry, and several research and technology projects are currently under way with the participation of Russian engineers and specialists.

Intel set up its Intel Lab Saint Petersburg in 2004. It carries out R&D on hardware and software technologies to improve connectivity and application performance on Intel platforms. Current research includes reconfigurable data-streaming accelerators, software tools for system-on-a-chip (SoC), and workload characterisation and optimisation on mobile Intel platforms. The Lab has also made major contributions in the areas of advanced forward-error correction techniques, methods to improve the quality of video over wireless, the standardisation and regulation of wireless technologies in Europe, and reconfigurable baseband processors to enable radios that support multiple wireless standards. The Lab collaborates closely with academic communities in Saint Petersburg and elsewhere in Russia.

Source: Relevant company websites, accessed December 2010.

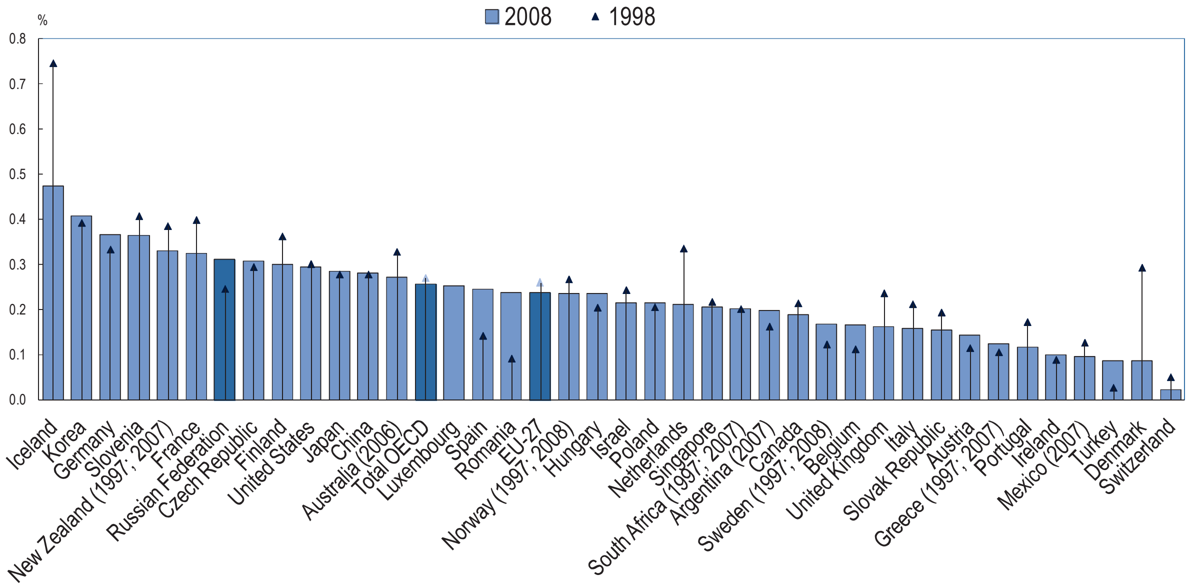
2.2. Public research institutes

The government research sector, excluding the branch institutes covered in the previous section, accounts for around 30% of the R&D performed in Russia. This is a high proportion by international standards (Figure 2.25) and reflects the separation of basic research from education in dedicated science academies. The vast majority of its funds typically come from the government, but the share of business funding has increased slightly since 1995 to account for 12% of the total in 2008 (Figure 2.26). The government research sector involves more than the science academies and most ministries have a number of associated research centres that support policy. This explains the mix of types of R&D performed in the sector; applied research and experimental development accounted for more than half of the total in 2008, a proportion that has changed little since 1995 (Figure 2.27).

This sector is responsible for most of the basic research performed in Russia, much of it performed by the institutes of the various academies of science. In 2008, the academies had 865 R&D institutes, more than half of which belonged to the Russian Academy of Sciences (RAS) (Table 2.3). The remaining institutes belong to field-specific academies: the Russian Academy of Agricultural Sciences, the Academy of Medical Sciences, the Academy of Fine Arts, the Academy of Architecture and Construction Sciences, and the Academy of Education. Their budgets, altogether, amount to less than one-third of the RAS budget.

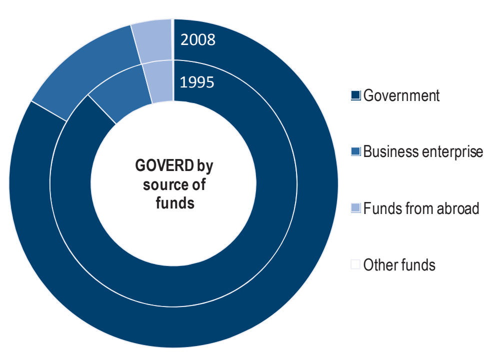
In addition, a new type of institute, the national research centre, has been established since 2008. At the time of writing, just one, the Kurchatov Institute, has been established. It is expected to provide a platform for the development of breakthrough advances in key technologies in which Russia would like to develop or maintain world leadership. The Kurchatov Institute is described in more detail in Chapter 3. This section focuses, for the most part, on the various academies of science, which account for a little over half of Russian government-funded R&D (GOVERD).

Figure 2.25. Research performed in government research institutes, 1998 and 2008 (percentage of GDP)



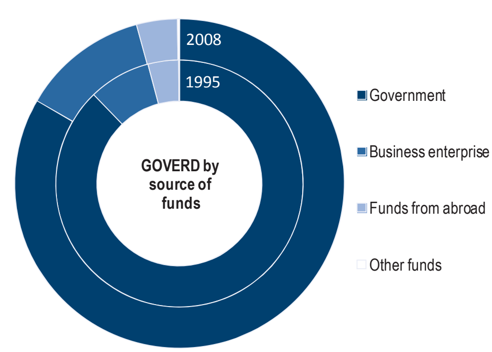
Source: OECD (2010a), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

Figure 2.26. GOVERD by source of funds



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.27. Percentage distribution of GOVERD by type of activity, 1995 and 2008



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Table 2.3. Number of academy R&D institutes (2000-08)

	2000	2003	2005	2006	2007	2008
Russian Academy of Sciences*	454	463	451	465	479	468
Russian Academy of Agricultural Sciences	291	286	297	292	312	304
Russian Academy of Medical Sciences	62	67	66	68	69	68
Russian Academy of Architecture and Construction Sciences	5	5	5	6	6	5
Russian Academy of Education	17	17	17	19	22	18
Russian Academy of Arts	2	1	1	1	3	2
Total	**831**	**839**	**837**	**851**	**891**	**865**

Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

2.2.1. The Academies of Science

The Russian Academy of Sciences is by far the largest of the academies of science and the largest research performer in Russia. It accounted for around 14% of Russian GERD in 2008 (Table 2.4). Founded by Peter the Great in 1724, the RAS is a self-governing non-profit organisation with public status. It is the home of Russia's scientific elite, and its members enjoy significant privileges (in terms of income, access to public services such as health care, etc.). RAS is a prestigious learning society but also a powerful R&D actor with its own network of institutes. It includes several regional affiliates: the Urals, Siberian and Far Eastern branches. The RAS employs around half of Russia's doctors of science and performs more than 50% of the country's basic research; 68% of its resources come directly from the government budget and 32% from other sources, including 24% from contract and entrepreneurial activities and rental incomes. Government funding amounted to 88% of total expenditure in 2008, up from 82% in 2002, while funding from the business sector decreased slightly to account for 10% of the total (Figure 2.28). The allocation of resources among different thematic branches is given in Table 2.4, which shows the relative importance of traditional disciplines, including mathematics, physics and chemistry, which together absorb approximately half of the total funding.

Table 2.4. R&D activities of the Russian Academy of Sciences

Share of the Russian Academy of Sciences (RAS) in national R&D activities
Selected indicators (%)

	2001	2004	2007	2008*
Doctors of sciences	43.2	43.4	41.4	50.7
Fixed assets	12.2	20.3	20.2	22.4
R&D performance	12.0	12.5	12.1	13.9
R&D expenditures	10.1	11.1	11.9	12.3

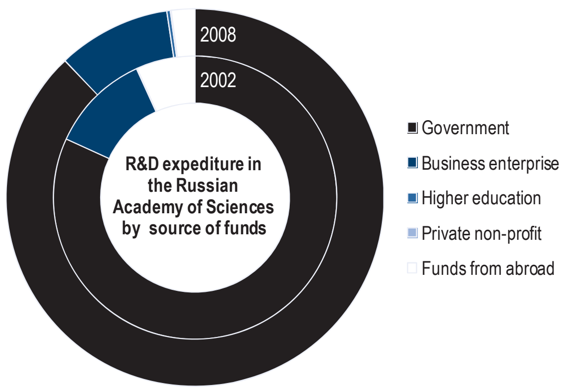
*estimates.

R&D expenditures by research field
RUB billion, 2009

Mathematical sciences	64
Physical sciences	180
Energy, machine building, mechanics and process management	75
Nanotechnology and IT	64
Chemistry and material sciences	116
Biology	65
Earth sciences	75
Social sciences	26
History and philology	25

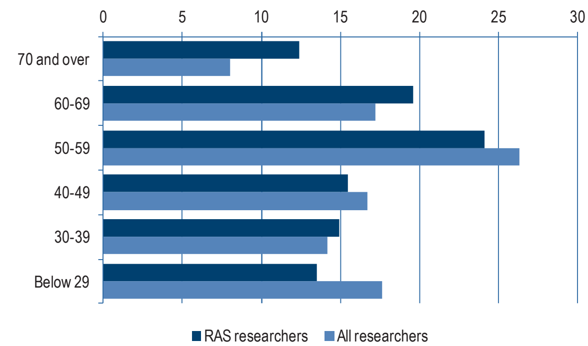
Source: Ministry of Education and Science.

Figure 2.28. Intramural R&D expenditure in the Russian Academy of Sciences by source of funds



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.29. Percentage age distribution of researchers in the Russian Academy of Sciences compared to all researchers in Russia (2008)



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

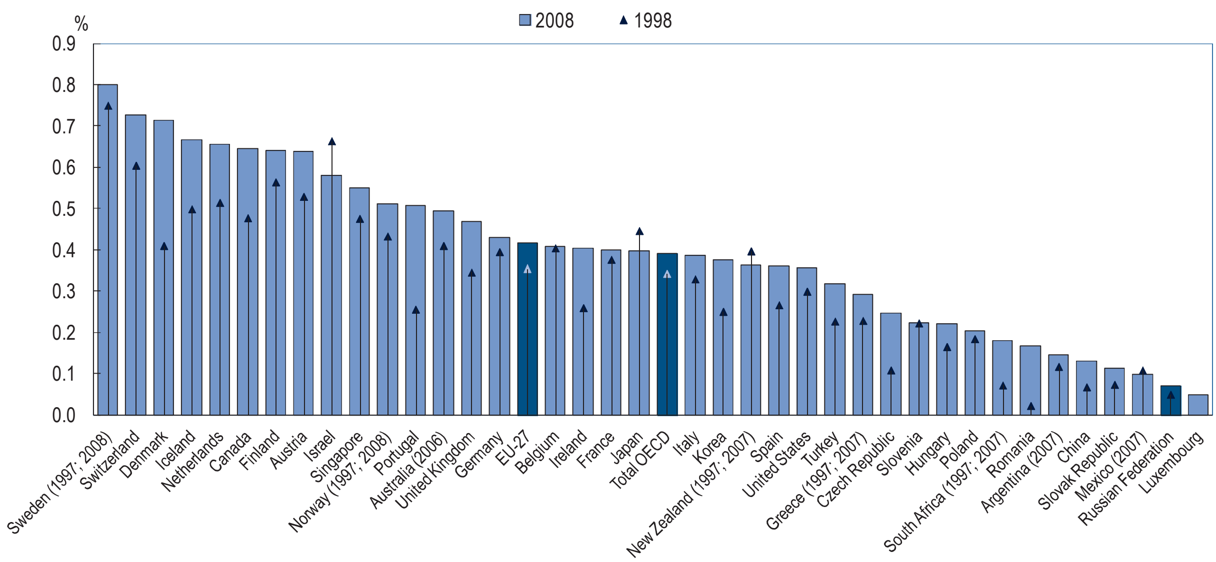
The RAS is a prestigious learning society and its researchers' outstanding contributions to the advancement of science are a legitimate source of national pride. However, for a long time it has also been the subject of severe criticism, with claims that it misuses its prestige to resist the necessary reforms of the Russian science system, including the reinforcement of the research role of universities. On the one hand, when these criticisms make the RAS a scapegoat for all of the problems of the Russian innovation system, they are certainly excessive. On the other hand, a more balanced and objective judgement is hard to make since there has never been a thorough and systematic evaluation of the Academy and its institute network. This in itself indicates some problems. There is much anecdotal evidence that RAS institutes mix real gold with a large quantity of lead. It has been estimated that perhaps only half of the statutory researchers of the Academy are engaged in real research (ERA Watch, 2010). The reasons for such weak performance are manifold and include low salaries (for non-academicians), which means many RAS staff have to support their incomes through other means; obsolescent research infrastructure and equipment;[7] an aged workforce, with almost one-third of RAS researchers 60 years or older (Figure 2.29); weak incentives in the shape of rewards and punishments, with a large proportion of RAS institutes' funding taking the form of block grants based on headcounts rather than on performance; and more generally, underdevelopment of monitoring and evaluation arrangements.[8]

Of the field-specific academies, the Russian Academy of Agricultural Sciences (RAAS) and the Academy of Medical Sciences (RAMS) are the most significant and most relevant for this review. The RAAS was founded in 1929 and concentrates the key scientific potential of Russia's agro-industrial complex. It employs close to 30 000 staff in more than 300 R&D institutes with 13 200 researchers, 150 academicians and 145 corresponding members. The RAMS was founded in 1944 and today has 68 R&D institutes employing around 13 000 staff, 8 000 of whom are researchers.

2.3. Higher education institutes as research performers

Higher education institutes (HEIs) perform just 7% of Russia's GERD, a relatively low proportion compared to OECD countries. Higher education expenditure on R&D (HERD) as a percentage of GDP stood at 0.07% in 2008, lower than in all OECD countries except Luxembourg (Figure 2.30). This low level of R&D activity has changed little since the late Soviet period and is a legacy of the latter's organisational separation of research and education. Although research by HEIs was recognised at the legislative level during Soviet times, it was not included in the centralised planning and financing system described above. Financing of research activity by HEIs came primarily from agreements with industrial enterprises and research organisations. As a result, only a small number of leading HEIs were active in research (HSE, 2007).

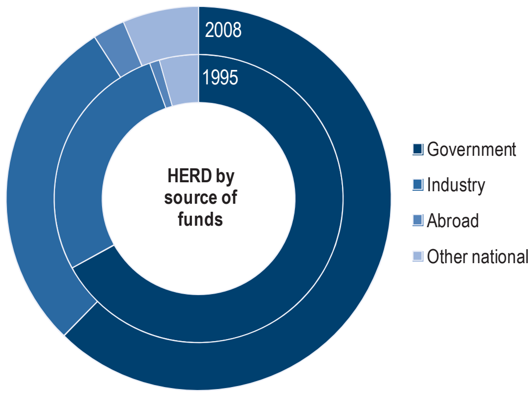
Figure 2.30. Higher education expenditure on R&D (HERD), 1998 and 2008 (percentage of GDP)



Source: OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

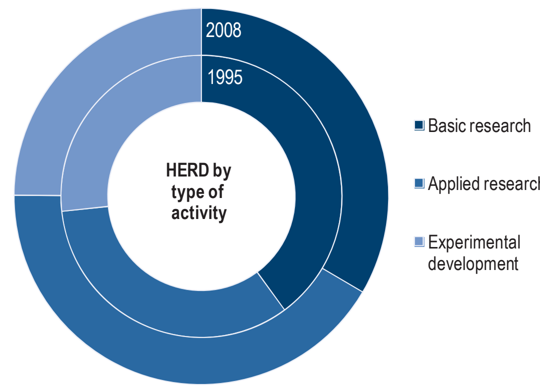
In 2008, 62% of HERD was funded by the government and 29% by industry (Figure 2.31), a rather high proportion by international standards, but more a reflection of the low levels of government support than of high levels of industry funding. This funding pattern affects the types of research performed in HEIs, with around two-thirds of R&D classified as either applied research or experimental development (Figure 2.32).

Figure 2.31. HERD by source of funds



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

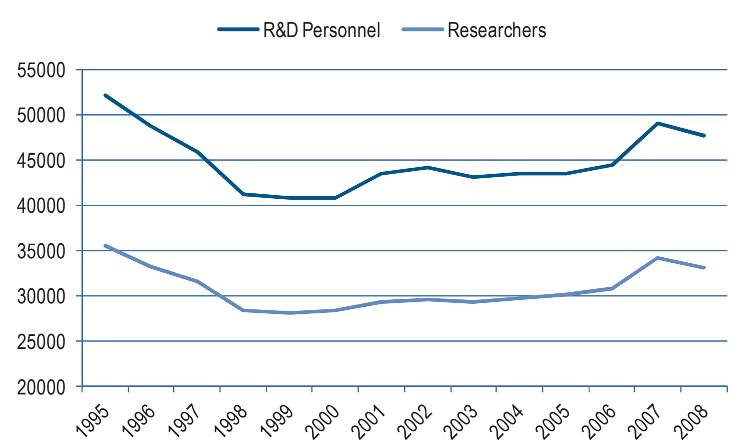
Figure 2.32. HERD by type of activity



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Although the proportion of GERD performed in HEIs remains low, there have been recent increases in the number of HEIs and HEI personnel conducting R&D. Around 500 HEIs performed R&D in 2009, up from 390 in 2000, and around 50 000 R&D personnel were employed in the sector in 2009, up from around 40 000 in 2000 (Figure 2.33). The HEI sector was therefore the only area of significant R&D growth over the last decade. This is the result of deliberate government policy – outlined in Chapter 3 – to better integrate education and research activities. The reasoning behind these moves is that academics who are regularly engaged in scientific research can more effectively pass on contemporary knowledge to students, especially graduate students. However, growth is hampered by unfavourable incentive structures and low levels of remuneration of research staff in HEIs. Faculty teaching staff tend to have heavy teaching loads and many have multiple jobs; they have little time or opportunity to engage in research. At the same time, the current practice of state budget financing discriminates against full-time researchers. Research work in HEIs is very poorly compensated as compared to teaching and thus remains unattractive to educators (HSE, 2007).

Figure 2.33. R&D personnel in the higher education sector



Source: HSE (2010b), *Science and Technology Indicators in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

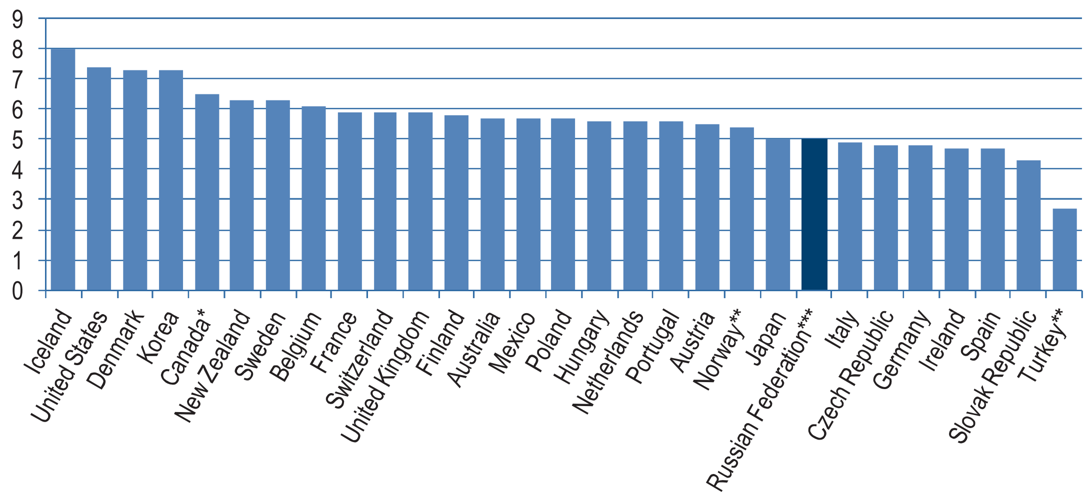
Despite these obstacles, a group of leading HEIs has actively developed research in recent years. They have strategic plans for developing their research and for their integration into international networks (Dezhina, 2011). This is a healthy development, as it brings education and research activities closer together and offers a measure of research competition with the academies of science. This should help to boost the quality and efficiency of research in Russia. But there are also important concerns. First, research-active HEIs remain poorly integrated with the institutes of the academies of science. This suggests a missed opportunity, since their complementary assets and capabilities could be usefully melded through closer co-operation on research and education. Second, increased policy emphasis on R&D in HEIs is leading to a stratification of the HEI system. This is no bad thing in itself, but should be based on a set of criteria broader than research performance and include indicators of teaching quality and "third-stream" activities. This issue is discussed further in Chapter 3.

2.4. Human resources, education and skills

Innovation depends on people. It requires people who are able to generate and apply knowledge and ideas in the workplace and in society at large. Though many skills are needed for innovation, individuals, firms and industries draw on different skill mixes at different times. Some factors likely to affect the required skill sets are the stage of innovation, the type of innovation and the industry structure. For instance, at the country level, adoption and adaptation skills will be more crucial for countries in which innovation means the introduction of products and processes "new to the firm" rather than radical inventions. They may also be needed in certain sectors in an otherwise highly advanced economy. These skills can raise economies' absorptive capacities and ability to perform incremental innovation by enabling people to better understand how things work and how ideas or technologies can be improved or applied to other areas. Importantly, adoption and adaptation skills are beneficial across the wider workforce and population, not just in R&D teams. The production workforce plays a particularly strong role in incremental innovation, when management encourages and acts on suggestions for improvement. More skilled users and consumers of products and services can also contribute to the adaptation of existing offerings by providing the supplier with ideas for improvement (OECD, 2011).

Formal education and training are an important source of skills. Figure 2.34 shows that Russia spends a proportion of its GDP on education that is comparable to that of many OECD countries, with marked increases in education spending over the last decade. Even more impressive is the educational attainment of the working adult population: 27% of 25-64 year-olds have received higher and postgraduate education. Only Norway, the United States and the Netherlands have a higher percentage of advanced qualifications among its adult population (Figure 2.35). This section includes a brief and rather selective review of the organisation and performance of the Russian education system. It begins by reporting on the comparative performance of Russia's 15-year olds in science and mathematics, before turning to the tertiary education sector. It then outlines the shape and dynamics of the R&D workforce before reporting on Russia's lifelong learning performance.

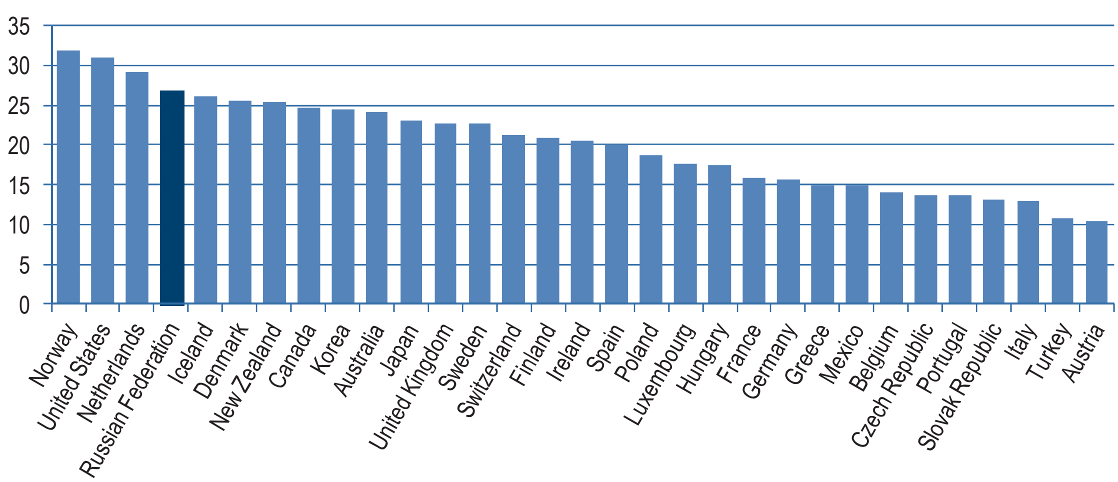
Figure 2.34. Expenditure on education as a percentage of GDP (2007 or nearest year)



*Data for 2005. **Public spending only. ***Data for 2008, including expenditure of households.

Source: HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

Figure 2.35. Educational attainment of 25-64 year-olds: Percentage with higher and postgraduate (ISCED 5A/6) education (2007 or nearest year)



Source: HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

2.4.1. Performance of 15-year olds in science and mathematics

The OECD's Programme of International Student Assessment (PISA) examines, through tests and surveys of 15 year-olds, how well individual national education systems are doing in equipping their young people with essential skills. Unlike many traditional assessments of student performance in science, PISA is not limited to measuring students' mastery of specific science content. Instead, it measures the capacity of students to identify scientific issues, explain phenomena scientifically and use scientific evidence as they encounter, interpret, solve and make decisions in life situations involving science and technology. This is important, since if students learn merely to memorise and reproduce scientific knowledge and skills, they risk being prepared mainly for jobs that are disappearing from labour markets in many countries. For today's global economy, students need to be able to solve problems for which there are no clear rule-based solutions and to communicate complex scientific ideas clearly and persuasively (OECD, 2007).

PISA also looks at student performance scores on questions that indicate students' science competencies at one of six proficiency levels (Box 2.9). While basic competencies are generally considered important for the absorption of new technology, high-level competencies are critical for the creation of new technology and innovation. For countries near the technology frontier, this means that the share of highly educated workers in the labour force is an important determinant of economic growth and social development. There is also mounting evidence that individuals with high-level skills generate relatively large externalities in terms of knowledge creation and utilisation, compared to an "average" individual. The latest round of PISA, carried out in 2009, shows Russian performance to be below that of most OECD countries. Just 4.3% of Russian students achieved proficiency levels of 5 or 6 in science, compared to an OECD average of 8.5% (Figure 2.36). Similarly for mathematics, 5.3% of Russian students achieved proficiency levels of 5 or 6 compared to an OECD average of 12.7% (Figure 2.37).

Box 2.9. The OECD's PISA: Definitions of literacy and proficiency in science and mathematics

PISA defines *scientific literacy* as an individual's scientific knowledge, and use of that knowledge, to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues; their understanding of the characteristic features of science as a form of human knowledge and enquiry; their awareness of how science and technology shape our material, intellectual and cultural environments; and their willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen. PISA examines both the cognitive and affective aspects of students' competencies in science. The cognitive aspects include students' knowledge and capacity to use this knowledge effectively, as they carry out certain cognitive processes that are characteristic of science and scientific enquiries of personal, social, or global relevance.

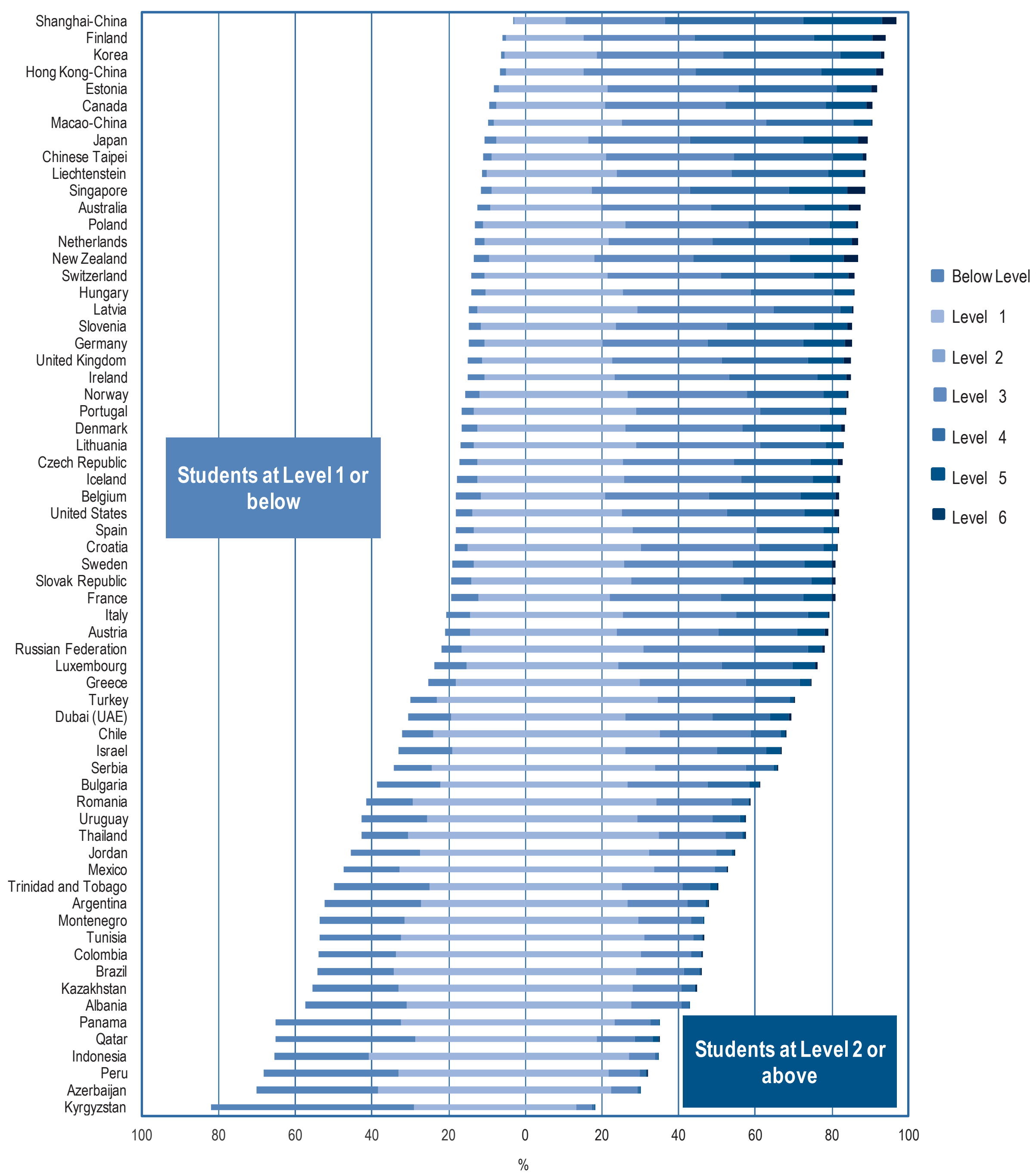
Summary descriptions for the six levels of proficiency in science

Level	What students can typically do
6	At Level 6, students can consistently identify, explain and apply scientific knowledge and knowledge about science in a variety of complex life situations. They can link different information sources and explanations and use evidence from those sources to justify decisions. They clearly and consistently demonstrate advanced scientific thinking and reasoning, and they demonstrate willingness to use their scientific understanding in support of solutions to unfamiliar scientific and technological situations. Students at this level can use scientific knowledge and develop arguments in support of recommendations and decisions that centre on personal, social or global situations.
5	At Level 5, students can identify the scientific components of many complex life situations, apply both scientific concepts and knowledge about science to these situations, and can compare, select and evaluate appropriate scientific evidence for responding to life situations. Students at this level can use well-developed inquiry abilities, link knowledge appropriately and bring critical insights to situations. They can construct explanations based on evidence and arguments based on their critical analysis.
4	At Level 4, students can work effectively with situations and issues that may involve explicit phenomena requiring them to make inferences about the role of science or technology. They can select and integrate explanations from different disciplines of science or technology and link those explanations directly to aspects of life situations. Students at this level can reflect on their actions and they can communicate decisions using scientific knowledge and evidence.
3	At Level 3, students can identify clearly described scientific issues in a range of contexts. They can select facts and knowledge to explain phenomena and apply simple models or inquiry strategies. Students at this level can interpret and use scientific concepts from different disciplines and can apply them directly. They can develop short statements using facts and make decisions based on scientific knowledge.
2	At Level 2, students have adequate scientific knowledge to provide possible explanations in familiar contexts or draw conclusions based on simple investigations. They are capable of direct reasoning and making literal interpretations of the results of scientific inquiry or technological problem solving.
1	At Level 1, students have such a limited scientific knowledge that it can only be applied to a few, familiar situations. They can present scientific explanations that are obvious and follow explicitly from given evidence.

PISA defines *mathematical literacy* as an individual's capacity to formulate, employ and interpret mathematics in a variety of contexts. This includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. Mathematical literacy also helps individuals recognise the role that mathematics plays in the world and make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens. In the PISA assessments, mathematical literacy is demonstrated through students' ability to analyse, reason and communicate effectively as they pose, solve and interpret mathematical problems that involve quantitative, spatial, probabilistic or other mathematical concepts.

Source: OECD (2010b), *PISA 2009 Results: What Students Know and Can Do – Volume I*, OECD, Paris.

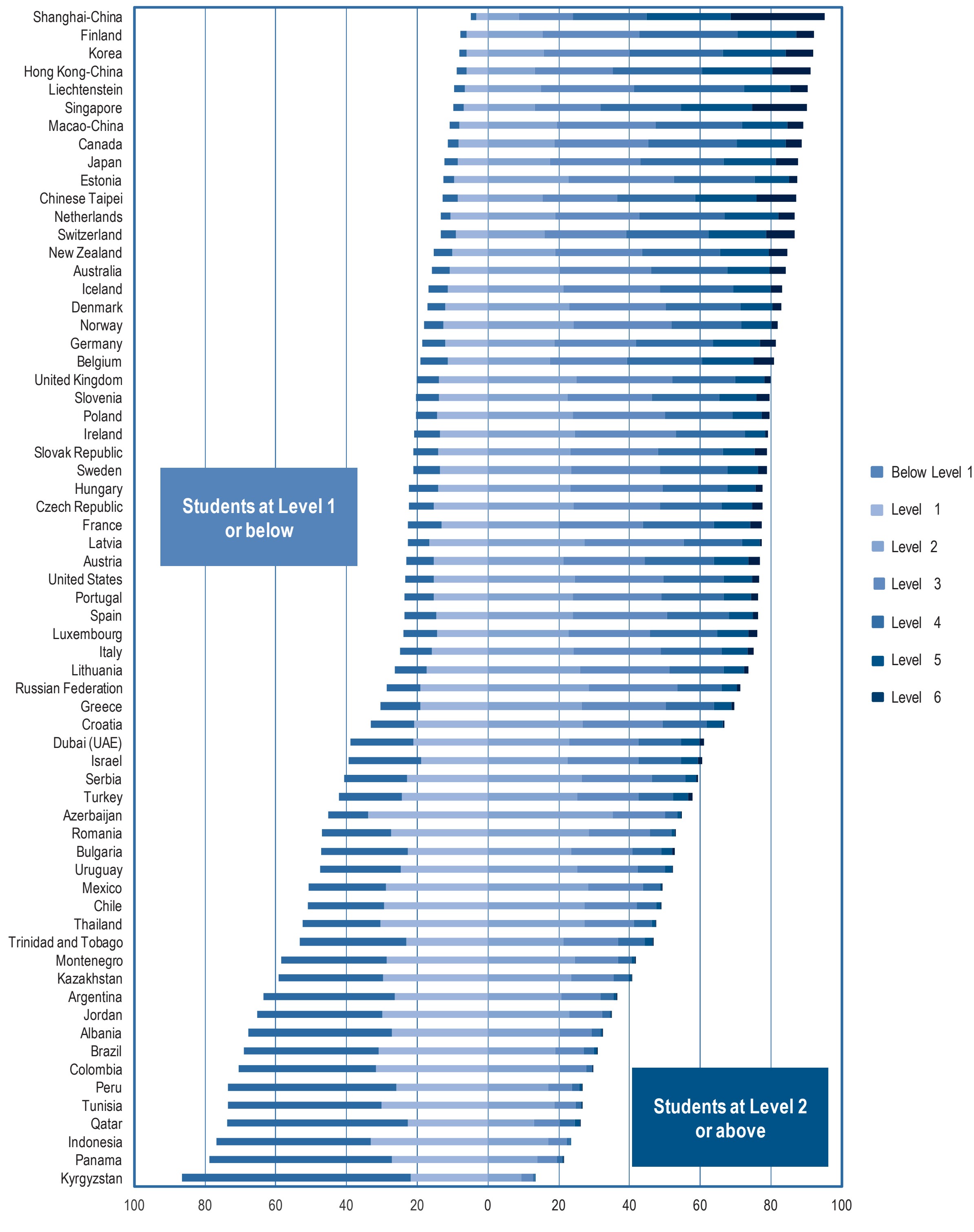
Figure 2.36. PISA 2009 proficiency in science



Note: Countries are ranked in descending order of the percentage of students at Levels 2, 3, 4, 5 and 6.

Source: OECD (2010b), *PISA 2009 Results: What Students Know and Can Do*, Volume 1, OECD, Paris.

Figure 2.37. PISA 2009 proficiency in mathematics



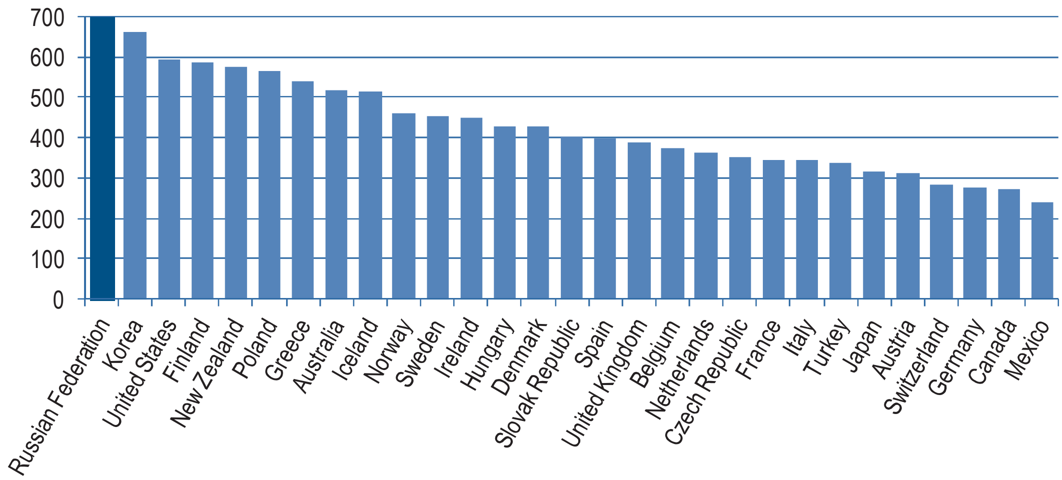
Note: Countries are ranked in descending order of the percentage of students at Levels 2, 3, 4, 5 and 6.

Source: OECD (2010b), *PISA 2009 Results: What Students Know and Can Do*, Volume 1, OECD, Paris.

2.4.2 Tertiary education

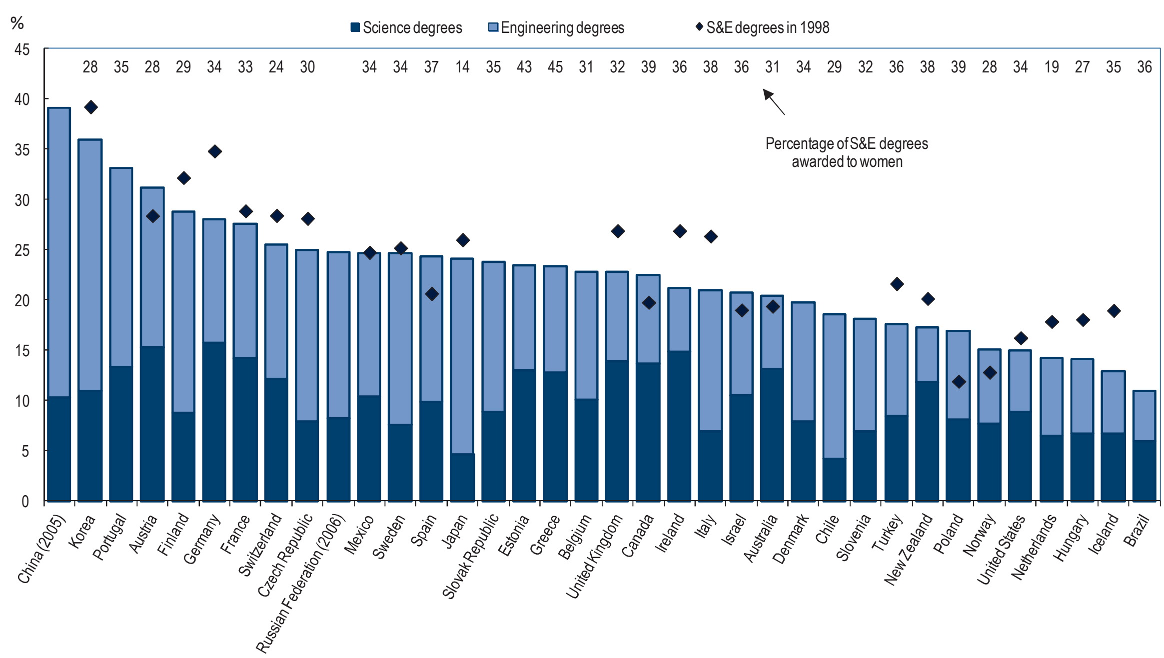
A large proportion of Russians have higher and postgraduate education. Figure 2.38 shows that this is more than a Soviet legacy, with contemporary Russia having more of its population enrolled in tertiary education than any OECD country. Around one-quarter of the new degrees awarded are in science and engineering disciplines, a slightly higher proportion than in most OECD countries (Figure 2.39).

Figure 2.38. Tertiary education (ISCED 5/6) enrolment per 10 000 population (2008, head count)



Source: HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

Figure 2.39. Science and engineering degrees as percentage of total new degrees, 2007



Source: OECD (2010a), *Science, Technology and Industry Outlook 2010*, OECD, Paris.

Several different types of HEIs operate in Russia (Box 2.10). They can be further classified by their ownership status: public institutions include those owned by the federal and regional authorities as well as municipalities; private educational institutions include those owned by private persons or commercial and non-commercial organisations. Education in the private institutes is always self-financed and cannot be funded by state budgets. By contrast, students attending public institutes can have their studies funded by state budgets (federal or regional). After Russia's accession to the Bologna Convention in 2007, the government decided on a transition to a mostly two-tier system (bachelor-master). Some HEIs have already adopted this system. However, the majority of graduates continue to study longer for specialist degrees.

Box 2.10. Types of higher education institutes

In Russia, a higher education institute is defined as an organisation providing higher professional education in accordance with state accreditation. There are three types of HEIs:

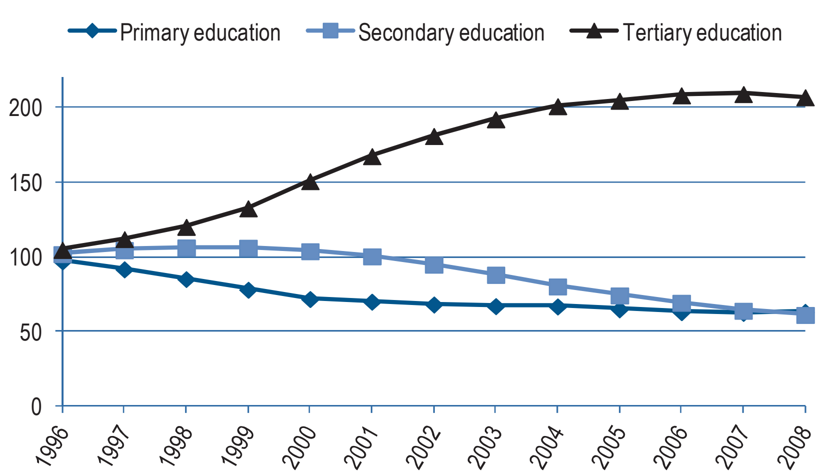
- Universities – multi-disciplinary HEIs performing education programmes and research in multiple areas of knowledge.
- Academies – focused on particular areas, such as agriculture, health, arts.
- Institutes – HEIs providing education services in certain narrow areas.

Source: Gokhberg *et al.* (2009), "Towards a New Role of Universities in Russia: Prospects and Limitations", *Science and Public Policy*, 36(2), pp. 121–126.

Demographic change has yet to have an impact on the numbers of new graduates. Figure 2.40 shows how the catastrophic fall in birth rates during the 1990s has fed through to levels of enrolments in education. The years 1995-2000 saw steep falls in enrolments in primary education. From 2000 to 2005, enrolments continued to decline at a slower rate and have since stabilised. Nevertheless, enrolment rates in 2008 were just 64% of what they were in 1995. Signs of demographic decline reached the secondary education level by 2000, with the situation stabilising only in the last couple of years. Reflecting the picture in primary education, secondary education enrolment rates in 2008 were just 62% of what they were in 1995.

Figure 2.40. Trends in education enrolment (1995-2008)

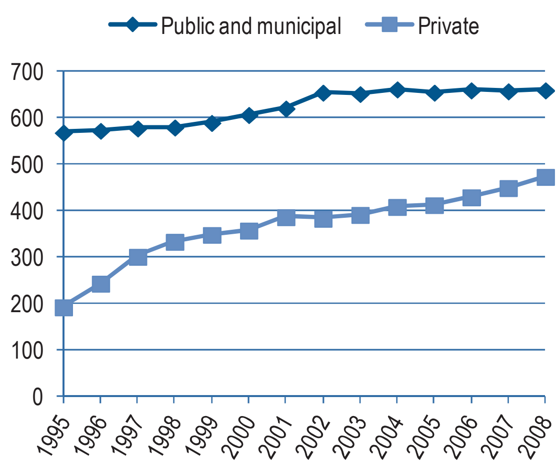
1995 = 100%



Source: OECD calculation, based on HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

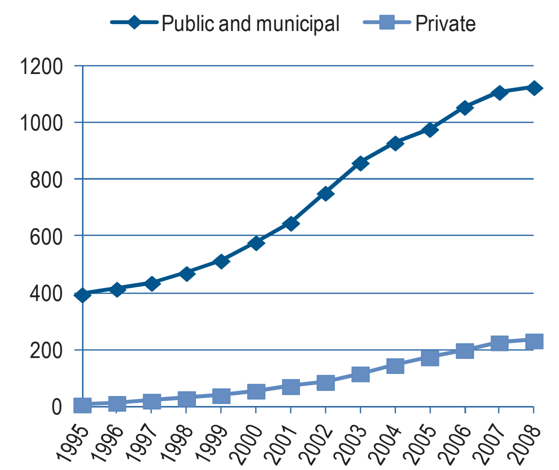
However, rates of tertiary education enrolments have soared over the last 15 years (Figure 2.40). There are a couple of important reasons for this. First, during the Soviet era, the number of specialists trained at the ISCED 5A level was strictly controlled. In 1990, for every 100 enrolments in secondary vocational colleges (ISCED 5B), there were just 63 enrolments in HEIs offering higher professional ISCED 5A training, a proportion that had remained more or less the same over the previous two decades. When these controls were removed in the early 1990s, the pent-up demand for ISCED 5A education led to a massive expansion in student numbers. A second reason is the expansion of part-time enrolments in ISCED 5A programmes, some in a new generation of privately owned HEIs (Figure 2.41). That being said, public and municipal HEIs, despite increasing their number only slightly over the last fifteen years, account for most of the expansion in bachelor graduation rates over the same period (Figure 2.42). As the total number of places funded by the state budget has remained practically unchanged since the 1970s, the expansion has been self-financed by students and their families.

Figure 2.41. Number of public and private institutes offering bachelor degrees



Source: HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

Figure 2.42. Number of graduates with bachelor degrees (thousands)

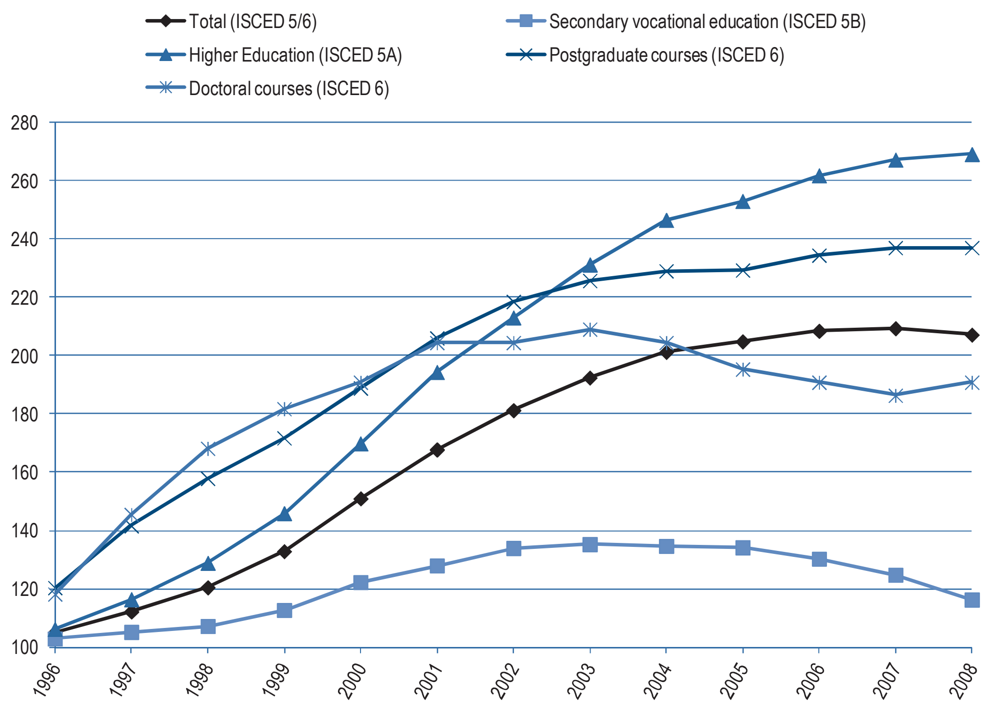


Source: HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

Clearly, this expansion cannot continue. The demographic decline that has so far had a major impact only on primary and secondary education is set to hit the tertiary education sector hard. Figure 2.43 suggests that 2007 may have been the turning point and that enrolments can be expected to fall quite sharply until 2015 before flattening out at a level considerably below the current one. Figure 2.43 also shows that vocational colleges have so far suffered the most. This is due in part to a "qualification inflation" phenomenon also seen in many OECD countries, with young people deserting vocational courses for degree programmes on account of their relative prestige. But it also reflects underinvestment in the "Cinderella" vocational education sector, as well as partial deindustrialisation of the economy since Soviet times. Figure 2.44 shows the relative shift from vocational education to higher education institutes, with the former's share of enrolments declining from 40% of the total in 1995 to just 23% in 2008. Furthermore, an increasing number of those studying in vocational institutes view them more as a "stepping stone" to higher education institutes. In 2007, 25% of entrants to degree programmes in public and municipal higher education had recently attained a qualification from a secondary vocational education institute, up from 18% in 1995 (Figure 2.45).

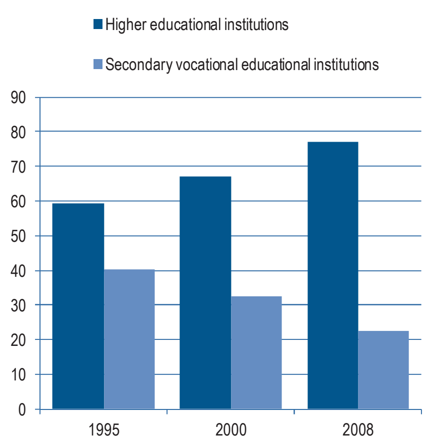
Figure 2.43. Trends in enrolment in tertiary education (1995-2008)

1995 = 100%



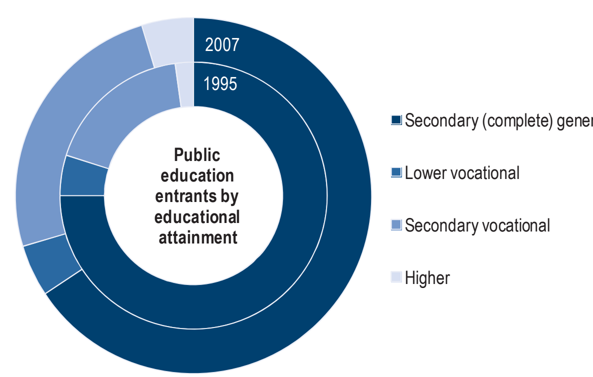
Source: OECD calculations based on HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

Figure 2.44 Percentage distribution of tertiary education (ISCED 5/6) enrolment by type of institution



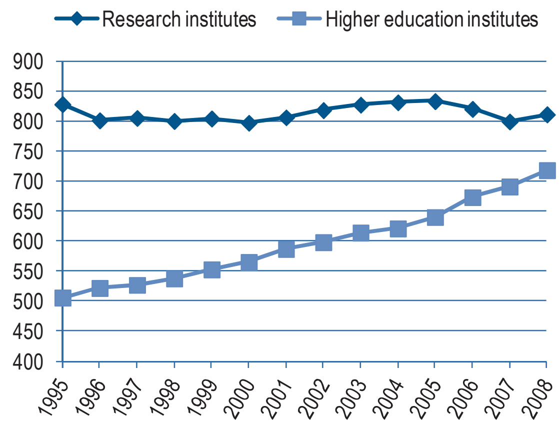
Source: HSE (2010c), *Indicators of Education in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.45. Public and municipal higher education entrants by educational attainment (percentage), 1995 and 2007



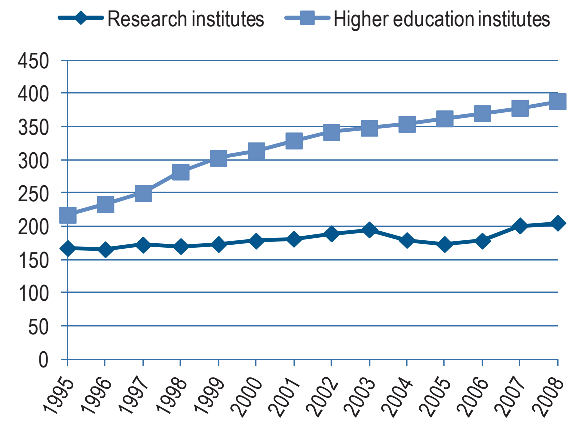
Source: HSE (2010c), *Indicators of Education in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.46. Number of institutes offering postgraduate courses



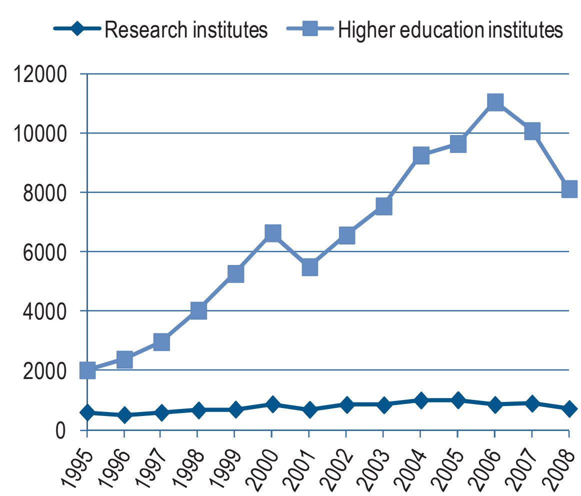
Source: HSE (2010c), *Indicators of Education in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.47. Number of institutes offering doctoral courses



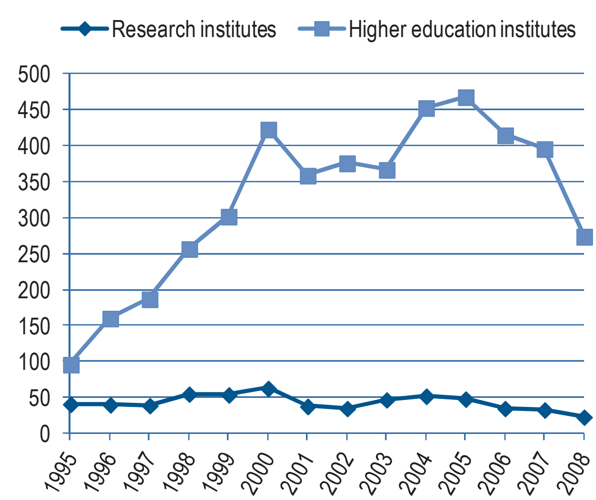
Source: HSE (2010c), *Indicators of Education in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.48. Number of postgraduates with defended dissertation, by type of institute (headcount)



Source: HSE (2010c), *Indicators of Education in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.49. Number of doctoral graduates by type of institute



Source: HSE (2010c) *Indicators of Education in the Russian Federation*, Higher School of Economics, Moscow.

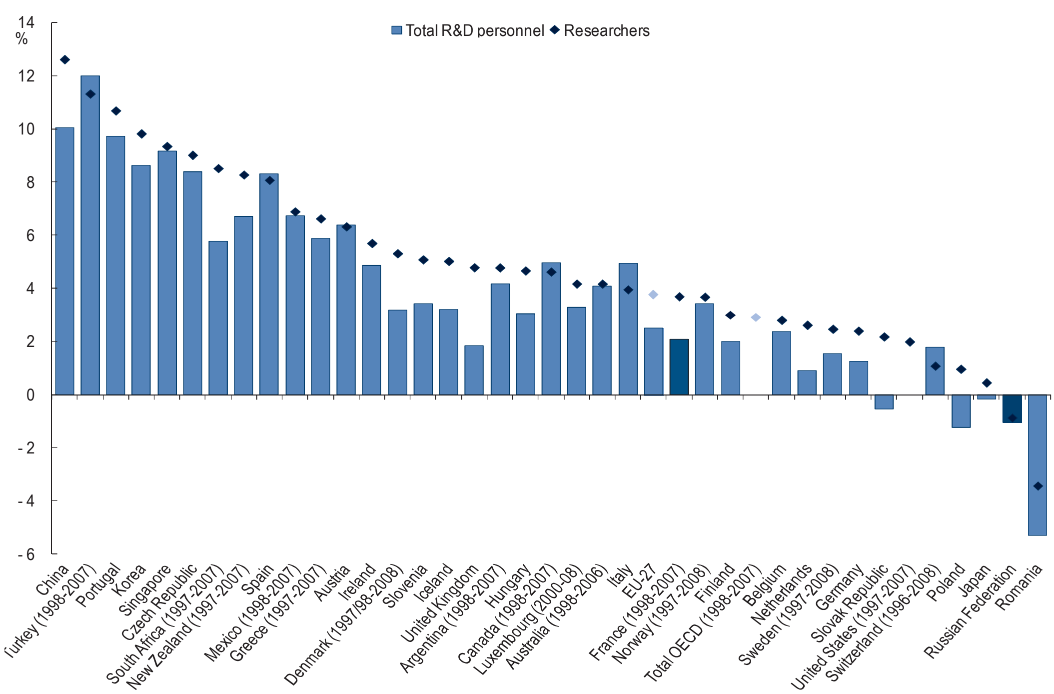
Postgraduate and doctoral courses are offered by both HEIs and research institutes, such as those of the Russian Academy of Sciences. Figure 2.46 and Figure 2.47 show the rise in the number of HEIs offering such training over the last 15 years but essentially no increase in the number of research institutes doing so. Even so, more research institutes than HEIs offer postgraduate courses. The growing dominance of the HEI sector in this type of training is, however, clearly illustrated in Figure 2.48, which shows that the number of postgraduates with defended dissertations has remained about the same in the research institutes but has climbed dramatically in HEIs, increasing more than five-fold from the mid-1990s to the mid-2000s and accounting for around 90% of the total in recent years. The picture is similar for the numbers of doctoral graduates (Figure 2.49). A couple of points are worth emphasising. First, with so many more postgraduates and doctoral graduates undertaking their training in HEIs, the need to upgrade and upscale their R&D activities is increasingly urgent. Second, the figures also show ominous declines in the numbers of postgraduates and doctoral graduates defending theses since 2005-06. The reasons are unclear, but may be related to other more attractive employment opportunities in the wider economy and/or demographic change.

2.4.3. R&D personnel

Russia is one of only two countries (the other is Romania) to have seen falls in the numbers of R&D personnel and researchers over the decade 1998-2008 (Figure 2.50). The reasons are well-known: relatively low salaries, antiquated research facilities and equipment, too few resources to fund research, and better employment opportunities in other parts of the economy and overseas. On a more positive note, this decline is much slower today than during the 1990s (Figure 2.51) and recent years have even seen marked inflows of young people into research careers for the first time in two decades (Figure 2.52), no doubt attracted in part by recent salary increases (Figure 2.53). Nevertheless, the average age of researchers has increased (Figure 2.54), and more than one-quarter are 60 years or older. Demographic change means that recent increases in the number of young researchers are likely to be unsustainable over the next decade or so. Labour markets will become increasingly competitive and scientific careers will need to become even more attractive than they are now to draw and retain the best talent.

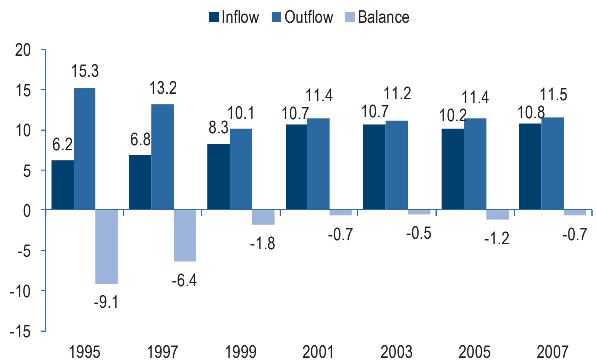
Figure 2.50. Compound annual growth rate of R&D personnel and researchers (1998-2008)

Percentage



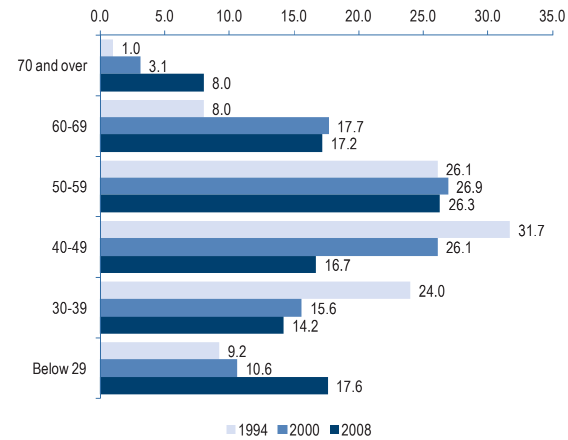
Source: OECD (2010a), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

Figure 2.51. Trends in inflow and outflow of researchers, 1995-2007 (percentage)



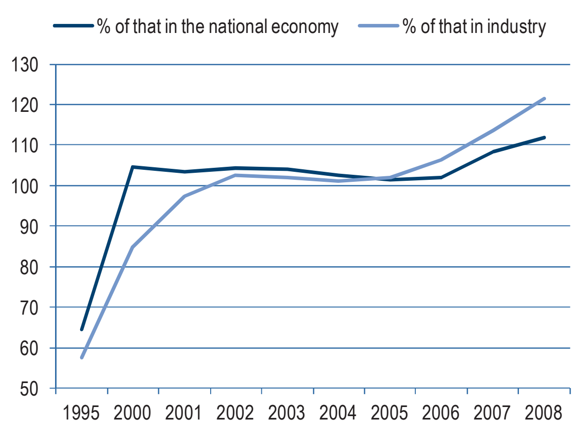
Source: HSE (2010a), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.52. Distribution of researchers by age, 1994, 2000 and 2008 (percentage)



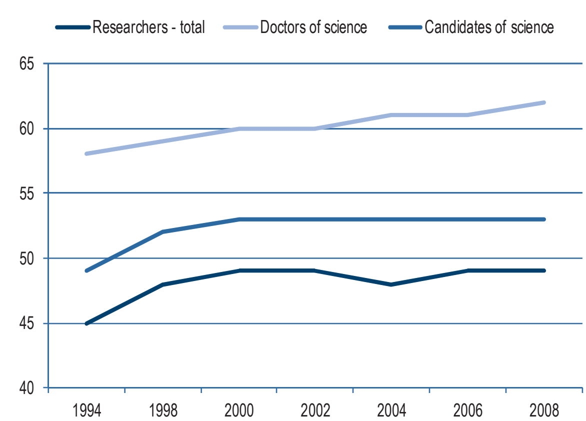
Source: HSE (2010a), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.53. Average monthly salary of R&D personnel (1995-2008)



Source: HSE (2010a), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

Figure 2.54. Increasing average age of researchers (1994-2008)



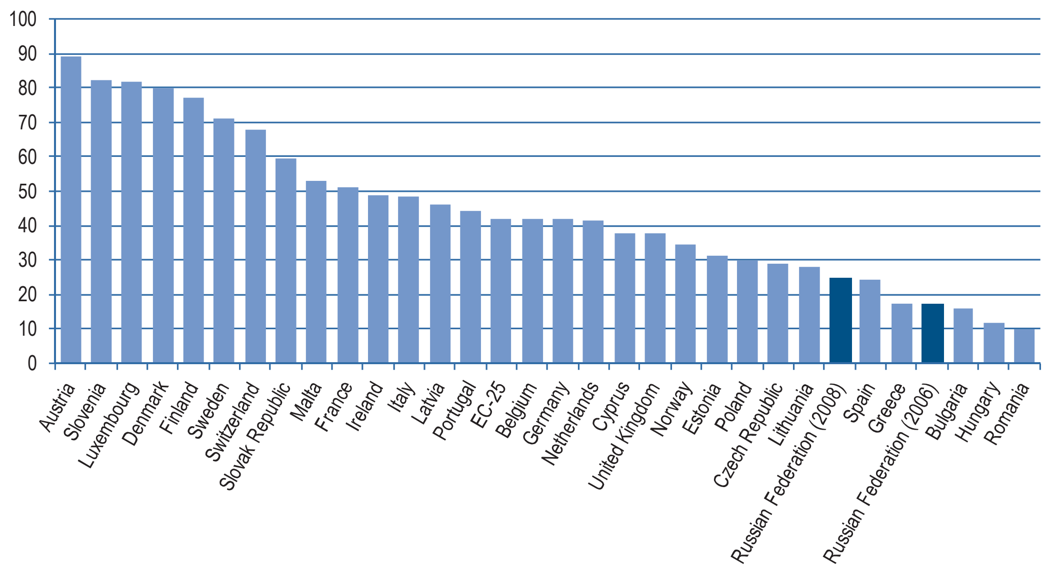
Source: HSE (2010a), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

2.4.4. Lifelong learning

Beyond the initial learning gained through school and tertiary study, people must now increasingly upgrade their skills throughout their adult lives. Training at work plays a key role, as it builds work-related competencies and helps workers cope with change. It also contributes to the technological capabilities of firms and is positively related to innovation (OECD, 2011). The incidence of training varies across countries and thus raises the question of whether enough training is provided and taken up by employees. Figure 2.55 shows that around one-quarter of Russian employees engaged in some form of lifelong learning in 2007, a proportion below the OECD average of around 40%, under a broad definition which includes non-formal and informal learning.

The rapid structural changes affecting the Russian economy over the last decade have meant equally rapid changes in the structure of labour demand. This has made forecasting labour demand difficult. Even when such data exist, education providers tend not to make use of them and students remain largely unaware of labour market needs for qualifications. This has resulted in qualification mismatches that need to be corrected through retraining. This partly explains the relatively high levels of part-time enrolments in HEIs by those already holding tertiary education qualifications.

Figure 2.55. Lifelong learning: Participation in formal education, non-formal education/training and informal learning during the previous 12 months (percentage of 25-64 year-olds), 2007



Note: Data for Russian Federation 2008.

Source: HSE (2010c); OECD (2010c), *Education at a Glance 2010*, OECD, Paris.

Notes

1. In CIS-2006, only in the Netherlands and Sweden did innovative enterprises report more R&D activity than acquisition of machinery.
2. Earlier declines in the BERD/GDP ratio between 2003 and 2007 can be accounted for by buoyant GDP growth outstripping growth in BERD.
3. The transition era is taken to be the 15 years from 1990 to 2004.
4. In fact, the two leading companies in the oil and gas sector, *i.e.* Gazprom and Lukoil, together account for nearly 60% of the sector's turnover, and for nearly 25% of the combined revenues of the top 100 companies in Russia (Liuhto and Vahtra, 2009).
5. At the same time, it should be borne in mind that the rise of vertically integrated conglomerates is a reflection of the less than competitive business environment that characterised the Russian economy during the 1990s. Uncertainties over the reliability of suppliers and sources of finance led firms to take ownership of their supply chains.
6. Other countries' innovation survey data show a similar but much less extreme relationship between firm size and innovativeness. For example, the EU's CIS-2006 indicates that around 35% of EU27 firms with 10-49 employees are innovative, compared to 52% of those with 50-249 employees and 70% of those with more than 250 employees (Eurostat, 2010).
7. A recent inventory of high-technology scientific equipment revealed that equipment at Academy institutes is generally older than at HEIs. Since 2007, 37% of new equipment has been installed at HEIs, compared to just 26% at Academy institutes (Dezhina, 2011).
8. While the situation is changing and a formal procedure of internal assessment exists, a system of independent assessment of institutes and individual achievements has yet to be established (Yegorov, 2009).

References

Alimpiev, V. and A. Sokolov (1997), "The institutional structure of applied R&D", in L. Gokhberg, M.J. Peck and J. Gacs (eds.), *Russian Applied Research and Development: Its Problems and its Promise*, IIASA, Laxenburg.

Arundel, A., C. Bordoy and M. Kanerva (2008), "Neglected Innovators – How Do Innovative Firms That Do Not Perform R&D Innovate?", *INNO-Metrics Thematic Paper*, MERIT, University of Maastricht.

BIS (2010), *The 2009 R&D Scoreboard: The Top 1,000 UK and 1,000 global companies by R&D Investment*, Department for Business Innovation and Skills, London.

Cohen, W.M. and D.A. Levinthal (1989), "Innovation and Learning: The Two Faces of R&D", *Economic Journal*, Vol. 99, September, pp. 569-596.

Dezhina, I. (2011) "Developing research in Russian universities", *Russie.Nei.Visions*, No. 57, IFRI Russia/NIS Centre, Paris.

Dunning, J.H. (1993), *Multinational Enterprise and the Global Economy*, Addison Wesley, Wokingham.

ERA Watch (2010), "Inventory Report: Federation of Russia", European Commission, Brussels.

Eurostat (2010), *Science, Technology and Innovation in Europe*, Eurostat, Luxembourg.

Evangelista, R., S. Iammarino, V. Mastrostefano and A. Silvani (2002), "Looking for Regional Systems of Innovation: Evidence from the Italian Innovation Survey", *Regional Studies,* 36(2), pp.173-186.

Evangelista, R. and V. Mastrostefano (2006), "Firm Size, Sectors and Countries as Sources of Variety in Innovation", *Economics of Innovation and New Technology,* 15(3), pp. 247-270.

Filippov, S. (2008), "Russia's emerging multinationals: trends and issues", *UNU-MERIT Working Paper Series*, No. 62, UNU-MERIT, Maastricht.

Fortescue, S. (1986), "Project planning in Soviet R&D", *Research Policy*, 14, pp. 267-282.

Gijsbers, G. and J. Roseboom (eds.) (2006), *The Russian Innovation System in an International Perspective: A Critical Analysis*, Science and Technology Commercialisation Project, EuropeAid, Brussels.

Glaziev, S., I. Karimov and I. Kuznetsova (1997), "Innovation activity of Russian industrial enterprises", in L. Gokhberg, M.J. Peck and J. Gacs (eds.), *Russian Applied Research and Development: its Problems and its Promise*, IIASA, Laxenburg.

Gokhberg, L. (1997), "Transformation of the Soviet R&D system", in L/ Gokhberg, M.J. Peck and J. Gacs (eds.), *Russian Applied Research and Development: its Problems and its Promise*, IIASA, Laxenburg.

Gokhberg, L., M. Peck and J. Gacs (1997), "Concluding comments", in L. Gokhberg, M.J. Peck and J. Gacs (eds.), *Russian Applied Research and Development: its Problems and its Promise*, IIASA, Laxenburg.

Gokhberg, L., T. Kuznetsova and S. Zaichenko (2009), "Towards a new role of universities in Russia: prospects and limitations", *Science and Public Policy*, 36(2), pp. 121–126.

Gottardi, G. (1996), "Technology Strategies, Innovation without R&D and the Creation of Knowledge within Industrial Districts", *Journal of Industry Studies*, 3(2), pp. 119-134.

Grimpe, C. and W. Sofka (2007), "Search Patterns and Absorptive Capacity: A Comparison of Low- and High-Technology Firms from Thirteen European Countries", *ZEW Discussion Paper* No. 07-062, ZEW Centre for European Economic Research.

Guriev, S. and A. Rachinsky (2004), "Ownership concentration in Russian industry", *CEFIR Working Paper Series*, Center for Economic and Financial Research, Moscow.

Hanson, P. and K. Pavitt (1987), *The Comparative Economics of Research, Development and Innovation in East and West: A Survey*, Academic Publishers, Chur, Harwood.

HSE (2007), *Country Background Report for the Russian Federation in support of the OECD Thematic Review of Tertiary Education*, Higher School of Economics, Moscow.

HSE (2010a), *Indicators of Innovation Activity: 2010*, Higher School of Economics, Moscow.

HSE (2010b), *Science and Technology Indicators in the Russian Federation*, Higher School of Economics, Moscow.

HSE (2010c), *Indicators of Education in the Russian Federation*, National Research University - Higher School of Economics, Moscow.

Huston, L. and N. Sakkab (2006), "Connect and Develop", *Harvard Business Review*, 84(3), pp. 58-66.

Kim, L. and R.R. Nelson (2000), *Technology, Learning and Innovation: Experiences of Newly Industrialising Economies*, Cambridge University Press, Cambridge.

Kline, S. and N. Rosenberg (1986), "An Overview of Innovation", in R. Landau (ed.), *The Positive Sum Strategy: Harnessing Technology for Economic Growth,* National Academy Press, Washington, DC.

Lhuillery, S. and M. Bogers (2006), "Measuring User Innovation: What Can a Standard Innovation Survey Tell Us?", Paper presented at the International Conference on Science, Technology and Innovation Indicators – History and New Perspectives, Lugano, 15-17 November.

Liuhto, K. and P. Vahtra (2009), "Who governs the Russian economy? A cross-section of Russia's largest corporations", *Electronic Publications of Pan-European Institute*, No. 12/2009, Turku School of Economics, Turku.

Nascia, L. and G. Perani (2002), "Diversity of Innovation in Europe", *International Review of Applied Economics*, 16 (3), pp. 277-293.

OECD (2007), *PISA 2006: Science Competencies for Tomorrow's World*, OECD, Paris.

OECD (2008), *Investment Policy Review of the Russian Federation: Strengthening the Policy Framework for Investment*, OECD, Paris.

OECD (2010a), *OECD Science, Technology and Industry Outlook 2010*, OECD, Paris.

OECD (2010b), *PISA 2009 Results: What Students Know and Can Do – Volume I*, OECD, Paris.

OECD (2010c), *Education at a Glance 2010*, OECD, Paris.

OECD (2011), *Skills for Innovation and Research*, OECD, Paris.

OECD and Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, Third Edition, OECD, Paris.

OPORA (2010), *Competing for the Future Today: A New Innovation Policy for Russia*, OPORA, Moscow (in Russian).

PricewaterhouseCoopers (2010), *Innovation by Large Companies in Russia*, PWC, Moscow.

Radosevic, S. (2003), "Patterns of preservation, restructuring and survival: science and technology policy in Russia in post-Soviet era", *Research Policy*, 32, pp. 1105-1124.

Sprenger, C. (2010), "State ownership in the Russian economy: its magnitude, structure and governance problems", Higher School of Economics paper, Moscow.

Tamura, S., J. Sheehan, C. Catalina Martinez and S. Kergroach (2005), "Promoting innovation in services", in OECD, *Enhancing the Performance of the Services Sector*, OECD, Paris.

Teece, D. (1996), "Firm organisation, industrial structure, and technological innovation", *Journal of Economic Behaviour and Organization*, 31, pp. 193-224.

World Bank (2001), "Curse or Blessing? Financial-Industrial Groups in Russia", *Beyond Transition Newsletter*, World Bank, Washington, D.C.

Yegorov, I. (2009), "Post-Soviet science: Difficulties in the transformation of the R&D systems in Russia and Ukraine", *Research Policy*, 38, pp. 600–609.

Chapter 3

The role of government

Governments have important roles to play in shaping the performance of their national innovation systems. Beyond the support for R&D, a wide array of public policies needs to be mobilised covering areas as diverse as education and training, competition and trade, and industrial and regional development. These policy areas utilise a mix of instruments, including regulation and direct funding. The coherence and effectiveness of this mix and of overall governance arrangements are major concerns for innovation policy makers.

This chapter provides first a brief account of the evolution of Russia's STI policy over the last two decades, paying particular attention to the main actors and their roles and the achievements and shortcomings of the prevailing governance arrangements. It then considers the public funding of R&D, specifically the overall trends in budgetary support, the main funding patterns by institutional type, and the use of selectivity and priority programmes. This is followed by a functional assessment of Russia's innovation policy that takes a number of strategic tasks as its starting points. These include securing the availability of qualified human resources; adapting public R&D institutes to the requirements of a modern innovation system; promoting business R&D and innovation; fostering the development of competitive innovation-oriented industries; providing supporting infrastructure to innovators; harnessing global opportunities through international co-operation; and developing and mobilising regional innovation capabilities. The chapter finishes with some concluding remarks.

3.1. Introduction

Creative individuals and market-oriented organisations are the central actors of innovation, but OECD work demonstrates that in all countries the government plays a key and continuing role in shaping and dynamising innovation processes (OECD, 2010a).[1] First, it must provide conducive framework conditions; these are discussed in Chapter 1. Second, it must compensate for various market and systemic failures that prevent optimal knowledge generation, diffusion and use within and between the public and private sectors through various regulatory, budgetary and institutional measures. These add up to what can be called an innovation policy *stricto sensu* and are the focus of this chapter.

Innovation policy presents similarities in all countries, in terms of broad rationale, generic principles and main objectives. It includes core funding and competitive grant schemes to support investigator-initiated research in universities, support for business sector innovation activities and a policy framework for overall strategies and for steering publicly funded research organisations, ensuring inter-departmental co-ordination in policy formulation, and evaluating policies and programmes. However, each country possesses unique characteristics and an inheritance from the past that condition its ability to translate common principles and objectives into concrete actions in order to exploit the opportunities offered by increasing globalisation, economic growth and social change, and developments in science, engineering and technology. This is particularly true for the Russian Federation, given its geography, strong cultural identity, political traditions and specific socio-economic fabric, including the still significant legacy of the Soviet system. The involvement of the Russian government in the governance of a still immature innovation system consequently has a number of distinctive features that must be taken into account when attempting to draw lessons from international experience with a view to making further improvements.

The current state of innovation policy in Russia results from an ongoing, often turbulent process of radical transformation of the socio-economic system, and should not be assessed in terms of the more common problem of incremental system optimisation. To convert a centrally planned economy, in which the main engine of innovation is military procurement, into an innovation-oriented market economy, in which the development of science and technology is pushed and pulled by multiple political, economic and social forces, is a formidable task.[2] Two decades is not very long, especially if one considers that during the first of these the economic reform agenda hardly included any innovation policy objective other than the downsizing of the public research system.

The shift and broadening of government objectives in the field of science and technology (S&T) and innovation – from “downsizing public research” to “modernisation and reconfiguration” of the entire innovation system – took time, because of adverse economic circumstances, the steepness of the learning curve, and the resistance of some powerful actors. In the 1990s, the main concern of S&T policy makers was to ensure that the downsizing of the research system would not destroy the most valuable pieces of the science and technology system built in Soviet times, in a situation in which market signals were still too weak to guide the selection process and the budgetary constraints too strong to permit a more proactive restructuring approach. At the turn of the current century, the oil boom and the improvement of the economic situation allowed S&T strategy to switch from a survival to a consolidation/renewal mode, with an effort to concentrate new resources on selected institutions, sectors, technologies and sites. But the integration of S&T policy in the broader economic development strategy, as part of an explicit national innovation strategy, did not really start much more than five years ago and only accelerated in the very recent past.

There is no single successful configuration of a national innovation system (NIS) that is appropriate to all countries once and forever. A successful NIS is one which, given the wider economic and technological environment, enables a country to build successfully on its inherited strengths and to remedy, offset or work around its inherited weaknesses in order to exploit to the extent possible its potential for future sustainable economic growth and social well-being. The three most striking features of the Russian NIS to be considered from this perspective are:

- Much more than in any other industrialised country, the bulk of research and development (R&D) is carried out by public organisations and financed by the government budget.[3] Publicly owned branch research institutes and design bureaus are the central players, while the private sector, including foreign firms, and higher education remain minor actors. The weakness of industry-science relationships reflects the lack of demand from, and absorptive capacity in, industry but also the inexperience of the research sector in transferring technology and knowledge, as well as the lack of appropriate incentives and institutional frameworks.
- The combination of radical transformation and the resilience of some former institutional arrangements and mindsets makes the development trajectory of Russia very different from that of any other emerging economy, including China,[4] and translates into some dualism in the NIS. In Russia today increasingly prevalent market-oriented mechanisms for allocating economic resources coexist with others that are based more on social/political networks, and there is a sharp contrast between progressive territorial, scientific, technological and industrial nodes of excellence and a rather large stagnant pool of firms and organisations with very low productivity and little innovation drive.
- Both centralisation and fragmentation characterise the institutional framework for policy formulation and implementation. A more top-down and centralist policy than in most OECD countries does not seem to lead to a greater ability to set and implement spending priorities because the fragmentation of funding and steering mechanisms and the persistence of a science and technology push approach give excessive power to some research-performing institutes with preservation strategies. As a result, despite considerable downsizing and restructuring over the last 20 years, the public R&D system has remained heterogeneous in terms of quality, overloaded with development activities, and generally poorly connected to both the education and the market-driven production systems.

In recent years, significant progress has been made in addressing these issues. This has brought the country closer to what could be a turning point in the maturation of an efficient national innovation system which, while maintaining distinctively Russian characteristics, would make a more decisive contribution to the realisation of the ambitious national socio-economic development agenda.

This chapter provides first a brief record of the evolution of Russia's science, technology and innovation (STI) policy; it then examines in more detail how Russia's government and government agencies currently support innovation, acknowledges achievements and identifies areas in which changes should be considered.

3.2. Institutional profile and system governance

The current policy setting – institutions in charge of policy supervision, formulation and implementation as well as the tools they use – results from an accumulation over two decades of far-reaching reforms and specific initiatives in a political environment and economic context that did not always facilitate the task of innovation policy proponents.

3.2.1. The evolution of Russia's science, technology and innovation policy

Three main phases of Russian STI policy can be identified (Figure 3.1).

Turbulent restructuring, with early experimentation of new innovation policy approaches

Right after the breakup of the Soviet Union, a Ministry of Science and Technology was established and took over the responsibility of the State Committee for S&T. Under its leadership, priority was given to the rescue of the best parts of the system inherited from the Soviet period, at a time when resources were drying up and many S&T specialists, including some of the most brilliant, were moving either to foreign countries or to more lucrative jobs.

The most important "defensive" measures were the selection of state research centres for priority allocation of resources and the decision and effort to mobilise foreign assistance to help in the conversion of military science and technology (*e.g.* the International Science and Technology Centre).

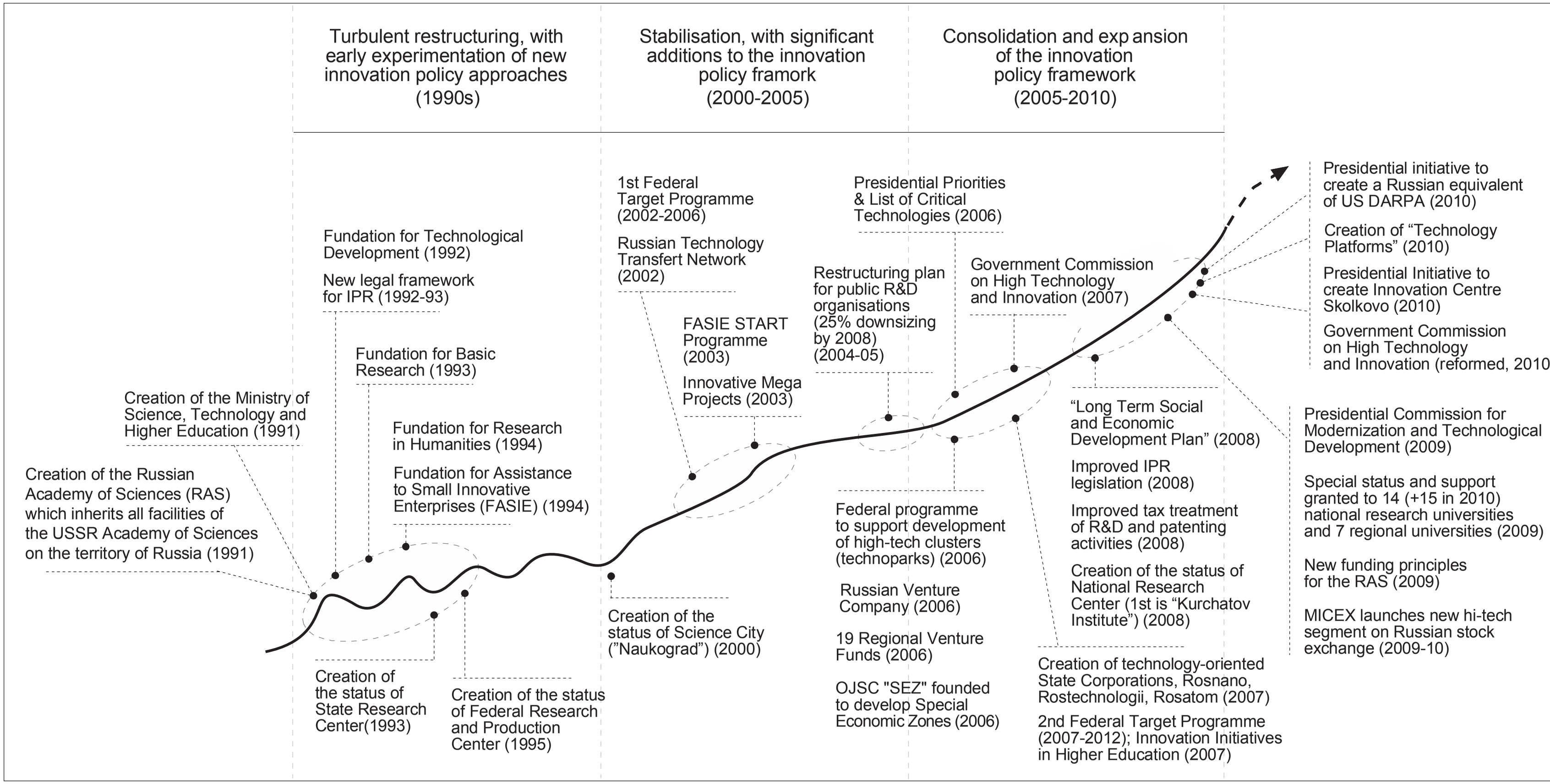
The most significant "early seeds" of a proactive innovation policy were the establishment of competitive funding mechanisms for basic research (the Russian Foundation for Basic Research) and for small innovative enterprises (the Foundation for the Assistance to Small Innovative Enterprises). In addition, important changes were made in the legal framework, notably a new intellectual property regime, to facilitate innovation in the emerging market economy, at a time of wrenching privatisation measures.

The second half of the 1990s was characterised by a very difficult economic situation, with further constraints on resources, high inflation and the 1998 financial crisis. Efforts in favour of research and innovation were rather limited. Noticeable initiatives included the development of technology centres and business incubators in liaison with local and regional authorities, at a time when the latter had acquired significant political and financial autonomy. A series of R&D tax incentives for the business sector were also introduced.

Stabilisation, with significant additions to the innovation policy framework

The situation began to stabilise in the late 1990s as the economic situation improved, owing to the oil and gas boom. In 1999, the federal R&D budget grew by 7% in real terms over the preceding year. Draft innovation laws, concerning in particular technology transfer mechanisms and collaboration between the research system and the economic sphere, were prepared, discussed by the Parliament, but not promulgated by the president, who was concerned with a lack of clarity in the concepts, objectives and priorities (Ivanova and Roseboom, 2006; Gijsbers and Roseboom, 2006).

Figure 3.1. Innovation policy learning in the Russian Federation



The situation was further consolidated with the change of the nation's leadership. A re-energised and a more powerful Ministry of Education and Science was established, with expanded responsibility and means, along with a Ministry of Economic Development and Trade. A clear turning point appeared in 2003 when a large-scale programme, Mega Projects, was launched, to mobilise the Russian scientific community for the development and production of breakthrough technologies defined jointly with the business sector.

Box 3.1. From S&T policy to innovation strategy: some landmarks

The foundations of Russian innovation policy were laid down in the 1990s, in the first federal law on "Science and State Scientific and Technological Policy" promulgated in 1996. At that time, the interest in innovation arose from a concern to protect and restructure scientific activities under crisis conditions. It took about a decade for the concept of a national innovation system to gain wider recognition and translate into a less "S&T-centred" approach. Some of the major landmarks are:

- *Fundamentals of the RF policy in the sphere of development of science and technology for the period up to 2010 and beyond.* This government document of 2002 was the first to emphasise the need for a transition to innovation-led economic development.
- *Principal directions of the RF policy in the sphere of development of innovation system for the period up to 2010.* This government document of 2005 was the first to define the objectives of S&T policy from an innovation system perspective. In 2006, the document *Science and State Scientific and Technological Policy* was revised accordingly.
- *The Strategy of Development of Science and Innovation in the Russian Federation for the Period up to 2015* was approved in 2006 by the Interdepartmental Commission for Science and Innovation Policy, chaired by the Minister of Education and Science. Its main stated objective is "the formation of a balanced effective R&D innovation system, providing the technological modernisation of the economy and enhancing its competitiveness through advanced technologies and the transformation of scientific potential in one of the major resources for sustainable economic growth". The first important step in the implementation of this new strategy was the *Integrated Programme of Scientific and Technological Development and Engineering Modernisation of the RF Economy until 2015*, elaborated in 2007 by the Ministry of Education and Science in 2007.
- *The Concept of Long-term Socio-economic Development of the Russian Federation for the Period up to 2020,* was adopted in November 2008. Section 6 ("Development of national innovation system and technology") defines how the creation and dissemination of innovations in all sectors of the economy should contribute to the achievement of development goals.
- *Innovative Russia – 2020*. In March 2010, the prime minister asked the government to translate the concept of long-term socio-economic development into a more fully articulated innovation strategy, with clear objectives, priorities and instruments of state support. In late 2010 the Ministry of Economic Development delivered a draft that emphasises the need for engaging all actors, including the business community.

Consolidation and expansion of the innovation policy framework

In the mid-2000s decisions were taken to reinvest massively in strategic sectors, advanced research structures and selected sites. A series of well-endowed federal target programmes (FTPs) were launched. Significant measures were taken to stimulate research and innovation initiatives in the higher education system. Administrative restructuring led to the creation of special agencies under the Ministry of Education and Science, one to fund science and innovation programmes and another to fund education programmes.[5] Powerful national corporations were established, with a view to increase coherence and efficiency in the management of the state-owned technology-oriented business sector and to speed up the commercialisation of new technologies on global markets, notably in the field of nanotechnologies (Rosnano).

More recently, innovation has become a watchword at the highest level, with the creation, in 2009, of a Presidential Commission of Modernisation and Technological Development and also, a year later, the rise in importance of the Commission of High Technology and Innovation, now chaired by the prime minister. Resources have been further concentrated on strategic research centres or centres of excellence. Initiatives to make the higher education a more significant player have intensified, with additional resources for selected elite universities. A flagship innovation city project (Skolkovo) has been initiated. Most ministries concerned with technological development, notably the Ministry of Economic Development, have elaborated some form of innovation strategy. The global financial crisis, which severely affected Russia, had a short-term impact on the overall budget effort but did not reduce political commitment and did not affect the general directions of S&T and innovation policy.[6]

3.2.2. The main institutions and their role

The institutional landscape is particularly complex and populated by many bodies, with at times overlapping responsibilities and mission and policy assignments that are not always crystal-clear. At the federal level, there are two major governance levels: overall policy guidance and supervision is ensured at the top state level (the president and the prime minister on the executive side and the two parliamentarian chambers on the legislative side), while detailed policy formulation and implementation are in the hands of ministries, agencies and a number of autonomous or semi-autonomous bodies (including the academies of science and the recently established state corporations). At a lower level of governance, regional governments and municipalities use their own resources to develop their S&T and innovation policies and influence how federal support is used by actors.

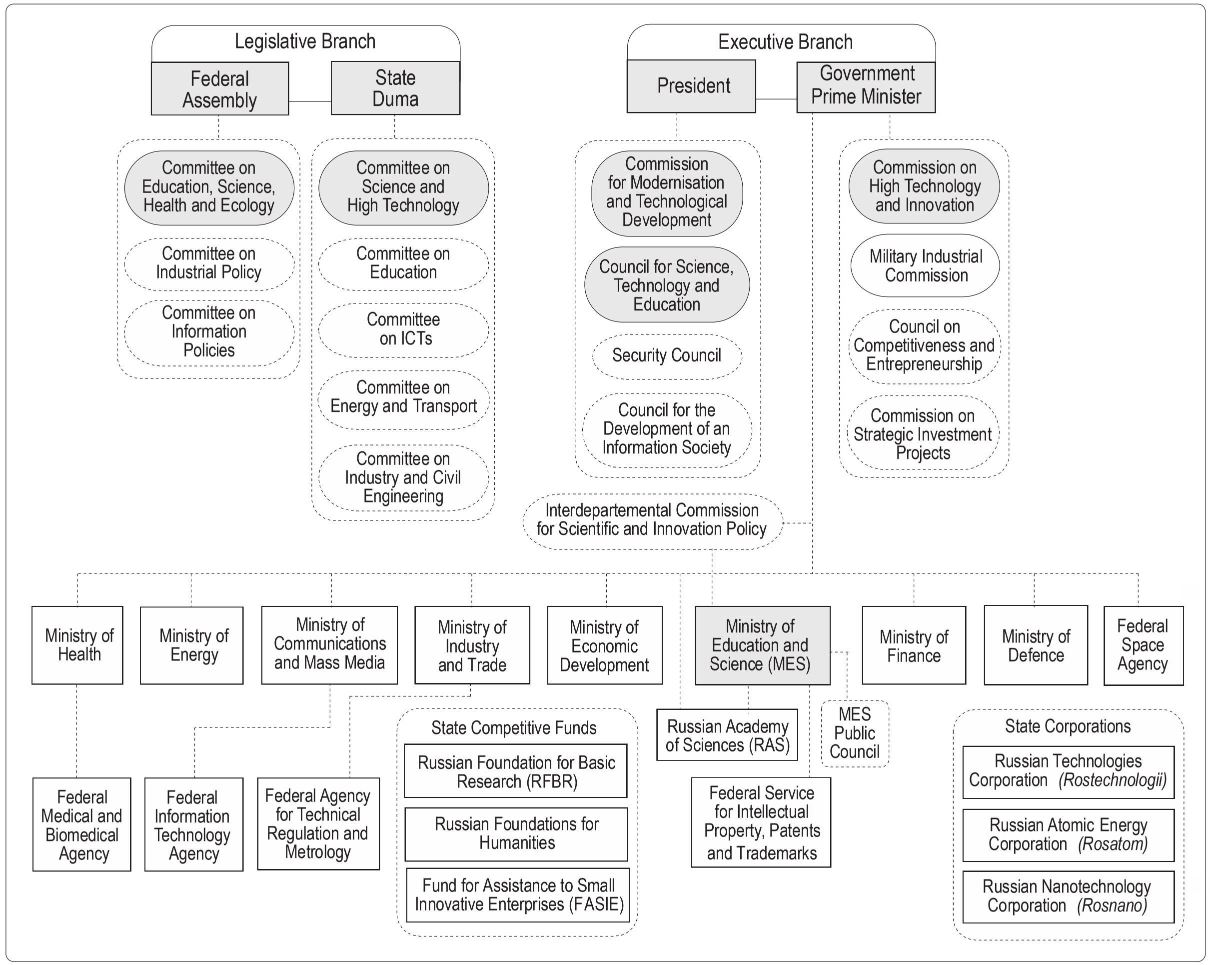
Overall policy formulation, guidance and supervision

At the highest level of the state, a growing awareness of the importance of innovation for Russia's future has led to the reinforcement of institutional mechanisms to develop and co-ordinate relevant policies.

The Presidential Commission for Modernisation and Technological Development was established in 2009 (Box 3.2). It has already formulated significant guidelines for the prioritisation of R&D efforts and for the areas in which urgent action is needed to stimulate innovation in state-owned companies and make Russia more attractive to highly qualified Russian expatriates and foreign scientists, engineers and innovative entrepreneurs. The president of the Russian Federation is also advised by a Science and Technology Council, composed of 60 high-level representatives from various spheres of the economy and society.

In early 2010, the prime minister took over the chairmanship of the High Technology and Innovation Commission, which was created in 2007 but had been chaired by a vice prime minister. It draws together the different ministers, as well as the heads of the key agencies concerned with innovation – 40 persons in all – and has become the main locus of policy decisions, with strong co-ordination powers, in matters relating to high technology and R&D policies.

Figure 3.2. Policy governance of the Russian Federation's innovation system: Institutional profile



Source: OECD, based on ERA Watch (2010) and Ministry of Education and Science (2010).

Box 3.2. The Presidential Commission for Modernisation and Technological Development: Main orientations, 2009

The main outcomes of the first year of activity of the Presidential Commission for Modernisation and Technological Development can be summarised as follows:

- Prioritisation of S&T efforts, with visible results by 2012.
  - Five priority sectors have been identified: energy efficiency, medical and pharmaceuticals, nuclear, telecoms and space, information technology (IT) and computers – a list of priorities that largely overlap those defined by the Ministry of Education and Science in 2007 and 2008. Roadmaps have been laid out, with target indicators, indicative financial investments, and instructions regarding implementation of related programmes by relevant ministries.
- Specific instructions.
  - Relevant ministries are to establish mechanisms: *i)* to attract prominent Russian expatriates and foreign scientists and entrepreneurs, notably by facilitating visa procedures and simplifying recognition of foreign diplomas and degrees by Russian universities; *ii)* to stimulate state-owned companies to invest in R&D by introducing mandatory innovation programmes, defining targets for R&D intensity, taking into consideration industry specificities and the results of international benchmarking, and proposing competitive grant schemes for technology developers.
- Emblematic large-scale initiative.
  - It has been decided to build from scratch a high-technology, innovative city at Skolkovo, near Moscow, with huge investments and strong tax incentives to attract foreign investors. The first facilities will be operational soon.

Source: Annual report of the Gaidar Institute (May 2010).

The legislative branch has been involved in the S&T policy-making process since the early years of the transition (Figure 3.2). The Duma, the Russian lower chamber, is quite active, mainly via its Committee on Science and High Technology, in discussing and amending laws and priorities. It has, for instance, added the management of natural resources to the five presidential priority areas. It has also helped to draw up the list of critical technologies. The Council of the Federation – the higher chamber representing the regions – also plays a role in the S&T policy-making process, mainly through its Committee on Education and Science.

Detailed policy formulation and implementation

Ministries and agencies

Many ministries and agencies have historically shared responsibility for managing innovation-related programmes and budgets. With the transition from an S&T-centred to a broader innovation policy approach, their number is not likely to decrease but their relative importance may change somewhat. However, subject to the stability of the government structure, the main actors will remain: the Ministry of Education and Science, the Ministry of Economic Development, the Ministry of Defence, the Ministry of Trade and Industry, the Ministry of Communication and Mass Media, the Ministry of Finance, as well as the two major mission-oriented agencies in charge of the space and nuclear programmes (Roscosmos and Rosatom).

The Ministry of Education and Science has been an important proponent of innovation policy in Russia. It controls some 20% of the civil R&D budget. It supervises several key FTPs that support and orient the science and technology system in its civil dimensions and components. It is also in charge of national foresight exercises; it completed one for 2020 and is embarked on a new one for 2030 (Box 3.3). In charge of the education system as a whole – a task that mobilises much of the minister's time – it has led the effort to strengthen the higher education sector, including its research capabilities, with undeniable success. The ministry oversees the Patent Office, which has been modernised, aligned on world standards, and endowed with significant additional resources.

Box 3.3. Evidence-based anticipatory policy making: The role of foresight

The government has initiated several rounds of foresight exercises aimed both at identifying priority areas for concentrating limited budget resources and at developing future-oriented policy mechanisms that could enable Russia's transition towards a knowledge-based economy. During the last 15 years, the major focus of foresight studies has moved from mid-term priority setting activities (via a number of critical technologies exercises) to constructing the National S&T Programme on the basis of selected priorities and, later on, to developing large-scale exercises covering macroeconomic trends, future research agendas, and technological modernisation of particular industries. Accordingly, the ongoing foresight activities address a broad range of innovation policy challenges and are increasingly interrelated with development of practical policy instruments.

A key trend in applications of foresight in Russia is a move from large-scale nation-wide exercises towards regional and sector-specific projects. At the regional level, foresight activities are mostly confined to regions with significant S&T and production capacities: *e.g.* Moscow, Saint Petersburg, Krasnoyarsk, and Bashkortostan. Smaller-scale activities at a more local level have also emerged, for example, in science cities (*e.g.* Troitsk and Obninsk) or manufacturing centres (Cherepovets – the heart of Severstal's metallurgic production). At the sectoral level, the Ministry of Industry and Trade has already implemented several medium-scale projects for particular industries (*e.g.* the energy sector, metallurgy, and pharmaceuticals) while other agencies have launched other initiatives (*e.g.* for the nuclear energy sector, power engineering, natural resources, and information technologies).

Rosnano also uses foresight as one of its key instruments for priority setting. It has commissioned a large-scale Delphi exercise covering over 1 000 specific products with radically new nanotechnology-based components for 20 specific markets. This was followed up by a roadmapping exercise in support of developing a nano-industry in Russia. The roadmaps reflect development prospects of particular product groups (*e.g.* carbon fibres; light-emitting diodes), whole industries (rockets and space; aircraft construction) or problem-oriented areas (energy saving; drinking water purification). The results have provided a basis for identifying more focused long-term investments and analysis of alternative technological solutions that reduce investment risks. The roadmaps have also turned out to be useful practical instruments for long-term strategic planning in the sectors covered.

Source: L. Gokhberg and A. Sokolov (2011), "Evolution of Technology Foresight in Russia: Rationales, Implementation and Policy Implications", *International Journal of Foresight and Innovation Policy*, forthcoming.

The task of implementing the policies defined by the ministry was delegated in 2005 to two agencies: the Federal Agency for Science and Innovation and the Federal Agency for Education. The two bodies were dismantled in 2010 and their functions are now directly assumed by the ministry. The fact that key strategic policy orientations are now formulated at the presidential and prime minister level implies that ministries should concentrate more on detailed design and policy implementation. The multiplication of more or less autonomous bodies, with funding authority, might have been seen as a potential source of bureaucratic tensions and possibilities for corruption.

The *Ministry of Economic Development* has initiated a number of measures to support small businesses: tax incentives for R&D, venture capital, technoparks and industrial zones. More recently, it has devoted attention to the need to stimulate innovation in large, especially state-owned enterprises (SOEs). It also manages a number of FTPs that do not focus specifically on science and technology, but on broader aspects of sectoral competitiveness or regional development, which are important in an enlarged approach to innovation policy. At the end of 2010, the ministry completed the draft of a national innovation strategy, prepared at the request of the prime minister (Box 3.4).

Box 3.4. Innovative Russia 2020

This new comprehensive innovation strategy, a draft of which was ready at the end of 2010, has been based on a SWOT analysis of the national innovation system. It considers several scenarios for developing innovation in Russia and identifies a preferred path for government to promote. The overriding goal will be to rebalance the NIS to make business rather than government its centre of gravity, in terms both of performance and of financing of innovation activities. It identifies the strategic tasks to be accomplished to achieve this goal and the key principles to follow to ensure the efficient implementation of government actions.

It envisions two phases: unleashing the innovation potential of the business sector (2011-16) and phasing out government support (2017-20). It sets out the objectives of co-ordinated reforms and measures on a broad front, grouped under a number of key headings that are generally consistent with those of the OECD Innovation Strategy: innovative people, innovative firms, innovative government, an effective science system, supportive infrastructures, participation in global innovation networks, innovative regions and territories.

The *Ministry of Defence* controls probably in excess of 50% of the total government budget appropriations or outlays for R&D (GBAORD);[7] it acts principally via procurement which affects, to a certain extent, civil innovation actors, although most military R&D and high-technology production are still carried out in specialised state-owned laboratories and facilities. It oversees a large network of some 50 research and testing centres operating in a vast array of technologies and armament fields (naval and shipbuilding, armoured vehicles, missiles, nuclear, etc.); a number are located in (still) closed cities. The ministry also has control of armament factories (about 50). Assessing the organisation and efficiency of military R&D and technologies is beyond the scope of this report. However, it is important to note that given the high share of military-related R&D in total public R&D spending, and of the importance of the military-industrial complex in the state-owned business sector, changes in defence policy and procurement will have major impacts on the development of the innovation system as a whole (Box 3.5). Suffice it to say here that such changes are high on the agenda of the Russian government, and that the military leadership itself has to some extent joined the proponents of an active national innovation policy, as they are dissatisfied with the insufficient capability of the Russian "arsenal" to supply the modern systems the army understands that it needs but is reluctant to see imports fill the gap.

The *Ministry of Industry and Trade*, which controls significant amounts of resources for R&D in industry, is responsible for a number of sectors that were managed by branch ministries in Soviet times (aviation, electronics, machines, etc.) and in which many industrial R&D institutes continue to operate (sometimes after becoming joint stock companies). The ministry has developed a number of strategic plans for stimulating those sectors' competitiveness and improving their performance, export capabilities, etc. It also oversees the Russian Agency for Technical Regulation and Metrology.

Box 3.5. Military procurement and innovation in Russia

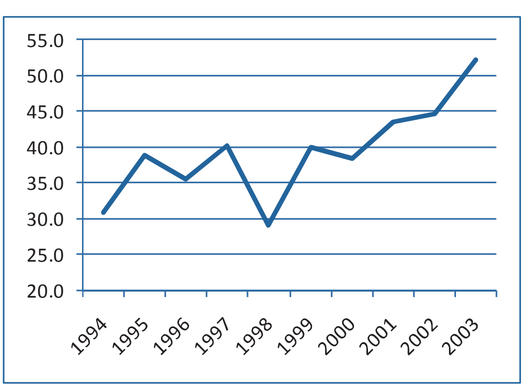
Mowery (2009) outlines three key channels through which public investments in defence-related R&D and procurement can affect an economy's innovation performance:

- *Support the creation of new bodies of scientific or engineering knowledge* – such knowledge can contribute to innovation in both defence-related and civil technology applications. Furthermore, investment in defence-related R&D will likely shape the development of institutional components of national innovation systems, such as national laboratories and university-based research and education.
- *Lead to spin-off technologies for civil use* – defence-related R&D programmes can yield technologies that have applications in both civil and defence-related sectors. The potential for spin-offs is greatest in the early phases of technological development where substantial overlap between defence and civil applications exist. Once technologies are more mature and innovation efforts more incremental in nature, the scope for spin-off technologies declines.
- *Act as a lead purchaser for early versions of new technologies* – defence procurement typically emphasises performance above all other characteristics, including cost. Large orders for early versions of new technologies can enable supplier firms to reduce the costs of their products and improve their reliability and functionality.

While there is wide agreement that these channels operate and have made major contributions to post-war economic development, particularly in the United States, strengthening them through policy intervention has proven much more difficult. Furthermore, the relationships between civil and military applications have changed dramatically with developments in dominant scientific and technological paradigms, especially in the field of information and communication technologies (ICTs). In many cases, the main direction of knowledge exchange flows for dual use technologies may have reversed. The armament industry now depends increasingly on critical technologies developed in an open civil environment.

The scale of Russia's investment in defence-related R&D is substantial. After falling dramatically during the 1990s, it has been rising since 2000 and almost certainly is in excess of 50% of GBAORD today (see figure below). Among OECD countries that declare defence R&D spending levels, only the United States devotes a similar proportion of GBAORD to defence. It should be noted, however, that GBAORD accounts for a much smaller proportion of GERD in the United States than in Russia (27% in 2008 compared to 65% in Russia). Defence R&D is therefore much more dominant in the Russian research system than in the United States or other OECD countries.

Defence budget R&D as a percentage of total GBAORD



Source: *OECD Main Science and Technology Indicators*.

Despite this level of investment, Russia faces big challenges for reconciling its defence and economic development policy from an innovation perspective. During the 1990s, the volume of new arms procurement fell sharply, only to increase again since 2005, though remaining at modest levels. Almost all the arms of the Russian forces date from Soviet times or are updated Soviet-era systems. The need for radical modernisation is clear (Cooper, 2010), but doubts remain about the current R&D infrastructure's ability to deliver them.

The recently announced creation of a Russian version of the US DARPA (Defense Advanced Research Projects Agency) responds to the need to mobilise creative resources better for radical innovations with military applications. At the same time, Russian defence policy should see the broader innovation agenda, notably the restructuring of the state-owned technology-oriented business sector, as an important contribution to its own objectives.

Source: J. Cooper (2010), "Military Procurement in Russia", unpublished presentation; D. Mowery (2009), "National security and national innovation systems", *Journal of Technology Transfer*, Vol. 34, pp. 455-473.

The *Ministry of Communications and Mass Media* plays a key role in the development of the information and communication technology (ICT) sector, either as industry or as enabling infrastructure. It controls the R&D for information technology, and has initiated large-scale programmes such as e-Russia which aim at speeding up the development of Internet equipment and use in the country. It is also in charge of public services, such as the postal system, which are in need of modernisation and are therefore important potential markets for innovation.

The *Russian Space Agency*, *Roscosmos*, created in 1992, is in charge of the entire Russian civil and military space programme, including research, commercial launching activities and exploration missions. It manages almost 25% of the civil budget.

Of course, the *Ministry of Finance*, as in any other country, exerts strong control over the use of public money invested in S&T and innovation. This function necessarily entails some friction with the "spending" ministries. In Russia, the likelihood of such frictions becoming conflicts is greater than in most OECD countries for two reasons. First, there is not yet a firm consensus on the rationale and scope of innovation policy and thus shared criteria on which to assess the costs and benefits of the corresponding public investment. Second, the fear of corruption makes the Ministry of Finance hesitant to accept the use of some instruments that have proved successful in foreign countries. As an example, it has imposed that public procurement must follow the same rules for R&D contracts as for the buying of goods, to the disappointment of the Ministry of Education and Science.

Academies

The *Russian Academy of Sciences* (RAS) is a key actor in the overall innovation system. It is the home of the scientific elite, and its members enjoy significant privileges (in terms of income, access to public services such as health care, etc.). RAS is a prestigious learning society but also a powerful R&D actor with its own network of institutes. It has several regional affiliates: the Urals, Siberian and Far Eastern branches. It controls some 15% of the civil R&D budget. It used to enjoy full administrative and budgetary autonomy, with a president with the rank of minister. It has recently undergone a reform that aims at reducing its autonomy and decision-making power.

In addition to the Russian Academy of Sciences, which is focused on "generic" hard and soft sciences, several other academies cover specific fields: these include the Academy of Agricultural Sciences, the Academy of Medical Sciences, the Academy of Fine Arts, the Academy of Architecture and Construction Sciences, and the Academy of Education. Their budgets, altogether, amount to less than one-third of the RAS budget.

State technology corporations

In order to facilitate the development and commercialisation of technologies considered of strategic importance for the competitiveness of the economy in a global context, the government created in 2007 three powerful organisations, fully owned by the state. These organisations have a special status which allows them to pursue public missions but operate at the frontier between the public and business sectors with more flexibility than other public bodies.

Rosnano is the corporation in charge of promoting the development of nano-technologies and related industries. It received at its creation RUB 130 billion from the federal budget. It works in tandem with the NanoNetwork in charge of co-ordinating

R&D actors (led by the Kurchatov Institute, see below). It is designed for multi-target interventions, including certification; infrastructure investment such as collective centres; education and training; support to innovative firms, including foreign enterprises if they invest in production in Russia, etc. It had invested some USD 500 million in 62 projects by the end of 2009, having received 1 600 project proposals in two years (two-thirds of them in the education and research commercialisation fields). It became a joint stock company in December 2010 in a move to facilitate further its market-oriented investment policy.

Rostechnologii (Russian Technologies) is in charge of the state's equity shares in more than 500 companies. Operating in many different sectors and technological fields, it is supposed to facilitate the development, production, marketing and after-sales services of new technologies, particularly military ones, in domestic markets and abroad. In 2009, its budget reached some RUB 6.4 billion, of which one-third was spent on personnel and administrative expenses. One of its important current tasks is to prepare a new wave of privatisation in its sphere of responsibility.

Rosatom was created as a result of the dismantling of the former Ministry of Atomic Energy (Minatom). It controls all parts of the nuclear chain: exploration of uranium fields, nuclear fuel, reactor development and production, reactor operation and sales. It oversees 200 enterprises (nuclear stations, uranium mines, fuel processing plants, specialised equipment, etc.), and its 70 research institutes employ a total of 300 000 persons. It operates on global markets and is much influenced by diplomatic and intergovernmental relations. It obviously has an important influence on both the demand and supply sides of part of the Russian innovation system.

Initially a legislative provision prevented state corporations from investing in R&D. This reflected a linear approach to innovation and met with the favour of the most conservative forces in the S&T system. From their point of view, the advantage of this legacy of the Soviet era was that enterprises were considered to lie at the end of the innovation process and were consequently not supposed to undertake R&D. Another reason may have been to prevent the use of public money to fund private R&D, because of fears of corruption. This provision has been suppressed *de facto*.

State corporations are too new to be thoroughly evaluated and each is a very specific case. Rosnano and Rostechnologii are the main subject of controversy but it is too soon to measure their achievements in order to convince those who opposed their creation, either because of their conservatism or because they favoured more radical solutions. Even for many of those who, like the government, consider them as the best current institutional response to crucial problems, state corporations nevertheless raise some concerns. First and foremost, and this applies especially to Rosnano, there is a fear that they take undue advantage of public money and of their links with influential networks and government departments to crowd out rather than stimulate the development of the Russian private high-technology sector. Second, there is also concern that pressures to demonstrate measurable results quickly have motivated short-sighted strategies. Third, and this applies to Rostechnologii, the lack of transparency of its management, owing in part to the military nature of many of its constituent firms and trading activities, fuels doubts about its will and ability to carry out a bold reorganisation that would include partial privatisation of the part of the military-industrial complex under its control. This will require a profoundly reformed corporate governance if it is to become more innovative and competitive.

Foundations

Three autonomous foundations provide funding on a competitive basis to individual researchers and innovators:

- The *Russian Foundation for Basic Research*, modelled on the US National Science Foundation, which, according to law, should channel 6% of the civil R&D budget.
- The much smaller *Russian Foundation for Humanities*, which supports social science research.
- The *Foundation for Assistance to Small Innovative Enterprises* (FASIE, also called the Bortnik Foundation after its initiator), which, according to law, should channel 1.5% of the civil R&D budget.

A fourth foundation – the *Russian Foundation for Technological Development* – has been established with resources from taxes on enterprises, business associations and non-profit organisations, with a view to support technological development of collective interest. The scheme has been suspended, owing to intractable problems with the tax administration.

Regional governments

Russian regions are very diverse in terms of their size and economic specialisation (Box 3.6). Outside Moscow and St. Petersburg, a small group of regions or republics have most of the remaining science-based and technology-intensive activities and high-quality higher education institutions (HEIs). However, a larger number (about 30) have become aware of the importance of S&T and innovation for their development and are now active in this field.

Box 3.6. Regional governance and policy in Russia

Nature and constitutional status of regions

The Russian Federation is divided into 83 constituent units or federal subjects (of which 21 republics) of very different sizes and economic specialisation. The federal subjects (members of the Federation) have equal representation – two delegates each – in the Federal Council (the upper house of the Federal Assembly). They differ, however, in the degree of autonomy they enjoy, which is much larger for republics than for other federal subjects, such as *krai* (territories) and *oblasti* (provinces).

The republics represent areas of non-Russian ethnicity. The indigenous ethnic group gives each republic its name, although it does not necessarily represent the majority of the population. Republics have the right to establish their own official language and have their own constitution. The chief executive of most republics has the title of president.

In the past the republics often enacted laws that were at odds with the federal constitution. However, their autonomy was lessened considerably under the former President of the Russian Federation. The establishment of seven large "federal districts" above the regions and republics of Russia, with presidentially appointed representatives overseeing their activities, has strengthened the rule of law and compliance with the federal constitution. The president of Russia now appoints the executive heads of republics, subject to approval by the republics' parliament.

…/…

Box 3.6. Regional governance and policy in Russia *(continued)*

Regional policy

One of the results of Russia's economic reform has been increasing demand for the decentralisation of important aspects of socio-economic policy. Regional and municipal authorities, the scientific and business community, as well as civil society organisations have tended to favour regional strategic planning, programmes and schemes.

In responding to regional expectations, the federal government is more than ever confronted with an equity/efficiency dilemma. On the one hand, it has constantly reaffirmed that its main objective is to equalise regional socio-economic development throughout the territory of Russia, as stated in its current "Strategy of diminishing disparities between regions until 2015". In the last decade many programmes were implemented in this spirit, for example: "Diminishing discrepancies between Russian regions", "Socio-economic development of Kaliningrad, the Kuril Islands, Far-Eastern regions, Southern republics in European Russia". Federal funding has also been granted to a number of projects to boost social and communal infrastructure in the 40 oblasts, republics and okrugs with a below-average level of social and economic development. Recently, the Council for Research for Productive Forces (CRPF) has developed four new programmes of socio-economic development for less developed regions, the Republic of Komi, Kemerovo and Jewish oblasts, and Khanty-Mansi autonomous okrug.

On the other hand, the federal government is clearly tempted to bet more on "regional engines" of national performance, by concentrating investment in areas where local conditions ensure greater returns. Current trends in regional economic development in Russia are in fact increasingly close to the patterns found in most catching-up economies, i.e. polarisation of the economic space with nodal centres accumulating an increasing share of productive resources, to the detriment of lagging regions.

The sub-regional level of governance also deserves attention. Some interesting developments over the last decade could become more widespread in the future. For example, cities originally created as closed military-oriented research-industrial complexes have developed a social identity and their municipalities have become significant players in innovation system governance.[8]

Federal/sub-national relations take place in a context of limited fiscal decentralisation; the regional and local authorities are therefore very dependent on funding from the central government. Restrictions are also imposed on investment by regional/local authorities; for example, they cannot provide core funding to universities. Moreover, the national priorities and criteria that determine access to federal support seldom fit regional needs and capabilities perfectly. This reduces the impact of that support on local development and affects the overall efficiency of federal spending on innovation. Regional and local success stories demonstrate that strong self-organisation capabilities at the sub-national level are necessary to ensure the best use of federal resources (see below).

Another issue is the "high-tech myopia" of Russian innovation policy which leads to widespread neglect of non-technological innovation. Too little is known about the real innovation potential of regions with economies that are less R&D-intensive than the national average. For the modernisation of regions, all forms of innovation should receive more attention at both the federal and local level.

3.2.3. Innovation system governance: achievements and shortcomings

A number of bodies are involved in the definition and implementation of policies that bear on innovation. They engage in a collective learning-by-doing process of definition and implementation of an innovation policy to fit the needs of the nation. It is no surprise that, under these circumstances, a number of issues arise regarding the efficiency of the resulting policy arrangements and processes.

The OECD Innovation Strategy has identified desirable "qualities" for innovation policy governance, including legitimacy, coherence, stability, adaptability, and ability to steer and give direction (OECD, 2010a). In Russia, legitimacy depends to a larger extent than in OECD countries on the involvement of the central government, particularly the offices of the president and prime minister. This leads to top-down approaches and, in theory, should also mean greater ability to ensure coherence and to steer and give direction to policy. As mentioned earlier, the situation has long been quite different, at least in the case of S&T and innovation policy, for two related reasons. First, innovation was not on the top-level national economic policy agenda until quite recently. Second, the fragmentation of the immediately lower layer of governance (ministries and autonomous agencies) has led to multiple and partly competing strategic visions, as well as to overlapping initiatives.

The major proponent of innovation policy has historically been the Ministry of Education and Science, but its control over the relevant resources and its influence on some key actors were too limited for it to ensure even the co-ordination of R&D. It had nevertheless the great merit of "incubating" what is now taking shape as a full-fledged Russian innovation policy. In addition, it addressed some generic S&T problems rather successfully. For example, a major criticism of S&T policy a decade ago was its inability to set and implement spending priorities. Funds were spread too thin and the support system lacked stability. The situation today is markedly different, at least in terms of new funding.

The recent establishment of two commissions at the highest level indicates not only the increased political commitment to an innovation agenda but also introduces new mechanisms for ensuring policy coherence. It remains to be seen how the co-ordination and steering functions of the presidential commission and the commission chaired by the prime minister will complement each other in practice. In principle the latter is in charge of ensuring and monitoring, at the "working level", the implementation of the orientations chosen by the former. However, there is significant overlap in the memberships of the two commissions, and they seem to meet only about twice a year, which may be too little, especially for the commission chaired by the prime minister, in view of its responsibilities.[9]

A major weakness of Russian policy decision and co-ordination processes is their lack of transparency and the insufficient involvement of actors that are important for the country's economic success but are not part of the influential informal networks that link top government officials, big business and powerful science lobbies. Of course, there are channels for some forms of consultation of various stakeholders (Box 3.7), but they should be broadened and strengthened and firmly linked to the new policy governance structures. A promising example is the recently initiated Technology Platforms programme, which brings together representatives of the business, government and research communities in defined technology areas (see below).

Box 3.7. Participatory governance: The contribution of business associations

The low level of R&D and innovation activities that are financed and carried out by the business sector has long been the Achilles' heel of the Russian innovation system. Measures to change this situation need to be taken with a full understanding of the business dynamics, expectations and constraints in different sectors and for different types of firms. The business community's strong participation in the policy formulation, implementation and evaluation process has become the rule in most OECD countries.

In Russia, some communication channels between the government and the business community are quite specific because of the importance of state-owned enterprises and for other reasons. Their relationship may appear either too strong or too weak, depending on the subject and type of business. It is worth mentioning the useful and exemplary role of some business associations: the Russian Union of Industrialists and Entrepreneurs (RSPP), the Union of Entrepreneurial Organisations of Russia (OPORA), and the Chambers of Commerce.

RSPP, which mainly represents large companies, focuses its efforts on the upgrading of the business environment and the improvement of the image of Russian business in the country and abroad. In order to contribute concretely to the development of legislative proposals, it has created some 17 working groups, including one on industrial policy, dealing with various matters affecting more or less directly the innovation climate.

OPORA gathers 88 sectoral and regional associations of SMEs, with about 20 working groups, including one on innovative SMEs. It has submitted several policy position papers to the government, notably on industrial parks and clusters (Ivanova and Roseboom, 2006).

The Chambers of Commerce is also involved in discussions of matters that concern framework conditions for innovation such as labour laws, quality and certification schemes, and transport and logistics.

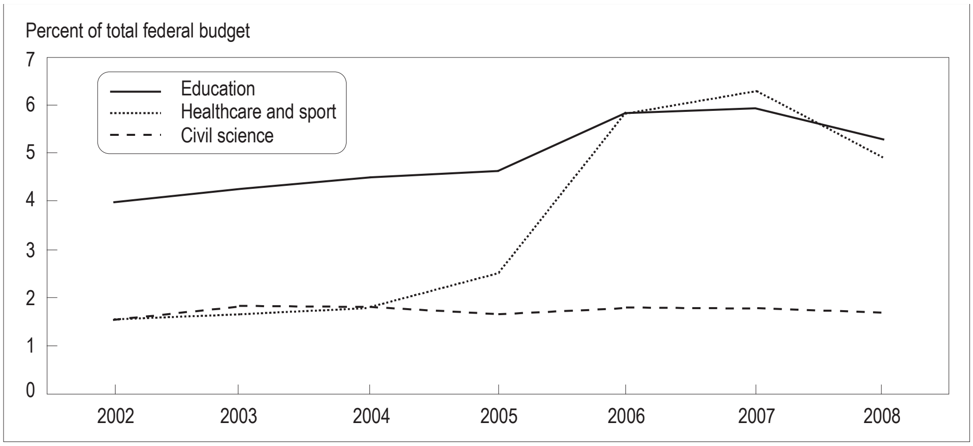
The fragmentation of the information system is another weakness of the governance of the Russian innovation system because evidence-based policy making requires a well-documented and constantly updated overview of the situation. However, the multiplicity of policy frameworks in which this system is embodied results in blind spots and some inconsistencies in the available data. The absence of consistent and internationally comparable information on several important aspects of policies and economic activities is striking to a foreign observer, including the OECD review team.

Russia has made considerable progress in adapting its statistics to international norms, including its R&D and innovation statistics, through intensive participation in OECD and EU work. It has excellent, often internationally renowned, experts and expert groups working in the university and government sectors and now in independent non-governmental organisations and the private sector. However, fuller use needs to be made of these assets to develop the information base and related advisory channels that the government now requires to steer economic modernisation effectively.

3.3. Public funding of R&D: Trends and allocation patterns

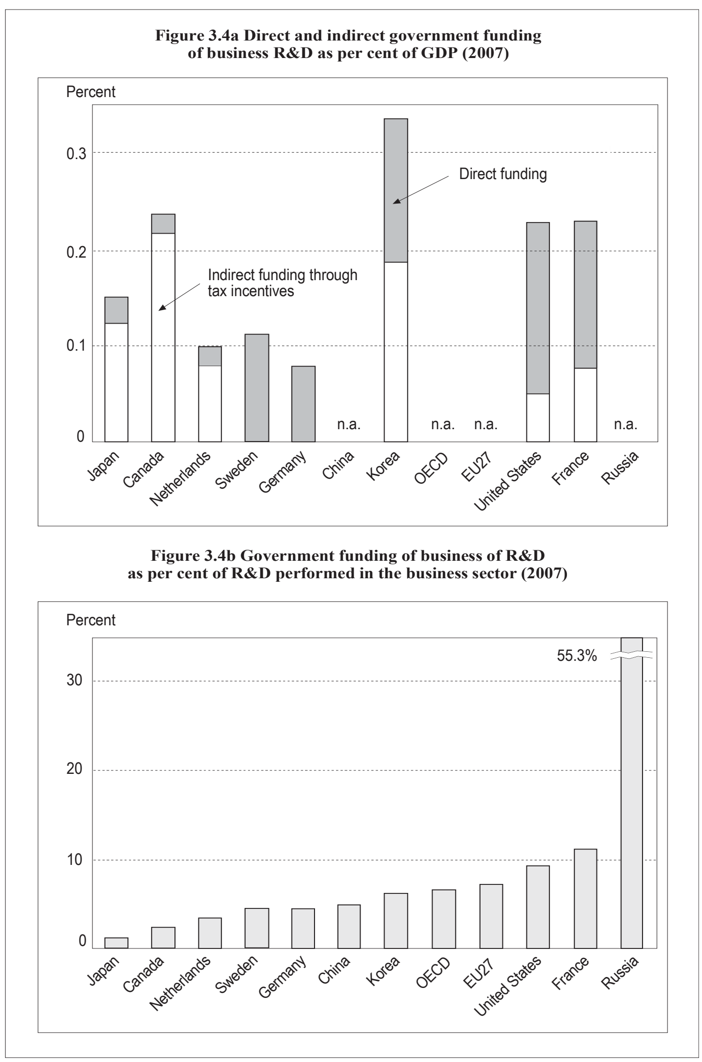
Financial support to R&D organisations and activities, in the form of grants (expenditures) and, marginally, tax incentives (foregone revenues) is the main steering mechanism of the Russian innovation system. Instruments such as open procurement policies or public-private partnerships so far play only a marginal role.

Figure 3.3. Federal budget appropriations for science, education and health care



Source: Ministry of Education and Science (2009).

Figure 3.4. Government funding of business R&D



3.3.1. Overall trends in budgetary support

Direct funding

The science and technology sector benefited from the budgetary improvement brought about by a decade of high growth up to the 2008 global financial crisis. Budget funding of S&T enjoyed an annual increase of 15-20% over 2003-08. The federal civil R&D budget reached some RUB 140 billion in 2008 (USD 4.2 billion). However, in relative terms the evolution has been less impressive. S&T represents today around 1.6% of the total budget, a proportion that has been stable over the last decade, in contrast to the growing share of other budget items, such as education and health (Figure 3.3).

The budgetary situation changed dramatically with the sharp recession following the global financial crisis. Fiscal revenues dropped and the government gave greater priority to short-term goals. The R&D budget fell by about 30% in nominal terms between 2008 and 2009. The shock to the whole S&T system was aggravated by reductions in extra-budgetary investment, notably for the federal target programmes (see below) which required matching funds by enterprises severely hit by the downturn. It is estimated that only 60-70% of planned off-budget expenditures were made (Gaidar Institute, 2010).

Budget trends foreseen for the coming years are not very encouraging. Significant deficits are anticipated. It is hoped that the government will consider public S&T expenditures as a strategic investment to be protected from further cuts, as they are essential to the success of Russia's innovation and economic modernisation agenda.

Tax incentives

Although precise data are not available, it seems fair to assume that tax incentives represent only a tiny share, much lower than in many OECD countries (Figure 3.4a), of the total budgetary effort in favour of R&D. One obvious reason is the exceptionally high level of government R&D grants to the business sector, which reflects the specific features of the Russian technology industry, notably the importance of former "branch" research institutes and design bureaus in the corporate R&D-intensive sector (Figure 3.4b). Another is the low level of R&D activity in part of the corporate sector, notably private firms, for which it makes more sense to consider tax incentives as a possible substitute for some grants.

The tax treatment of R&D expenditures is complex and changes frequently. Currently, companies can write off R&D expenditures over two years if the R&D is used in production or sales. The government is considering the possibility of allowing accelerated write-off, possibly up to 100% in one year, for related capital expenditures. Specific tax incentives include (ERA Watch, 2010):

- From January 2008, the tax exemption on funding used for R&D projects has been extended to cover not only funding from the federal budget but also funding from non-budgetary resources.
- Another tax exemption introduced in 2008 applies to the sales of intellectual property rights (IPR), including exclusive rights on inventions, databases and IPR licensing.
- Tax incentives are used to attract companies to special economic zones (SEZ) for technology development (see below). Companies settling in the SEZs are exempt from property and land taxes for a period of five years and benefit from reduced rates of social taxes.

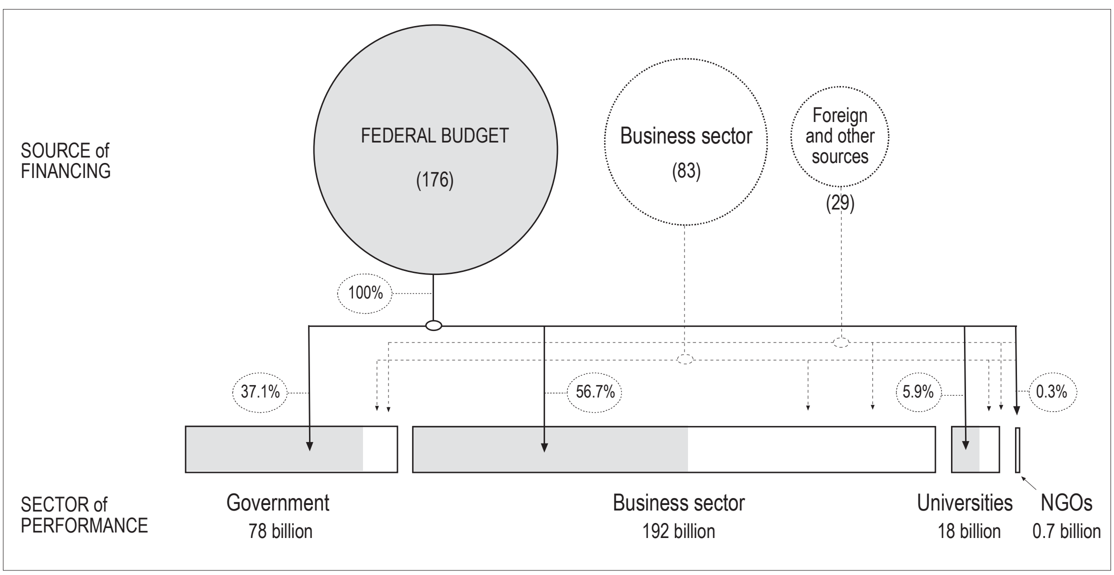
The individual and combined efficiency of these schemes has not yet been thoroughly assessed, but the government seems to consider that their impact on the overall level of business investment in R&D is generally rather modest. This explains why new fiscal stimuli are being prepared jointly by the Ministry of Education and Science, the Ministry of Economic Development and the Ministry of Finance.

3.3.2. Public funding patterns: main institutional channels

The federal budget is the main source of R&D funding (Figure 3.5). Statistics on federal R&D funding distinguish between basic and applied research. The allocations by department and agency are given in Tables 3.1 and 3.2 for 2009 and 2010 (estimated expenditures for the former and planned expenditures for the latter, as of 1 January 2010).

Figure 3.5. Federal funding of R&D (2006)

RUB billion, %



Source: OECD, based on data from the Institute of World Economy and International Relations, (IMEMO), Russian Academy of Sciences.

The expenditures for basic research are half of those for applied research, although the criteria for classifying R&D activities in Russian statistics may sometimes give more weight to the nature of the institutional channels than to the actual nature of the research activities being funded. The Russian Academy of Sciences and its regional branches get the lion’s share, with more than 60%, and they benefited from a significant increase in 2010, in both relative and absolute terms. The other academies altogether receive about 13% of total funding. The Russian Foundation for Basic Research has experienced a reduction of its funding in both absolute and relative terms. The Federal Agency of Education gets about 6% of the total, mostly to fund the strengthening of the research capabilities of universities (see below). The support to the two state universities (Moscow and Saint Petersburg) is in addition to the resources allocated by the Federal Agency for Education.

Table 3.1. Basic research funding: Breakdown by institution

	2009		2010	
	RUB billion	%	RUB billion	%
Russian Academy of Sciences	46.0	60.6	49.1	64.0
Other academies	13.0	17.1	13.4	17.5
Federal Agency for Education	4.7	0.6	4.3	5.6
Federal Agency for Science and Innovation	0.5	6.2	0.8	1.1
Russian Foundation for Basic Research	7.1	9.4	6.0	7.8
Russian Foundation for Humanities	1.2	1.5	1.0	1.3
Ministry of Economic Development	0.5	0.6	0.1	0.0
Moscow State University	2.8	3.5	1.3	1.7
Saint Petersburg State University	0.0	0.0	0.2	0.3
Others	0.1	0.0	0.5	0.6
Total	75.9	100.0	76.7	100.0

Source: Ministry of Education and Science.

Table 3.2. Applied research funding: Breakdown by institution

	2009		2010	
	RUB billion	%	RUB billion	%
Russian Academy of Sciences	1.8	1.0	1.3	0.1
Federal Space Agency	47.2	32.3	49.9	32.9
Federal Agency for Science and Innovation	20.5	14.0	18.3	12.1
Federal Agency for Education	4.2	2.8	5.6	3.7
FASIE (SME support)	2.4	1.6	2.4	1.6
Ministry of Defence	5.6	3.8	6.0	3.9
Ministry of Health + Bio Med Agency	4.0	2.7	3.5	2.3
Ministry of Industry and Trade	35.6	24.3	42.2	27.9
Ministry of Economic Development	0.6	0.4	0.5	0.3
Ministry of Energy	1.1	0.7	0.7	0.6
Rosatom	3.0	2.0	4.4	2.9
Fed. Agency for Tech. Reg. and Metrology	0.7	0.4	0.6	0.3
Fed. Service for IP. Patents and Trademarks	1.9	1.3	1.7	1.1
Others	17.7	12.1	20.0	13.2
Total	146.3	100.0	151.5	100.0

Source: Ministry of Education and Science.

The breakdown of applied research funding shows the importance of the Federal Space Agency (about one-third of the total) and the Ministry of Industry and Trade (more than one-quarter, mostly to fund the branch institutes under its control). Both benefited from an increase in their relative share in 2010. The resources of the Federal Agency for Science and Innovation (since April 2010 included under the Ministry of Education and Science) were reduced in 2010 and represent only about half of the resources of the Ministry of Industry and Trade. FASIE has maintained the level of its resources. The Ministry of Defence also benefits from significant civil R&D resources, some 6% of total civil support to applied research. Appropriations for Rosatom are quite small, but most of this agency's funding comes from the military budget.

When the funding of applied and basic research is consolidated, it appears that more than two-thirds of the federal civil R&D effort goes to three institutions – the Federal Space Agency, the Academy of Sciences and the Ministry of Industry and Trade. These three institutions manage the activities that were the pillars of the Soviet S&T system, including the former "branch" research institutes and design bureaus that are now "corporatised", generally as joint stock companies or unitary state enterprises. This reflects an important institutional continuity (if not inertia) in the Russian R&D system, even if significant resources are now allocated through the competitive schemes of the (former) Federal Agency for Science and Innovation, the Russian Foundation for Basic Research and FASIE.

State contracts and public procurement

A significant part of government R&D spending, especially for applied research, takes the form of state contracts – state orders in the Russian terminology – through which, in theory, the state buys R&D results to satisfy identified needs. To a certain extent, this looks like public procurement of R&D in OECD countries. However, many of these state orders are not filled through a transparent process; some are probably disguised unconditional subsidies and many others do not seem to be the result of fair competition in the tendering process. Although research themes are published on the web, it is generally considered that the conditions of competition are often biased and even at times affected by corruption practices.

Table 3.3. Budget appropriations for applied research in selected ministries and public agencies, including state contracts (SC) and grants to subordinated organisations (SO)

RUB billion

	2009			2010		
	Total	**SC**	**SO**	**Total**	**SC**	**SO**
Total	146.3	98.6	14.4	151.4	104.9	15.8
Ministry of Defence (civil budget)	5.6	4.2	0	6.0	4.4	0
Ministry of Health and Social Development	2.7	0.2	2.4	2.6	0.2	2.4
Ministry of Industry and Trade	35.6	24.1	0.0	42.2	28.4	0.1
Federal Agency for Science and Innovation	20.5	13.9	2.4	18.3	11.4	4.5
Federal Agency for Education	4.2	2.7	1.3	5.6	4.2	1.3
Federal Space Agency	47.2	47.2	0	49.9	49.9	0
Rosatom	3.0	1.3	n.a.	4.4	2.3	n.a.

Source: Ministry of Education and Science.

In this context it is extremely difficult to evaluate the resources that are effectively allocated through fair and open competitive mechanisms, other than those channelled through agencies with very explicit and transparent procedures, such as the Russian Foundation for Basic Research. The information provided by the Russian government about funds appropriated for applied research includes data on amounts allocated through theoretically open state contracts, as well as on funds allocated to subordinated organisations as "sovereign" grants from their parent organisation. Table 3.3 presents this information for selected bodies.

Box 3.8. Innovation-friendly public procurement: International experience

Among OECD countries recent years have seen some shifts in the mix of policies used to support innovation. A common trend is to pay more attention to the need to correct on the demand side and to systemic failures that inhibit innovation processes. Examples include: information asymmetries that impair market introduction and the diffusion of innovations; high switching cost to new technologies; high entry costs (especially for areas with high network effects); difficulties to translate some user needs into clear market signals; and technological lock-in and path dependencies (Edler, 2007).

Countries such as Finland and the United Kingdom are quite advanced in articulating comprehensive demand-side innovation policies but all countries have taken new initiatives to remove demand-side bottlenecks to innovation. An important factor has been the fact that traditional mission-oriented technology policies have had to change in order to respond to evolving societal needs (*e.g.* green growth, health in ageing societies, security in the face of new risks) and must be now pursued through approaches that give higher priority to stimulation of demand, supply/demand articulation and public-private partnerships, often with the active participation of individual citizens/consumers.

If the scope and intensity of government intervention varies in different countries, it always relies on a combination of the same basic instruments that affect more or less directly the demand for innovations across the board or in more specific fields: public procurement; regulations and standards; pricing (or taxation) schemes; awareness and education. Public procurement is seen everywhere as having a central role in boosting demand for innovation. It can be made more innovation-oriented in two main ways.

First, government can incorporate an innovation dimension into general public procurement, *e.g.* by incorporating new qualitative criteria in tenders and in the assessment of tender documents. This is very demanding, however, since procurement is generally not carried out by the agencies or ministries responsible for innovation but by specialised agencies which are mainly responsible for cost-effective purchasing. The linking of the two is a major governance challenge which a growing number of countries have decided to tackle. In Finland, innovation-friendly procurement is a key pillar of the 2010 “Action plan for the implementation of demand and user-driven innovation”. In Australia, according to the 2008 Commonwealth Procurement Guidelines, agencies “should seek to ensure that wherever possible their processes allow for suppliers to provide innovative solutions to their requirements”. In the Netherlands, a new public innovation procurement (PIP) programme aims at promoting innovative solutions to solving societal problems in priority areas (water, energy, security, health, education, mobility, construction, and agriculture and fishing). The United Kingdom introduced an Innovation Procurement Plan in 2009, making innovation a key requirement in large facilities and capital programmes.

Second, public procurement of technologies and research can be made more strategic if greater attention is paid to their systemic as well as sectoral impact on incentives and capabilities to innovate in the public and private sector, including the search for greater synergies between civil and defence-related activities. In this context, the participation of small and medium-sized enterprises has received greater attention in many countries, following the pioneering example of the United States, which introduced as early as 1982 the Small Business Innovation Research (SBIR) programme. Examples of recent variants of the SBIR programme include: the United Kingdom's Small Business Research Initiative (SBRI) launched in 2001 and reinforced in 2009; the Dutch Small Business Innovation Research (SBIR) pilot programme introduced in 2004; in Australia, the Market Validation Program (MVP) introduced in 2008 by the Victoria State Government as part of its Boosting Highly Innovative SMEs (BHIS) programme; and the Canadian Innovation Commercialisation Program (CICP), launched in 2010 to help entrepreneurs, through contracts, to bridge the pre-commercialisation gap for their innovative products and services.

In addition to state orders for R&D, some state orders for goods are important for innovation, especially on the demand side. Such purchases by all levels of government in Russia would have been of the order of USD 133 billion in 2009 (OECD, 2010b). The procedures were modernised in the mid-2000s, inspired by those in place in OECD countries, *e.g.* competitive calls for tenders and rules reserving 20% of procurement markets for SMEs. Late 2010 and early 2011 saw a lively debate over a proposed overhaul of federal legislation on public procurements, following a call from President

Medvedev to amend the legislation. The existing regime, with its extremely rigid formal requirements, was adopted in an effort to eliminate corruption by depriving officials of discretionary authority in the procurements process, on the basis that such discretion merely enabled them to manipulate tenders for corrupt purposes. Critics of the law argue that it has not eliminated corruption in procurements, which the federal authorities estimate costs the state RUB 1 trillion (USD 35 billion) a year, but that it has nevertheless made it extremely difficult to conduct honest tenders. It has also eliminated any scope for using tenders to promote innovation, SME development or other policy goals, treating the procurements as a governance integrity issue pure and simple. The proposed reform would grant officials greater discretion, including the power to set some preliminary requirements for eligible suppliers, and would attempt to address the risk of corruption via greater transparency, to be assured in part by creating an all-powerful federal watchdog (possibly under the aegis of the Ministry of Economic Development) to oversee public procurement tenders.[10] While few would argue that the current system has proved its effectiveness at reducing corruption in procurements, there is much uncertainty about whether an approach that relies more on transparency than procedural rigidity can do better, let alone whether it might become an effective vehicle for using public procurements to promote innovation (Box 3.8).

Public procurement in the defence sector is a case apart. For obvious reasons its impact on the civil innovation system is especially important in Russia. It is important to distinguish between R&D procurement and purchases of goods and equipment (including repairs and modernisation). In 2009, in a total of some RUB 484 billion of military procurement, R&D amounted to some RUB 136 billion (*i.e.* 28%), of which a significant part went to the research and testing centres of the Ministry of Defence. As in the case of civil public procurement, there have long been serious problems and disappointments, excessive costs, lack of delivery, endemic corruption, etc. These problems, which date back to Soviet times, have motivated a serious reorganisation of the military-industrial complex, the outcome of which is not known to outsiders (Cooper, 2010).

3.3.3. Selectivity and focused programmes

Federal target programmes (FTPs)

In order to speed up the modernisation of the Russian economy and society, the Russian government launched 51 FTPs in the mid-2000s as a way to focus a significant part of public investment on priority areas, and to test new approaches, inspired by the EU Framework Programmes, to selecting and funding relevant projects.[11] Twelve FTPs are directly related to science, technology and innovation and received some RUB 98 billion in 2009; the overall spending of the FTPs amounted to RUB 840 billion, including RUB 420 billion in capital investments.[12]

Table 3.4 shows the time scale and overall budget of S&T-related FTPs. State funding is complemented by business sector funding for several of them, in a proportion that varies, depending on the nature of the activities supported. As mentioned, the actual funding for 2008 and 2009 was significantly lower than planned (half in the worst cases).

Table 3.4. Selected S&T-related federal target programmes

	Period	Total budget (RUB billions)	% share of state funding
R&D in priority areas of S&T[1]	2007-13	195	70
National technological base[1]	2007-11	23	--
Development of nanotechnology infrastructure[1]	2008-10	27	--
Research and academic teaching personnel[1]	2008-15	187	--
Development of civil aviation	2006-10	158	22
Federal space programme	2006-15	480	60
Development of electronic components and radio electronics[1]	2008-15	187	60
Development of nuclear energy complex – radiation nuclear waste management	2008-10	40	--
Global navigation systems (Glosnass)	2002-11	140	--

1. Managed by the Ministry of Education and Science.
Source: Ministry of Education and Science.

The largest S&T-related FTPs target high-technology sectors such as aerospace and ICTs, but also human resource development. In addition a large FTP supports a wide range of research activities in S&T priority areas (Table 3.5).

Table 3.5. Planned budget appropriations for the FTP on R&D in priority areas of S&T
RUB billion, 2007-13

By technological field		By functional activity	
Nanotechnologies and materials	43.0	Knowledge generation	30.6
Life sciences	27.9	Technology development	68.7
Power engineering and energy	19.7	Technology commercialisation	12.5
Rational nature management	9.8	Research infrastructure	5.5
Information and communication technologies	8.9	Innovation infrastructure	15.5

Source: R. Burger (2008), "Russian Federal Targeted Programme for Research & Development in Priority Fields for the Development of Russia's S&T Complex for 2007–2012: An outside view', PowerPoint presentation, RUSERA-EXE training course: Opportunities & challenges for EU-Russian RTD co-operation, 30 January-1 February.

The programme on R&D in S&T priority areas should have RUB 195 billion, of which RUB 134 billion from the budget and the remaining RUB 61 billion from the business sector (Burger, 2008). With planned funding of RUB 17 billion in 2009, it accounted that year for about 10% of the civil R&D budget. The funds are allocated on a competitive basis. The impact of the programme is monitored on the basis of very detailed criteria.

When adding up the different relevant schemes one may estimate that around 30% of the overall civil R&D budget is now allocated through competitive funding.[13]

Other approaches to selectivity

In addition to the FTPs, the government has adopted other ways to concentrate resources on selected centres, institutions or sites considered of high potential and/or of strategic importance. The selection of beneficiaries has been made either based on "sovereign judgement" or through a competitive process. Examples are the special status and support granted to 27 research universities, 50 state research centres and 14 science cities.

The extensive use of the "special status" approach raises some questions. As noted by the Gaidar Institute, instituting such "progressive inequality" can contribute to the development of high-quality science and research by crystallising the research system around poles that better satisfy the criteria of excellence and critical mass and provide greater opportunities for cross-fertilisation of scientific disciplines and projects. Such concentration can also entail unwarranted consequences sooner or later, such as complacency in the chosen groups if they do not feel that their position is contestable in one way or another (increased competition between winners and/or from foreign institutions, social accountability) and frustration among the others if they have little hope of increasing their resources through other, more accessible forms of merit-based competition. Rigorous monitoring and evaluation are necessary to prevent such potential perverse effects. Also, it is important to consider this approach as commendable as an alternative to the Russian form of "pork barrelling" but not to generic support to individuals and research teams through competitive schemes. These remain invaluable for detecting, empowering and rewarding the talent – and the organisations in which they are nurtured – that, in the field of innovation, often emerges in unexpected ways and in unpredictable places.

3.4. Strategic tasks of innovation policy: A functional assessment

Against the background of the information provided by the preceding sections on policy-making institutions and government funding patterns and channels, this section undertakes an analysis and assessment of how and how well Russian S&T and innovation policy performs the following strategic tasks:

- Securing the availability of qualified human resources.
- Adapting public R&D to the requirements of a modern innovation system.
- Promoting business R&D and innovation.
- Fostering the development of competitive innovation-oriented industries.
- Providing supportive infrastructures to innovators.
- Harnessing global opportunities through international co-operation.
- Developing and mobilising regional innovation capabilities.

3.4.1. Securing the availability of qualified human resources

The importance attached to education by the state and citizens is a positive legacy of the Soviet era and explains why Russia today has a higher proportion of university graduates in the population and workforce than any OECD country. The quality and quantity of people trained in science and technology was a key feature of the Soviet system. But Russia also inherited less desirable features, notably the strict separation of education and research and the lack of training in many disciplines required in a market economy. In addition, the collapse of former productive structures entailed that of certain layers of the education system, notably professional and vocational training, which were difficult to rebuild in the new environment. The government worked hard during the last two decades to solve these issues, with a good deal of success in many areas, but in a context of new challenges created by demographic trends.

Minding a human a resource gap

As a consequence of demographic losses, a major human resource gap is to be feared. The consequences for the innovation system, already badly affected by an "emigration shock" in the 1990s, might be aggravated by: *i)* the disaffection of students for science and engineering studies; *ii)* the fact that most of those finishing secondary school prefer to enter university rather than professional and vocational schools, although a lack of technicians already severely constrains the use and maintenance of scientific equipment in many places; and *iii)* the pronounced ageing of scientific and R&D personnel.

To counteract the disaffection *vis-à-vis* science and engineering studies, the government has put in place a strong policy of quotas for so-called "budget places", which are free of charge for students, and has reduced authorised entry contingents in some disciplines.[14] But of course quotas will not solve the problem if they do not match labour market trends. Only an increase in innovation activities in the corporate, especially private, sector can lead to the necessary changes on the demand side of the labour market.

The same holds true for the objective of making vocational and professional education more attractive to youth and better attuned to the evolving needs of more innovation-oriented economic development. Better-paid jobs and more interesting careers are essential for changing attitudes. However, this is not amenable to any specific policy; it can only result from the success of the overall economic development strategy. The government has the more direct responsibility to rejuvenate the professional and vocational education system itself. The most significant initiatives have been taken so far in sectors related to the defence industries. A programme was launched to review the skills needs and availability of qualified personnel, with a view to establishing "corporate universities" that can fill gaps through new training programmes.[15] Similar approaches should be considered in other sectors, with an effort to mobilise the business community and to learn from successful foreign experience (Box 3.9).

Strengthening universities and enhancing their contribution to research and innovation

The reform of the higher education system has been an important item on the reform agenda since the very early years of the transition. In broad terms, it involved the huge task of adapting curricula to the new political, economic and societal context, along with efforts to adopt, with adaptation to Russian conditions, international best practices regarding how universities should be organised, managed and internationally connected. This continuing adjustment process has come over time to focus more and more on generic issues similar to those dealt with by OECD countries, rather than on "transition-specific" ones. For example, Russia has recently engaged in the Bologna process by deciding to adapt key aspects of its education system to European norms. The law passed in October 2007 gave universities two years to introduce the system of Bologna-type credits.[16]

Box 3.9. Vocational education and training (VET) – lessons from OECD policy reviews

In recent years, vocational education and training (VET) has become a policy priority in OECD countries for three main reasons. First, VET has an important economic function, providing trade, technical and professional skills for the workforce. Second, there are signs of emerging strains in VET systems, including a lack of workplace training places and a shortage of vocational trainers and teachers. Third, VET has been neglected in the past, certainly by analysts, but also to some extent in the policy arena. In the light of this strategic priority, the OECD has launched a set of policy reviews covering 15 countries over the period 2007-10. Some of the main conclusions of this work are as follows:

- VET programmes should include an element of workplace training because, apart from the learning benefit, employers' willingness to provide such workplace training reflects labour market demand for the skills acquired in the VET programme.
- Within individual VET programmes, a good balance between generic and specific skills is important. VET graduates need the occupationally specific skills that will allow them to enter skilled jobs without lengthy additional training. They also need generic transferable skills to carry them through their working career, including the ability to adapt to fast-changing workplace requirements.
- Interchange and partnership between VET institutions and industry is important. Vocational teachers and trainers should spend time in industry to update their knowledge, and vocational trainers in firms should spend some time in VET institutions and enhance their pedagogical skills.
- VET policy development and implementation requires engagement with employers and unions. Their involvement helps to ensure that the content of VET – what is taught in VET schools and at the workplace and how exams are designed – is relevant to the labour market. Typically this means a set of interconnected institutions at national, regional and sectoral levels, with clear responsibilities for different elements in the VET system.

Source: OECD (2009), *Learning for Jobs: OECD Policy Review of Vocational Education and Training*, OECD, Paris.

The wish to give a more prominent role to universities in the national research system was present early on the reform agenda, but for some time mainly sought to counterbalance the excessive weight of the academies, with only modest results. However, more significant moves with broader motivations were made possible in the last decade with the establishment of a renovated Ministry of Education and Science possessing more resources and a stronger mandate.

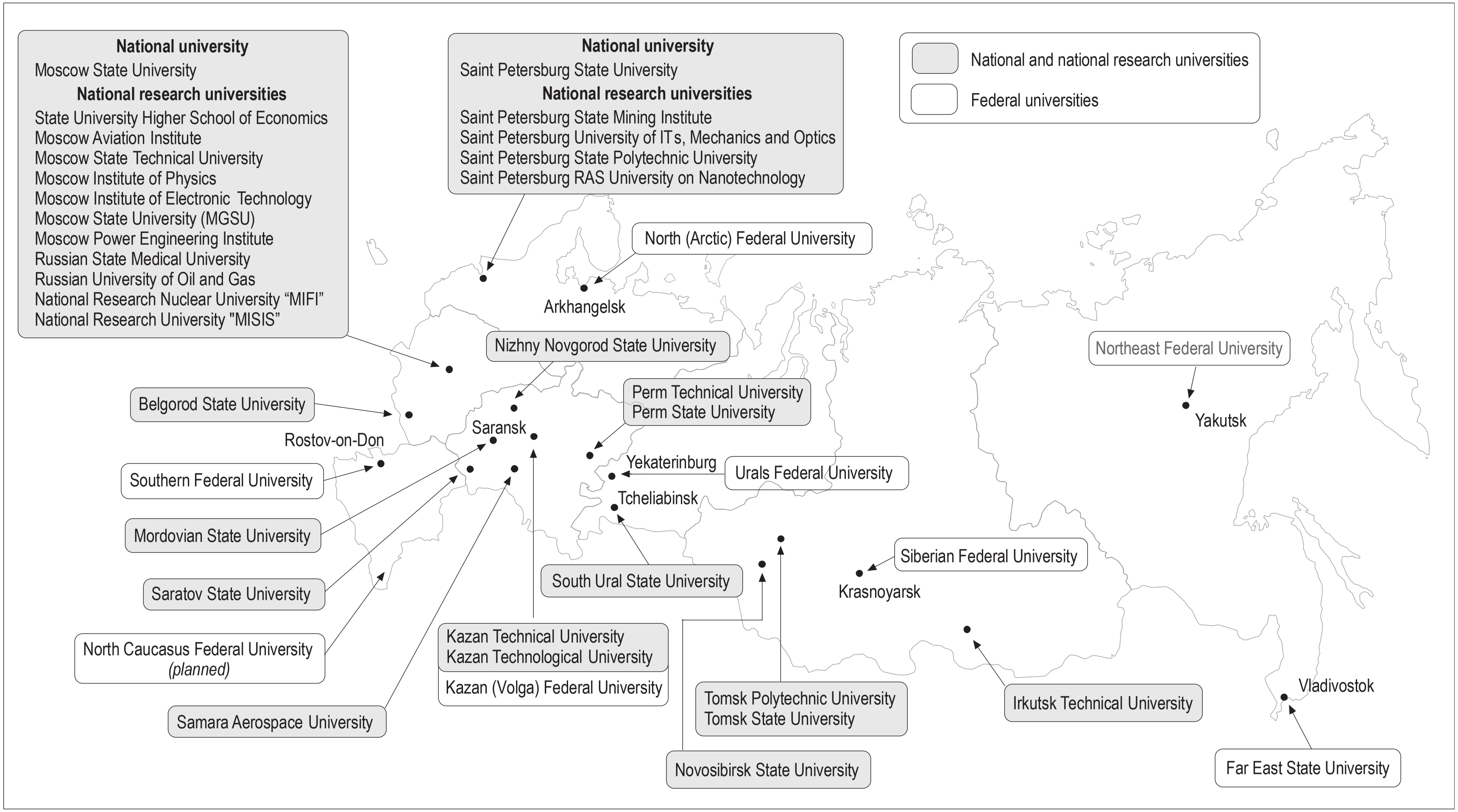
An important step was the launch in 2006 of a programme to fund innovation initiatives in higher education in which 57 educational institutes, 17 of which are universities, participated during the last three years (2007-10). The programme supports, for instance, student-business incubators and study-research-innovation complexes (following a model tested successfully in previous years in co-operation with the Academy of Sciences). In 2010 it was extended with the introduction of a new scheme. With a budget of RUB 2 billion, this scheme will provide RUB 50 million a year to universities' initiatives for three years (Government Decree 219).

The boldest recent decision was to accelerate the development of research capabilities of higher education institutes by selecting and supporting those most capable of playing an effective and leading role in this process, with the following hierarchy (Figure 3.6).

- At the top, the status of "national universities" was granted to two HEIs: the Moscow State University and the Saint Petersburg State University. Beyond the prestige it confers – helping to attract students, professors and resources – this special status also means greater autonomy for the rector and the university management. In addition, significant new block funding of some USD 400 million has been awarded to the two national universities.
- Next, 27 national research universities have been designated (12 after a first competition held in 2009, and 15 after a subsequent one in 2010). With this new status, given for a ten-year period, they will benefit from assured additional funding for five years to develop their research capabilities. The competition has been fierce, with an approximate rejection rate of 90%. The selection criteria gave significant weight to international exposure and connections. A committee of 36 members representing different communities (the government, the academic sphere and the business sector) administered the selection process. More than USD 600 million has been earmarked for the programme.
- Seven regional universities have received a "federal" status that distinguishes them as leading teaching institutions in the Russian territory, with a view to increasing their contribution to the development of the regions in which they are located. They are supposed to better integrate education, science and business in a number of thematically defined priority areas. The two first federal universities were selected in southern Russia and in Siberia in 2006. In 2009, a further five were created in other federal districts. USD 600 million has been earmarked for this programme.

This formalisation of the *de facto* stratification of the university system is consistent with the general approach pursued for some time by the Russian government; it consists in concentrating new resources on "hotspots" where greater returns can be expected. It should be understood against the background of the less helpful logic long imposed by conservative forces. In the field of S&T and innovation it is in particularly sharp contrast to what is still the practice of the Academy of Sciences in allocating the R&D budget under its control. A legitimate sense of urgency has motivated the decision to manage an accelerated selection proactively rather than wait for the results of a more organic but longer process. The cost of delayed restructuring should therefore be weighed against that of possible mistakes in the selection made.

Figure 3.6. Universities with special status



Source: OECD, based on information from the Ministry of Education and Science.

Beyond the natural disappointment of some of those that failed in the competition, independent experts have voiced concerns that the government must take seriously. One relates to the management of expectations when ensuring that the benefits of rewarding the best are not undermined by the costs of discouraging the others. As pointed out by the Gaidar Institute (2010), the shorter the list, the easier it is to ensure its legitimacy. When the list expands, so do the expectations of an ever larger number of candidate institutions. The risk of inequitable choices also rises, up to a point beyond which no selection, however appropriate, will gain acceptance. From this perspective, the government should probably resist pressure to add new rounds of competition and find other ways to maintain the motivation of non-selected HEIs to keep improving their performance.

Other issues relate to the need to ensure the balanced development of the innovation system and, consequently, balanced support to all the components of the education system that underpin it. It is important for the government to avoid misunderstandings about its approach to excellence and to demonstrate in practice that it rewards excellence not only in high-level R&D activities but also in others that require other types of skills which are vital for successful innovation even if they require a lower level of education.

Renewing the scientific and teaching personnel and upgrading its qualifications

As indicated above, a major FTP aims at rejuvenating scientific and teaching personnel while upgrading their skills. This programme is generously endowed with some RUB 90 billion for the initial period of 2009-12 (11% from non-budget sources). It provides multiple forms of support to facilitate the recruitment and career development of researchers and teachers, including through higher salaries, better training, increased mobility, easier travel and stays abroad, new equipment, improved residential infrastructure, etc.[17] The plan is to spend 40% for natural sciences, 40% for engineering sciences and 20% for social sciences. The implementation of the programme has been hindered by the economic downturn which could compromise the realisation of its ambitious objectives for 2015, the final year of the programme; these include lowering the average age of the research personnel by three to four years, increasing the share of researchers with higher qualifications (candidates of sciences and above) by 2-4%; increasing the share of Russian publications in leading world science reviews by 1-1.5%.

An important dimension of the new policy to strengthen the human resource base of the S&T and innovation system is the effort to draw on foreign experts, especially the Russian diaspora. It is estimated that more than 200 000 qualified scientists fled Russia during the most difficult times of the economic transformation, the vast majority to the United States, western Europe or Israel. Many have maintained their qualifications and often acquired new ones, while taking part in dynamic professional networks with global reach. A number renewed links with Russia when economic conditions improved, but most have not found conditions appropriate for stronger engagement in the Russian education and research system. The programme launched by the government in April 2010 to mobilise Russian scientists working abroad and other world-class foreign scientists is of great significance in this context.

The programme is reserved for universities, which submit their applications to a newly established Grant Council.[18] Funding is provided on a competitive basis to Russian teams who will work under the guidance of the selected scientists; these must spend at least two calendar months in Russia. RUB 12 billion are earmarked for the period 2010-12. In 2010, 110 projects were selected to be carried out in 84 Russian organisations.[19]

Nurturing entrepreneurial spirit and training in innovation management

Russia is not short of entrepreneurial energy and creative minds but needs to channel them towards the most socially useful purposes in a long-term economic development perspective. As Chapter 1 argues, a prerequisite is to provide framework conditions that at least do not discourage existing or would-be entrepreneurs from investing in innovation-oriented ventures. Creativity and genuine entrepreneurship cannot be taught as such, but the education system can help to reveal and empower these qualities by bridging the divide between S&T and management studies and by providing students with opportunities to experiment, in environments other than an academic lab, applications of the knowledge they acquire.

Many Russian universities are now equipped or associated with business incubators or science parks/technoparks in which students can test their motivation and acquire experience and specific management skills, with the help of business angels and other types of mentors, including foreign enterprises in some cases. There are also schemes managed by FASIE that offer training to scientists who intend to create their own business. Overall, many channels for commercialising academic research through entrepreneurship now exist in Russia, and they are used as training platforms for students. An evaluation of these necessarily dispersed initiatives would be timely and would help to identify and then upscale and spread the best practices.

Russia might instead be lagging behind the worldwide trend to offer students a dual curriculum combining science/engineering education with business/commerce/economics education. This grouping gives students the two areas of skills needed for successful innovation projects and creates favourable conditions for the emergence of multidisciplinary teams of young would-be entrepreneurs.[20] A project of the Management School of Skolkovo is therefore particularly welcome. It aims at training 500 scientists and engineers a year in business and innovation management with the involvement of foreign specialists and professors. The training programme should be available by 2013 and aims to double the student contingent to 1 000 by 2015.

3.4.2. Adapting public R&D institutes to the requirements of a modern innovation system

As noted, under the Soviet system, the bulk of basic research was carried out by the institutes of what is now the Russian Academy of Sciences and most of more applied research in a large number of "branch institutes"; higher education institutions as well as enterprises were negligible players. Over the past two decades many reforms have changed this situation but less profoundly than would have been necessary to ensure the efficiency of the overall investment in the public R&D sector.

At first sight public, R&D investment patterns are not so different from what they were in the early 1990s. In 2008, the RAS received about 15% of the federal budget (a percentage close to its level in 1992), the university about 7% (against 6% in 1992), and the public research centres continued to attract the bulk of the federal money (about 60%). However, these aggregate data hide major changes in two respects: a strong concentration of resources on fewer institutes and an increasing share of competitive funding through various mechanisms. The result is an extremely heterogeneous set of public institutes, in which well-equipped world-class research groups working on national priorities coexist, sometimes under the same roof, with others operating with an unclear mission in survival mode.

Concentrating resources on fewer selected public research institutes

In the 1990s, as part of a defensive strategy to protect what were considered the most important and viable parts of the national research system, a number of institutes were granted a special status, that of either state science centre or federal research and production centre. More recently, as part of a more proactive strategy to exploit Russia's comparative advantages globally, the status of national research centre was introduced.

State research centres (SRC): The status was awarded as early as 1993 in the harsh context of the early transition years. About 30 institutes, recognised for the quality of their research teams and equipment, received this qualification. It gives access to extra budgetary resources as well as tax privileges, especially regarding property and land. Today 50 organisations with this status operate in priority areas as diverse as nuclear physics, power generation, aerospace, chemistry, machine building, biology, computer science and optics. Many conduct research for the defence complex. There are 32 in Moscow, five in the Moscow region, and 10 in Saint Petersburg. A selection process takes place every two years under the aegis of the Interdepartmental Commission for Scientific and Innovation Policy. Altogether the SRCs employ 70 000 persons, of whom 42% are researchers; about 7 000 doctors and candidates of science work in the SRCs.

Federal research and production centres (FRPCs). This status, introduced in 1995, is given to organisations operating in the defence, aerospace and nuclear industries that perform development, manufacturing, repair or testing activities and work on the basis of federal defence orders. Their legal status is that of a federal public enterprise or a joint stock company with federal ownership. The Ministry of Industry and Trade, the Russian Space Agency Rosatom, and the Ministry of Education and Science evaluate the activities of FRPCs every five years and decide, in consultation with the Ministry of Defence and the Ministry of Economic Development, whether or not to maintain their status.

National research centres (NRCs). So far this status, introduced in 2008, has been awarded to only one organisation, the Kurchatov Institute, Russia's largest research centre (Box 3.10). NRCs are expected to provide platforms for the development of breakthrough advances in key technologies in which Russia would like to develop or maintain world leadership, such as nanotechnologies or neurosciences. Special funding procedures ensure flexibility and avoid red tape: the institutes are free to make R&D contracts, their researchers are free to take part in the commercialisation of their research results, including through technology-based firms and start-ups. Is it planned to grant the NRC status to eight other research organisations or consortia. These have not yet been selected.

Box 3.10. The Kurchatov Institute: A prestigious research organisation for innovation

The Kurchatov Institute is Russia's leading R&D institution in the field of nuclear energy. Founded in 1943 initially to develop nuclear weapons, it was named after Igor Kurchatov, the "father of the Soviet atomic bomb". The majority of Soviet nuclear reactors were designed in the Institute, which also led Russian research in the field of thermonuclear fusion and plasma physics. It developed the first tokamak system in 1968, the foundation of ITER, a current major international megaproject.

The Kurchatov Institute was the first Russian institution to receive the status of state research centre and, as such, became directly subordinated to the Russian government. The prime minister appoints its president, based on proposals from Rosatom.

It is the country's biggest research institution. It initially employed 5 000 researchers but currently has 15 000, following a merger with two other bodies. Thanks to its prestige and political clout, it was able to maintain its researchers' qualifications and research infrastructures at a very high level, even in the difficult 1990s, and expensive new equipment, such as a synchrotron, was inaugurated as early as 1999. More recently, the Institute received support to develop its multidisciplinary capabilities. Notably, a RUB 10 billion top-notch biotechnology lab (genome mapping, protein reactors, etc.) was started.

The government has mobilised the Kurchatov Institute in support of its innovation policy agenda with the idea of building new comparative advantages in emerging technological fields underpinned by sciences in which the country has built undisputed world leadership over many decades.

In 2007 the Kurchatov Institute was entrusted with the task of co-ordinating R&D efforts in nanotechnology to complement the commercialisation activities of the newly established Rosnano. There is a plan to develop a Kurchatov technopark/incubator, but the project has been frozen for budgetary reasons. Innovation developments are, however, taking place as expected, in co-operation with Rosnano.

The decision to concentrate resources on fewer public research institutes (PRIs) cannot be questioned. But the choice of a "special status" approach could be, in light of the historical circumstances under which it was made, the fact that the creation of SRCs and FRPCs had a different rationale from that of the NRCs, and the feasibility of alternative solutions in the current economic and policy environment.

In the case of SRCs and FRPCs, one may wonder why there is still a need for a special legal status to channel priority funding to well-functioning institutions performing quality research in areas important for Russian society. This admittedly somewhat candid question implicitly raises another very serious one. Why do hundreds of low-quality branch institutes continue to benefit from government funding and be to some extent exempted from evaluation as compensation for their lower level of support? Closure, restructuring or full corporatisation, including through privatisation, as occurred in China in less than a decade, would free idle resources, increase the productivity of others, and boost market-led R&D.

For NRCs the issues are quite different. On the one hand, and looking at the first of these, Kurchatov, NRCs can be welcomed as a Russian transposition of international good practices in the promotion of pre-competitive multidisciplinary R&D in areas of strategic importance. On the other, it remains to be seen how new NRCs will be configured in areas other than nanotechnologies, where a strong involvement of the business sector will be necessary and where the lack of an undisputed leader such as Kurchatov will entail greater rivalry among public research actors. Nevertheless, as already advocated by the OECD years ago (OECD, 2004), the centre of excellence approach implemented through research consortia, on a single location or in a more network-based approach, is the way forward for Russian science-based innovation.

Reforming the Russian Academy of Sciences

There have been, since the early years of the transition, several attempts to reform the status and management of the RAS. Finally, in 2006, new rules were imposed. The government now has the final word regarding the appointment of the president. The RAS must present an annual report to the federal government on its scientific, financial and other activities, together with plans and forecasts. These decisions, which have elicited intense discussions, have already triggered some significant changes. A number of institutes have been closed, staff reductions have been carried out in others, and budget allocation procedures have started to improve. For instance, the RAS has put in place an internal competitive fund for projects emanating from its institutes, and institutional funding has been reduced to support for staff salaries and maintenance of equipment (see below).

The tradition of separating research and teaching functions is still a source of tensions between the RAS and the universities, especially now that the latter benefit from strong support to develop their research activities. The government has adopted a pragmatic approach towards managing the frictions arising from the convergence of the RAS and universities towards common territories. The RAS entered the education sector a long time ago: its affiliated universities have a dominant position in places such as Novosibirsk, many academicians have always taught, and many RAS institutes have always been training platforms at the postgraduate level. The RAS has also contributed to innovative developments in the higher education sector (Box 3.11).

Box 3.11. The Saint Petersburg Academic University: An innovative transgenerational campus

The Academician and Nobel Prize Laureate Alferov created this unique institution under the auspices of the Russian Academy of Sciences. The novel idea is to bring together not only research and education activities, but also different generations, from eminent academicians to teenagers interested in science. The Academy University has three organisations:

- A higher education centre provides training for masters and PhD degrees (about 25 a year) in various fields, including theoretical physics, neutron physics, astrophysics, nanotechnologies, mathematics, information technology, and philosophy.
- A Nanotechnology Research Centre, equipped with most the modern technologies, pursues pioneering research; its funding amounted in 2009 to RUB 34 million (of which RUB 26 million from the federal budget).
- A special lyceum (last four years of secondary school) for educating talented youth recruited through a highly selective process (100 a year).

The Academy is located within a highly knowledge-intensive cluster. It co-operates closely with surrounding institutions such as the prestigious Ioffe Institute and the Saint Petersburg State Polytechnic University.

The intensity and forms of co-operation between the RAS institutes and universities vary from place to place, having often developed as a result of bottom-up initiatives backed by influential academicians, rather than according to a master plan. The federal government has only been directly involved when these relationships were important in the context of large national priority projects. Without stifling the ongoing organic development, the government could accelerate the crystallisation of more structured, stable and fruitful relationships. It should first take stock of the best experiences in Russia, draw the lessons of successes, and then invite proposals on how successful models could best be replicated in different institutional and regional contexts. In doing so it should mobilise a rich foreign experience, notably from countries such as France and Korea where strong public research institutes (PRIs) have had to leave room for growing university research (Box 3.12).

Box 3.12. The changing role of public research institutes: An international perspective

Public research institutes (PRIs) have always been important actors in innovation systems and have been the source of important technological and innovation breakthroughs. PRIs were set up to compensate for the market or systemic failures of their respective innovation systems. They have performed a wide range of functions in various disciplines, by conducting "strategic", pre-competitive research, offering technological support to business, support for public policy, support in creating and establishing technical norms and standards, and constructing, operating and maintaining key facilities.

Following World War II, the number and variety of PRIs established for civil and military applications expanded rapidly in many OECD countries. This growth continued in the 1960s but began to slow down in the 1970s. By the 1980s, the relative role of PRIs started to decline in most countries for several reasons, notably the reinforcement of the R&D capacities of the business enterprise sector, reductions in defence budgets and the rise of university research.

In many OECD countries the diversity of PRIs, in terms of their main function, their research orientations and their linkages with other innovation actors and the education system, has contributed to the "fuzziness" of their role in rapidly changing innovation processes. When governments' expectations regarding the contribution of public research to innovation-led sustainable growth rose, many institutes found themselves under considerable pressure to justify not just their performance, but at times their very existence. Significant changes were introduced in the steering and management of PRIs. Together with broader changes in the research environment, PRIs were induced to reconsider their management and strategies. Although this took place in quite specific national contexts, some common trends can be identified.

In many instances, the active involvement of and co-financing by the business sector have become mandatory through privatisation or public-private partnerships. The extension of the role of universities has led to considerable convergence with the activities of PRIs and to stronger competition but also greater collaboration. Competitive funding plays an increasing role in financing the PRIs. Even core institutional funding is often conditioned by terms and targets set out in performance agreements. PRIs are trying to adapt to these new environments, for example through the introduction of new business models based on concepts such as "open innovation". Many institutes are also taking steps to internationalise their operations by opening overseas branches and/or through cross-ownership arrangements.

Source: Guinet (2010).

Competitive funding of basic research projects

The Russian Foundation for Basic Research (RFBR), established in 1992, supports basic research on a project basis. Its resources in 2009 amounted to RUB 7 billion, 4% (below the 6% defined in the law) of the total federal civil R&D budget. The budget was reduced by 10% in 2010. Only 2% of the budget is used for the management of the foundation, including the remuneration of its staff of 100 persons. It is overseen by a board of 26 persons from different parts of the society, although most are scientists. It operates as an independent body but has closer relationships with the RAS than with the Ministry of Education and Science.

RFBR funds research teams selected through a rigorous peer review process involving a broad network of 2 000 experts (Box 3.13). It also organises joint calls with foreign research institutions.

Box 3.13. The review process of the Russian Foundation for Basic Research

The RFBR outsources the reviews of incoming applications. It co-operates with independent experts throughout Russia; these are prominent specialists, mainly with PhDs. One-third of the experts are renewed every year. According to foundation rules a scientist cannot occupy the position of expert more than six years in a row.

There are nine expert panels (70-100 people each), elected for three years. Eight are thematic, covering an area of knowledge in accordance with the research priorities of the foundation; the other is for targeted basic research. The expert panels are divided into sections (5-15 individuals) in order to be able to cover all the main directions of research in the given area of knowledge. The expert panels and their sections make decisions by majority.

The expertise process is carried out in stages. First the applications are reviewed by 2-3 experts, who work independently and anonymously. Then, together with the results of the expertise, they go to the appropriate section of the expert panel. Next, the expert panel examines the outcomes and works out final recommendations which go to the Foundation Council, whose decision constitutes the last stage of the selection process.

Source: ERA Watch (2010).

Since its inception RFBR has financed about 10 000 projects. The distribution of RFBR funds by type of activity and by knowledge area is shown in Table 3.6. The major scheme is the Initiative Research Projects which supports unsolicited research proposals from the scientific community. The average project size in 2008 was about RUB 400 000 and is on a rising trend, and 8% of the budget goes to goal-oriented interdisciplinary fields. RFBR is generally considered a well-functioning source of competitive funding. However, to the knowledge of the OECD review team, no formal and independent evaluation of the impact of RFBR funding on scientific activities and achievements has been undertaken. An evaluation would be useful not only for fine tuning RFBR but also for providing new insights into the dynamics of research in Russia, at the level of teams rather than disciplines or institutions.

Table 3.6. Breakdown of RFBR funding (2008)

By type of activity	%	By knowledge area	%
Initiative Research Projects and other competitions	59.9	Physics and astronomy	19.8
Goal-oriented interdisciplinary research	7.9	Engineering science	13.9
Support for acquisition of scientific equipment	6.7	Chemistry	13.0
Scientific electronic libraries	4.5	Biology and medicine	18.9
International collaborations	4.5	Mathematics, mechanics, informatics	9.5
Mobility of young scientists	2.8	ICTs and computing systems	6.0
Regional and CIS countries' competitions	6.4	Geosciences	14.6
Others, including joint calls with other organisations	5.6	Humanitarian and social sciences	4.3
RFBR staff and peer review panels	2.2		

CIS = Commonwealth of Independent States.

Source: RFBR, 2009 Annual Report.

New funding structures for R&D institutes

A research market has now emerged in Russia, together with multiple sources of competitive funding. This rewards good performance by research institutes and allows the government to use funding more effectively as a steering mechanism to induce desired changes in public research. For example, as a result of the reform mentioned above, a number of RAS institutes must now finance a significant part of their budget through contracts and competitive funding. Typically, their funding structure is now as follows: 30% from contracts for services to government departments or regional authorities, with Russian or foreign enterprises, and from international sources; 70% from the federal budget, of which more than three-quarters is core funding for staff and equipment, and the rest is competitive funding from RAS, the FTPs, and/or the Russian Foundation for Basic Research. Similar ratios can be observed in other public or university R&D institutes. The government has allowed public research institutes to reward the researchers involved in projects attracting non-core funding with salary increases.

This new funding pattern and the associated incentives help to raise the quality and relevance of public research institutes. But some safeguards are needed to avoid possible perverse effects of non-core funding: mission drift towards remunerative activities, at the expense of more strategic ones; crowding out of the development of a private sector of technological services; use of research contracts as quasi-subsidies in opaque research and production networks, etc. Experience in OECD countries would seem to suggest that some of these risks are real but only when the share of non-core funding is significantly higher than it currently is in Russia. However, in the Russian context they could materialise more easily if only because of the specific features of the technological services market: the lack of a strong private sector on the supply side, and the importance of state-owned firms belonging to the same networks as research institutes on the demand side.

The main safeguard is monitoring and evaluation of individual institutes and of the whole system.[21] As long as core funding is systematically renewed on a yearly basis with insufficient consideration of performance, there will be severe misallocations of resources, and inefficient organisations will survive. Also, in the absence of evaluation, new funding requirements might encourage good organisations to pursue adventurous strategies to maximise the proceeds from contract research. To reinforce the evaluation culture, methodologies and institutional mechanisms, Russia could draw on a rich international experience (Box 3.14).

3.4.3. Promoting business R&D and innovation

Inducing the business sector to become more involved in innovation is an issue of paramount importance for Russia and calls for a whole-of-government approach. Chapter 1 discussed the need to improve key framework conditions (competition policy, corporate governance, public procurement, labour market regulations, the tax system, etc.). This section focuses on the contribution of S&T and innovation policy *stricto sensu*, against the background of the information provided by Chapter 2 on the specific features of the business sector in Russia.

A striking feature of the current S&T and innovation policy toolkit is that while the stimulation of business R&D is at top of the policy agenda, very few instruments channel direct financial transfer to the business sector through the types of schemes that are widely used with success in other countries. Financial support is provided indirectly, through the public research sector, an approach very seldom found in OECD countries.[22] This must be understood in a context in which the government, especially the Ministry of Finance, is extremely reluctant to use any tool that is not "corruption-proofed" and/or would be hard to manage by the existing bureaucracy. However, this reduces the overall efficiency of the Russian innovation policy mix.

Box 3.14. Evaluation of publicly funded research: International experience

Evaluation is now a central part of the management and governance of publicly funded research in OECD countries for two main reasons. First, greater expectations regarding S&T as a key driver of sustainable growth at a time of tighter fiscal discipline led governments to look at research activities in terms of their ultimate relevance while taking greater care to ensure that public investment in the research system achieves the expected social return. Second, changing drivers of increasingly globalised innovation processes have forced decision makers to become more adaptive in optimising support policies; evaluation has played a central role in more self-reflective and evidence-based policy making, including international benchmarking, which has helped to spread good practices. The refinement of evaluation methodologies has both enabled and resulted from changes in evaluation practices.

Evaluation is carried out at four levels: *i)* research performers, *i.e.* the groups that effectively carry out research activities, such as research departments, laboratories or teams; *ii)* research institutions, *i.e.* the large organisations in which research performers operate; *iii)* support programmes and schemes managed by ministries and S&T policy agencies; and *iv)* systems consisting of whole research systems or sub-sets of thematic R&D policies. Broadly speaking, the first two levels of evaluation show some main trends.

Research institutions have demonstrated renewed interest in the evaluation of their research groups and have adopted new approaches with some common key elements:

- They aim at improving the allocation of core funding, following two complementary models, one based on open competition between institutes for access to additional funding, and the other based on inducing individual institutes to focus their activities on strategic projects.
- Significant participation by foreign experts has become the norm and even foreign-based peer review committees are no longer rare exceptions.
- The evaluation processes are institutionalised in a way that strengthens their impact on decision making regarding the funding and organisation of research.

In the case of university research, a growing trend has been to provide budgetary support directly to research groups, based on an evaluation at a higher level than the research institution to which they belong. It has two main aspects:

- One is the sophistication of the allocation mechanisms of core grants to university research groups at the national level. It leads to bypassing the intermediary level of universities. The archetype is the United Kingdom's Research Assessment Exercise (RAE).
- The other, which first concerned university research institutes but later other public research organisations, reflects a growing concern to achieve critical mass and excellence and leads to a growing concentration of public funding on a limited number of laboratories or centres, often in the context of public-private partnerships.

There have also been interesting developments in the evaluation of research institutes, funding agencies or research councils. For a long time evaluations mostly focused on research institutes and were one-off events, following the "distinguished scientist model", in which a small group of scientists is entrusted with the task by political decision. In the last decade, this picture was altered, if not radically changed, by three main trends.

- The evaluation of funding agencies or research councils has become a frequent, if not yet common practice, with the professionalism of their management an important objective.
- The frequency, motives and focus of the evaluation of research institutions have changed, and greater attention is paid to their contribution to the efficiency of the overall innovation system.
- Correlatively, the "distinguished scientist model" of evaluation has been gradually replaced by one in which consortia of professional multinational evaluators – academics, economists, sociologists, in addition to scientists – play a central role in a process open to the participation of all major stakeholders.

Source: OECD, based on OECD (2006a).

Another problematic feature is the “high-technology bias” of the overall support system. The benign neglect of non-technological innovation cannot be justified by the nature of Russia’s comparative advantages, since even in research-intensive industries value creation processes require many forms of creativity and thus a good deal of “soft” innovation.

Currently, the main policy initiatives undertaken are of three types, according to their main objective: fostering collaboration between the business and the public research sectors, promotion of new technology-based firms, and stimulation of innovation by large firms. Some specific measures directed at these objectives have already been discussed, *e.g.* public/private partnerships in the framework of some federal target programmes and R&D tax incentives.

Fostering co-operation between the business and the public research sectors

In contrast with OECD countries, where the mobilisation of the public sector to support business innovation became a top priority early, in Russia attention was for a long time mainly paid to restructuring the public research sector, at times with some consideration of the contribution that the emerging business sector could make. With the maturation of the Russian market economy and progress achieved in reshuffling the public research sector, policy orientation has gradually shifted and recent years have seen initiatives more in line with international good practices.

A turning point probably came in 2003 with the launch, at the initiative of the Minister of Education and Science, of Megaprojects, a pioneering public-private partnership to support innovation projects with a clear market orientation. A number of specific technologies with strong commercial potential were selected, with the active involvement of the business sector. Next, 12 projects were chosen for support up to the pre-industrialisation phase in diverse fields (*e.g.* new types of materials, genetically modified seeds, high-performing diesel engines). A total of about RUB 8 billion was invested over four years (2003-07), of which half from non-government sources and the other half from the budget of the RAS or of branch institutes associated with the projects. This programme can no longer be identified in the portfolio of instruments of the ministries concerned. It is likely to have been integrated in broader schemes, such as the FTPs.

In 2010, the government introduced a new mechanism to stimulate R&D co-operation between the business sector and universities.[23] It will provide the business sector with incentives to collaborate with research groups in universities. The novelty is that the scheme is not narrowly targeted at specific technologies and that support is explicitly directed at enterprises, through matching funds of up to RUB 100 million a year per project, provided that the enterprise invests an equivalent amount, of which at least 20% should be used to finance the part of project carried out by the university research team(s). This programme should have very significant impacts, given its large total budget (RUB 19 billion for 2010-12) and the fact that the implementation procedures seem to have been well designed.[24]

Another very recent decision that epitomises the renewed efforts of the Russian government to foster science-industry relationships is the creation of Technology Platforms, a programme to bring together the business sector and the R&D institutes and provide a framework for their more intensive co-operation. Promoted by the Ministry of Economic Development and officially announced by the government in October 2010, this initiative, inspired by EU experience with such platforms (38 currently in operation), aims at improving the efficiency of the overall national R&D effort by reducing "duplications that currently lead to enormous waste",[25] and by focusing on areas in which capabilities match market opportunities, as identified by the business opportunity, and which fit the priorities set out by the presidential commission. A preliminary list of 14 proposed platforms was presented in December 2010 (Box 3.15). Under each platform, "sub-platforms" (a total of 170) will be set up to discuss issues and perspectives in narrower technological fields. In each case a designated organisation, such as a state corporation (*e.g.* Rosnano or Rostechnologii), a leading research institute, or a business association, will lead the discussions and report on their outcomes.

Box 3.15. Technology platforms (as of December 2010)

Energy	Traditional industries
Gas and oil production and processing	Biotechnology
Transport	Medical technology
Space technology	Radiation technology
Consumer technology	Agriculture and food
Information and communication technologies	Technologies for the development of the Arctic
Electronics and instrument making	Others

Source: Ministry of Economic Development.

Technology platforms are particularly welcome as they will help the government to co-ordinate and assess from a systemic perspective a large number of scattered support measures and schemes, in order to monitor and magnify their impact. As a useful addition to the policy governance structure, they will also provide space for exchanges of ideas between policy makers and policy users and the elaboration of new proposals.

Supporting new technology-based firms

The development of the SME sector has been a key priority since the early years of the transition for the obvious reason that its development was vital for building a well-functioning market economy. The first step was the creation in 1992 of the Russian Agency for Small and Medium Sized Enterprises, with the support of the United Kingdom's Know How Fund. In 2007 a new law on SME development was passed which simplifies their accounting and taxation and secures access to public procurement (20% reserved for SMEs). Shortly after his inauguration in May 2008 President Medvedev signed a decree on urgent measures to eliminate administrative barriers to entrepreneurship and achieve speedy development of relevant legislation. Several initiatives followed, including one-stop shops where small firms can easily find information on and access to the different types of incentives available and the various regulations and related administrative channels.[26]

The Foundation for Assistance to Small Innovative Enterprises

SMEs, especially new technology-based ones, have also been identified as an important vector of innovation. The Foundation for Assistance to Small Innovative Enterprises (FASIE), also known as the Bortnik Foundation after the name of its initiator, was created in 1994 to support their creation and initial development.

Today, with resources amounting to 1.5% of the total civil R&D budget, FASIE channels its support through seven main programmes (Box 3.16). The largest is START, which was to some extent modelled on the US SBRI (Small Business Research and Innovation) programme. The foundation has funded some 7 500 projects and has reviewed more than 20 000 applications. While only 5% may have survived, a number are clear success stories.

FASIE has been adaptive. Its toolkit and procedures have evolved, not only in response to national policy guidelines but also because it has been able to learn from experience. For example, in recent years it has emphasised "seed financing" to the benefit of young scientists willing to commercialise their ideas (in co-operation with the Russian Venture Company, see below).

The work of FASIE is much appreciated in all circles. It obviously fulfils a special role in the Russian innovation system. It is a funding agency but also a strong and influential advocate of innovation and, more broadly, an efficient "agent of change" working in close contact with the new generation of talented Russians.[27] As a sign of the government's recognition of this role, the FASIE budget has recently increased substantially (RUB 3.4 billion in 2010, compared to the RUB 2.4 billion initially planned, and RUB 4.0 billion in 2011).

Box 3.16. The programmes of FASIE

- START provides assistance to would-be innovators in two stages, seed money for prototype development, test, patenting, etc., and start-up support. Up to RUB 6 million can be granted over three years, with RUB 1 million the first year, RUB 2 million the second, and RUB 3 million the third. There is no project selection in the first stage: all submitted projects can be funded; projects for the second stage are selected through competition. The support takes the form of fee-free, non-repayable grants (federal contracts).
  - Since 2004, more than 12 000 applicants have benefited from START; 2 906 small companies went through the second stage; and 62 companies have successfully completed the third stage, *i.e.* 5% of the 2004-06 winners (1 357). The average turnover per company is RUB 15.5 million a year, a significant amount in the Russian context.
- UMNIK (Clever) supports young scientists who wish to undertake innovation projects. It benefits students, postgraduates and young researchers aged between 18 and 38. Winners receive RUB 200 000 to advance their innovation projects and get training and, if selected for a second phase, they again receive RUB 200 000.
  - Since 2007 UMNIK has received more than 30 000 applications. Over 4 000 people were selected and 45 businesses have been created. It is planned to increase the number of young scientists supported by UMNIK to 1 500 a year.
- PUSK (Launch) supports projects developed through a partnership between a company and a higher education institution.
- TEMP (Technologies for small enterprises) supports the acquisition by small companies of new technologies and engineering solutions by paying the licence costs and the subsequent R&D expenditures for exploiting it (to be completed within three to four years).
- RAZVITIE (Development) supports development and commercialisation projects in established small companies through a competitive process.
- STAVKA (Interest rate) repays part of the interest costs of bank credits provided to small companies subsequently engaged in specific R&D projects.
- INTER supports small companies that are residents of special economic zones and designated technoparks.

The support provided to innovative start-ups by FASIE is obviously vital and could certainly be extended, as there is unmet demand (as shown by surveys undertaken by the Foundation in university and research structures). However, it is not only "more of the same" that is needed and FASIE cannot be expected to "do it all". Complementary measures are necessary to overcome current limitations, as a number of young firms do not survive the stage at which projects require more investment (much above the upper limit of some USD 150 000 per project provided by FASIE) but the market is still out of reach or insufficiently prepared. In Russia, this "Death Valley" seems to be even more daunting than in most OECD countries, owing to the underdevelopment of venture capital (see below) and alternative sources of financing that are able and willing to back promising but risky ventures.

The Russian authorities should take the need to correct this market failure seriously by opening new channels of support in the form, for instance, of subsidies that are reimbursable in case of success, or of state guarantees for bank credits, even though fears of corruption might complicate their design. They could find in many OECD countries examples of successful schemes, such as France's OSEO Agency (the former ANVAR), to mention only one (Box 3.17). A welcome first step in the right direction is the opening, in June 2009, of a new line of SME support by the Bank of Development and Foreign Economic Relations (Vnesheconombank). Through its programme *Financing for Innovations and Modernisation*, Vnesheconombank now supports innovative SMEs, not directly but via banks or infrastructure support entities (*e.g.* certified technology centres, technoparks or incubators) that select eligible enterprises.

Box 3.17. OSEO: The French SME support agency

The French government created OSEO in 2005, by bringing together ANVAR (the former French innovation agency) and BDPME (the former SME Development Bank) to strengthen and rationalise public support to SMEs. OSEO provides assistance and financial support to SMEs in all the main phases of their life cycle (start-up, development, business transfer/buy-out), using a set of instruments: information, grants, loan guarantees, equity financing.

In 2009, OSEO assisted 80 000 enterprises in their early or later stage of development, notably through EUR 12 billion in loan guarantees and EUR 500 million in financial support to innovation (which leveraged a total of EUR 2 billion in related investment).

This financial support for innovation has two interesting features. First, there are two types of risk sharing, depending on the characteristics of the firm and its innovation project: subsidies reimbursable in case of success (EUR 380 million in 2009) or pure grants (only EUR 180 million in 2009). Second, a significant part of this financial support is channelled through programmes that are not SME-specific in order to ensure consistency between SME support and the broader innovation policy strategy, *e.g.* priority innovative clusters ("poles of competitiveness"), collaborative innovation involving other firms and public research organisations, and international co-operation, especially in the context of European projects.

Improved financial support alone is unlikely to provide the necessary boost to the renewal of industrial structures through the market entry and subsequent growth of new companies that are more innovation-minded than incumbent firms. Specific regulatory obstacles might have to be removed and, most importantly, large firms have to play their structuring and leading role in dynamic innovation networks more fully, as they do in all advanced countries (see below).

Regarding regulations, the recent decision to facilitate scientists' investments in innovative ventures is worth noting. A government decree (No. 217) was passed in August 2009 to allow university and RAS researchers to invest in innovative ventures and science commercialisation undertakings. It has already had some impact.[28] However, serious problems of implementation have arisen, demonstrating that one regulatory obstacle can hide others.[29]

Young innovative enterprises that have to cope with the inherent risks of innovation are particularly vulnerable to uncertainties and other disincentives in their business environment.[30] Chapter 1 suggests guidelines for the upgrading of relevant aspects of the broad business environment, including those that influence the incentives of large firms to innovate and thus create markets and spillovers that benefit smaller ones.

Venture funds

The government set up in 2006 the Russian Venture Company (OJSC RVC) with a total investment of RUB 30 billion in which it holds 100% of the equity shares. The government is represented in RVC by the FASIE. The RVC is a "fund of funds" which has invested in ten venture foundations (two under the jurisdiction of the United Kingdom) with a total capitalisation of RUB 22 billion, of which RUB 12 billion from RVC (Table 3.7). The legal status of the venture foundations is a "Closed Equity Investment Fund" (CEIF) with co-investment of RVC and a private entity at 49/51%. The foundations should invest in companies operating in areas corresponding to government priorities or a list of critical technologies.

Table 3.7. Venture funds supported by RVC

	RUB million
VTB - Venture Fund	3 061
Bioprocess Capital Ventures	3 000
Maxwell Biotech	3 061
The Leader - Innovations	3 000
Tamir Fishman CIG Venture Fund	2 000
S-group Ventures	1 800
New technologies	3 061
The RVC Seed Investment Fund	2 000
Russian Venture Capital I LP	300
Russian Venture Capital II LP	300

As of July 2010, the ten CEIF had examined more than 1 500 projects, and 31 companies had been supported for a total of invested capital of RUB 4.5 billion. The main areas of investment are biomedical technologies, power engineering and energy saving, information and telecommunication systems, and software manufacturing.

The relatively limited investment so far by RVC in Russian firms has elicited criticism, including by Russian auditors who have pointed to its under-spending. In particular, the venture funds do not seem to invest enough in early stages of project development. In order to fill this gap, a "seed investment fund" has been established jointly by RVC and FASIE, with a RUB 2 billion budget, which will provide up to 75% of the resources needed by eligible innovative projects.

The federal government has also encouraged the formation of regional venture funds, 23 of which have been created in 21 regions, in the form of CEIF with private partners and representatives from the regional government and the Federal Ministry of Economic Development (the experience of the fund established in the Republic of Tatarstan is discussed below). As of mid-2009, the total capitalisation of the regional venture funds was RUB 8.6 billion with federal appropriations amounting to RUB 2.1 billion, and 29 companies had been supported with a total of RUB 1.4 billion. In 2008, the Ministry of Economic Development initiated a new scheme to help three mono-industrial or depressed regions to support the creation and development of small companies through state/private partnership (RUB 100 million per region).[31]

The venture capital industry is obviously still in its infancy in Russia. The limited number of deals, considering the huge size of the economy, cannot yet have any significant impact on the country's economic performance. It is difficult to change this situation because in the current Russian context venture capital cannot be "the" trigger for accelerating the renewal of the industrial fabric. The growth of venture investment in innovative firms will be severely constrained as long as a new dynamic has not taken firmer shape on the demand side of the financial market. More innovative big firms will have to create much larger market opportunities and knowledge spillovers for smaller ones (see below). The government should continue to promote the development of VC funding and associated financial mechanisms such as specialised secondary markets, but also maintain as long as needed the different forms of transitory support that can compensate for their immaturity.

Stimulating innovation in large enterprises

The majority of large Russian firms, which account for a large share of gross domestic product (GDP) and employment, are currently not interested in innovation. Yet, the Russian government will not achieve its ambitious goals of economic modernisation and innovation-led growth without the active engagement of a large number of them, whatever the dynamism of the SME sector. When looking for ways to unblock this situation, it is important to be clear about the reasons for this widespread neglect of innovation in large firms' strategies. The two main reasons are interrelated but very different in nature. Government should therefore act on two fronts, and S&T policy should contribute on both. The first is the legacy of a system that separated research from production. The second is the lack of competition but also other factors that distort corporate investment patterns by creating "monopoly rents" that are much higher than "innovation rents" which are too low owing to the structural problems of the industrial research sector.

It is far beyond the scope of this report to review all of the policy implications. Chapter 1 has addressed those relating to competition and corporate governance. Here, it suffices to underline again the importance for Russia to take decisive actions and to mention some recent initiatives more closely related to the S&T and innovation policy agenda that seem to be important steps in the right direction.

The prime minister has instructed the Ministry of Economic Development to formulate R&D and technological performance contracts to be underwritten by state-controlled corporations. Two groups of about 20 enterprises each have been identified. The first comprises state-owned enterprises with a clear commercial orientation, such as Gasprom, Rosneft and Aeroflot. They are requested to establish strategic development plans with detailed objectives for R&D and technological renewal and will have to report on their implementation to the prime minister's Commission on High Technology and Innovation. The second group includes enterprises in the public services sector, such as transport, airports and communications. They are also to establish strategic development plans and will report to their respective parent ministries (*e.g.* trade and industry, communications and medias). A public/private partnership working group, chaired by a vice minister of economic development, will administer the whole exercise. It remains to be seen how well this contractual and, at the same time, directive approach is able to counteract the factors that have so far pushed the concerned enterprises in other directions.

Again, this points to the urgency of bold decisions regarding the organisation and governance of the large enterprises that are expected to play a vital role in the modernisation through innovation of the Russian economy. In this respect, the new round of privatisations of around USD 40 billion of assets decided by the government in autumn 2010 represents a golden opportunity. It will concern enterprises from many sectors, including many that are currently under the umbrella of the state corporation Rostechnologii.[32]

3.4.4. Fostering the development of competitive innovation-oriented industries

Owing to the inherited scientific and industrial specialisation of Russia, discussed in Chapter 2, but also to the myopia of the dominant innovation policy concept, mentioned above, the government of Russia has so far directed the bulk of its S&T and innovation-related investment to high-technology industries such as space, aviation, nuclear and defence. More recently it has put major emphasis on nanotechnologies with the aim to build globally competitive industries. However, this does not mean that government innovation policy has shaped all sectoral patterns of innovation. For example, it played a rather limited role in the success of the software industry (Box 3.18).

Space, aviation, nuclear and defence technologies

These sectors were built during the Soviet era and went through very difficult times during the transition, as they found it hard to adjust to the new environment. They have lost weight and influence but remain centrally positioned in the technology-intensive part of the industrial structure. To survive and resist harsh changes, they could always count on some support from the government, and more broadly from society, because of their importance for national defence policy, because they employ a large number of citizens, and because they are repositories of "national treasures" of skills and sophisticated equipment that are hard to reconvert to other uses but have to be preserved and are a subject of national pride. For all these reasons they still capture today the lion's share of the federal budget devoted to S&T and innovation. Military R&D alone represents at least 50% of the national R&D effort.

In each sector, however, an important restructuring process has been going on and is set to continue, notably in light of the recent announcement of an imminent new round of privatisation. The creation of state corporations in 2007 was the climax of the effort to give a clear leadership role to a powerful organisation in each sector, a kind of "national industrial champion" that, in the Russian context, would also be a new layer of policy governance. The space industry is now in the hands of the Russian Space Agency, Roscosmos. The aviation sector is led by a consortium – the United Aircraft Corporation – a grouping of the major aircraft design bureaus (Sukhoi, Tupolev, Ilyushin and

Yakovlev), and the source of almost 50% of the total sales of the industry. Rosatom, and its subsidiary Atomenergoprom, in charge of civil assets, lead the nuclear industry. The armament industry is in the hand of a few large holding companies, notably Rostechnologii, which accounts for 25% of the total sales of the defence sector.

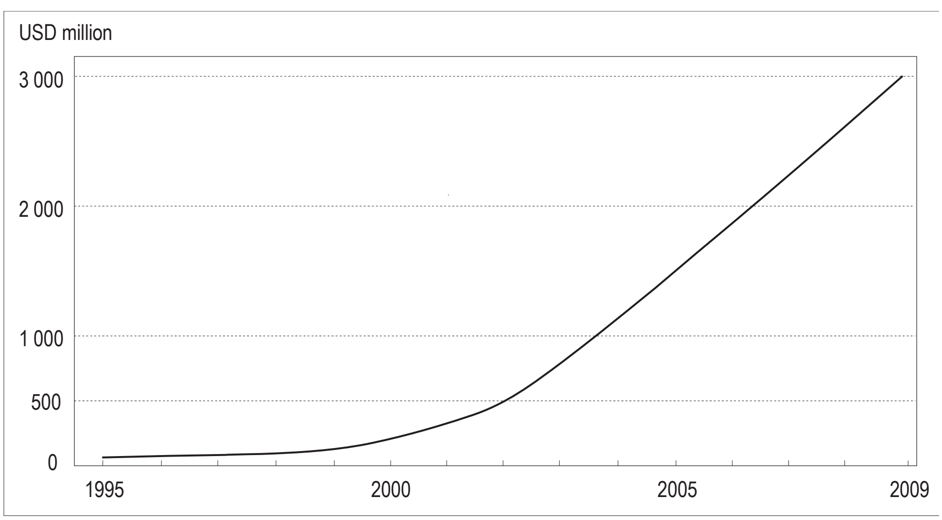
Box 3.18. The Russian software industry: A success story

The software and IT services sector is a clear success story. Starting in the early 1990s and developed by dynamic, highly qualified entrepreneurs from the Russian science system, it has grown at double-digit rates. The Russian software development revolution has been comparable to that of India and Israel, although with different patterns and prospects.

The Russian software industry is concentrated mainly in Moscow, Saint Petersburg and, to a lesser extent, Novosibirsk. It has three components: software packages, offshore programming and captive software development centres. The market is dominated by SMEs that occupy small market niches, so that they do not compete primarily with one another, but mainly with foreign software developers in both domestic and international markets. The most successful are small companies with flexible organisational structures located on major universities and research institutions, as well as R&D centres established in Russia by international ICT corporations.

A good indicator of the competitiveness of the Russian software industry is the skyrocketing growth of its exports, which reached USD 3 billion in 2009 (see figure below). The industry is also closely integrated in the world economy through substantial inward and outward foreign investment. It competes with global players without government protection.

Dynamics of Russian software exports



The Russian software industry specialises in complex and sophisticated projects requiring very strong technical skills and creativity. It needs to continue to maintain a competitive edge in the high-end segments of the offshore development markets and in packaged software. With higher wages in the IT sector than in India and China it is unlikely to challenge large emerging economies in the offshore IT business process outsourcing market. As a whole its future seems bright provided that the overall business overall climate allows Russia to retain the human capital on which its comparative advantage relies. As pointed out by Crane and Usanov (2010), currently "bribing inspectors, tax collection agents, and the police places a substantial burden on companies. … A climate of intimidation and fear discourages entrepreneurs from expanding their business and puts a premium on moving assets outside Russia." The improvement of framework conditions for innovation is therefore the major contribution that the government can make to the further development of this promising industry (see Chapter 1).

A recent evaluation of performance in these sectors shows a mixed picture (Crane and Usanov, 2010). In the space sector, Russia continues to hold a strong position on the launcher market, with its Soyuz rockets.[33] In aeronautics, attempts to enter civil export markets have not been very successful, except to some extent through joint ventures with foreign partners and for components and technological services (Table 3.8). In the nuclear industry, Russia has secured a strong position in uranium enrichment (with superior centrifuge technology), but faces greater challenges for selling nuclear power plants. For armaments, a large part of exports (around 70%) have been deals with China and India and some developing countries. At the same time, as mentioned, the Russian industrial-military complex has had increasing difficulty supplying the Russian army in a timely way and at the expected level of cost and quality, a situation that led the government to open some of its procurement to the foreign competition, recently in warships.

Table 3.8. The Russian aviation industry: Some performance indicators (2008)

	Unit	
Sales of the aviation industry	RUB billions	27.8
Sales within co-operation projects	RUB billions	4.1
After-sales services	RUB billions	3.9
Exports of technologies and technological services	RUB billions	0.5
Sales of airplanes	Numbers	11
Patents	Numbers	31

Source: ERA Watch (2010).

Nanotechnology: A top national priority

The Russian government has great expectations regarding the possibility of becoming a world leader in many applications of scientific advances in nanotechnology, as demonstrated by its large and growing investment in this field (Table 3.9).

Table 3.9. Public and private spending on nanotechnology

RUB billions, 2008-15

	2008	2009	2010	2011	2012-15
R&D	8.2	9.8	11.2	13.1	25.7
Infrastructure	10.9	9.1	9	2	0
Rosnano spending	20.3	21	22.8	19.5	80.5
Private investments in Rosnano projects	n.a.	n.a.	6.5	7	40
Other	0.1	0.3	0.4	0.6	0
Total	39.5	40.2	49.8	42.2	146.2
In USD billion[1]	1.3	1.3	1.7	1.4	4.9

1. At RUB 30 = USD 1.

Source: Crane and Usanov (2010).

In 2008, nanotechnology attracted about 5% of total federal civil R&D spending. The R&D programme is implemented though an FTP and mobilises a large network of institutes and higher education institutions (for teaching and training). It is co-ordinated by the Kurchatov National Research Centre. Complementary investment in commercialisation through Rosnano is already significant, and is likely to increase over time with growing co-investment by the private sector.

It is too early to assess the impact of the Russian policy to promote the development of nanotechnologies and their industrial applications. The jury will be out for some time (Crane and Usanov, 2010). For R&D, the government should closely monitor performance indicators, such as trends in scientific publications in nanotechnology; Russia ranked sixth in the world when the new policy was introduced. For commercialisation, one benchmark is that, in terms of patents, Russia only ranked 16th, and there are hardly any other internationally comparable indicators (*e.g.* on firm creation, turnover of the nanotechnology industries). However, there is some anecdotal evidence on early successes.[34] It is also important to take into account that the first years of operation of Rosnano, a new institution in a new technological field, have necessarily been to some extent a trial-and-error process that is vulnerable to changes in the economic environment. For example, in 2009, as a result of the crisis, the Russian government instructed Rosnano to transfer approximately half of its funds back to the federal budget for other expenses.

Revitalising other industries

The Ministry of Trade and Industry has recently outlined a series of plans to revitalise a set of industries under its supervision, namely: electronic components and equipment, automotive, pharmaceuticals, metallurgy, shipbuilding and light industries (including agro-food, textiles and clothing). These industries suffer from common problems, partly inherited from the planned economy, partly created afterwards by government failure to put them under strict market discipline. This has translated into insufficient capabilities and incentives to innovate. Of course, certain exceptions reveal success factors that government should consider in orienting its action in more problematic industries.[35]

For each industry, strategic objectives have been set for the 2015-20 horizon, a diagnosis has been made (notably regarding the degree of technological backwardness), and a process of consultation with the concerned actors has been set up to define the need and form of government action, mostly using available instruments. Depending on the industry, these instruments may include federal technology programmes (of particular importance for the electronics industry), regulations and standards (for the consumer industries and pharmaceuticals), the restructuring of enterprises (automotive industry), or military procurement (shipbuilding). It is surprising that the potential role of collaboration with foreign partners for technological upgrading and better integration into global market is barely mentioned.

The energy and natural resource sector: a source of wealth but not yet an innovation pole

Large enterprises such as Rosneft and Gasprom seem to invest large amounts in R&D, but their technological performance has been weak compared to leading foreign companies, not only from the large advanced countries, but also from smaller ones (*e.g.* Norway's Statoil), as well as emerging ones (*e.g.* Brazil's Petrobras). The industry has long failed to invest in the latest technical advances, which explains why the production and transport of oil and gas in Russia give rise to enormous leakages. This represents a huge economic waste and is the cause of serious environmental damage.

The problem is recognised by Russian policy makers but they have so far found it difficult to resolve. It largely results from a "compromise" between the industry and the government, which balances the industry's desire to maximise profit with the government's desire to keep domestic energy prices low. Now that modernisation has become an imperative, the spotlight is on the fact that the Russian oil and gas industry has become increasingly dependent on foreign equipment and specialists. Moreover, although Russia has kept investing in high-quality specialised education and research, these are appropriated more by foreign than by domestic companies. For example, many of the graduates of the State Mining Institute, located in Saint Petersburg (Box 3.19), while they are not very numerous, cannot easily find jobs that fit their high qualifications in the Russian industry, one of the largest in the world.

Box 3.19. The Saint Petersburg Mining Institute: A future-oriented heritage

Founded by Catherine II in Saint Petersburg, the Mining Institute was the first higher education institution established in Russia. It is one of the oldest mining schools in Europe and home to one of the world's finest and most exclusive collections of minerals, gem samples and mining equipment miniatures. It was designed as an elite body in charge of training the nation's mining engineers.

It currently hosts 7 000 students – of which 45% are women – through a highly selective process (one position for 20 applicants in 2009) and provides engineering diplomas up to doctoral degrees. It performs almost 50% of the R&D work of the mining and natural resource sectors in Russia. It receives 85% of its funding from the business sector (Russian and foreign firms). It was recently granted the status of national research university.

The fact that foreign firms recruit the majority of the best graduates proves the excellence of the institution, but is also an indication of Russian firms' low interest in technological development.

Changing course is a difficult task but also a great opportunity if energy policy is properly included in the innovation policy agenda. Many actions to be considered fall outside the scope of this report, such as energy pricing, environmental regulations or competition policy. The actions that fall under the mission of S&T and innovation policy should be dealt with through a cluster approach that could be developed using the relevant technology platform(s)[36] (Box 3.20).

3.4.5. Providing supportive infrastructure to innovators

The availability of and easy access to appropriate physical and immaterial infrastructure is crucial to the success of innovative firms. In this area Russia had to reconfigure a very large set of regulations, pre-existing facilities, sites and organisations, while creating new ones. A myriad of incubators, technology centres, science and technoparks, as well as special economic zones have appeared in the last 15 years, as a result of federal decisions but also of regional initiatives driven in part by interregional competition. For the federal government at least, the time has come to learn from sufficiently extensive experience in order to implement a more selective approach to infrastructural development, with priority to projects that are of global or national significance (*e.g.* Skolkovo Innovation City) or that can have a real impact at the regional level.

Box 3.20. A cluster approach to innovation policy: Lessons from the experience of OECD countries

Governments can nurture the development of innovative clusters primarily through regional and local policies and programmes to stimulate knowledge exchange, reduce information failures and strengthen co-operation among firms and between firms and knowledge institutions. But more direct policy tools can be used at the national level to encourage cluster formation and development, such as public-private partnerships for R&D, public procurement, and competition for government funding to provide incentives for firm networks to organise themselves on a regional basis. OECD work suggests that efficient cluster policies:

- Build a shared vision, based on a sound diagnosis of initial conditions, and ensure a vibrant dialogue between industry and government in defining and implementing the cluster development strategy.
- Catalyse rather than plan local development, by bringing actors together and supplying enabling infrastructures and incentives.
- Back and empower local leaders instead of trying to "pick winners".
- Improve availability of and access to key resources (skilled people, R&D, physical and "intangible" infrastructure, smart money).
- Avoid high-technology or manufacturing myopia and recognise the importance of knowledge-intensive services and of technological upgrading of traditional industries for innovation-led growth.
- Build on existing innovation networks, but keep incentive schemes open and attractive to outsiders, especially new firms.
- Customise policy approaches to fit the specific needs of different industries and technological fields, since, depending on a cluster's characteristics, the government's role for addressing the following problems varies: lack of interaction; informational imperfections, mismatch between knowledge infrastructure and business needs, lack of sophisticated demand.
- Leverage regional resources through interregional co-operation and participation in national and international innovation initiatives.
- Allow experimentation and learning-by-doing in an area which still has large scope for improved international diffusion of good practices.

A typology of innovative clusters

		Knowledge intensity		
		Low	Medium	High
Sectoral focus	High	Some industrial districts (e.g. shoes, textile) Product-specific agro-food cluster	Sub-contactors co-located around a large firm Some industrial districts (e.g. machine tools)	Small bio-tech firms co-located around a major university or public lab
	Medium to low	Natural resource-based network of small firms (e.g. tourism)	A diversified set of interrelated activities serving a localised physical infrastructure (e.g. the port of Rotterdam)	A diversified set of interrelated activities drawing from a localised knowledge infrastructure (e.g. Silicon Valley)

Source: Guinet (2003), partly based on OECD (2001).

Technical standards and metrology

Technical norms and standards constitute a major element of the immaterial infrastructure of innovation. The size of the system in place in Soviet times was exceptional, with more than 30 000 employees, the presence in each industry of technical institutes specifically devoted to formulation, testing, certification, etc., and more than 100 antennas located all over the territory. Central bodies were plugged into international systems such as ISO (International Organization for Standardization), in order to facilitate linkages and compatibility with Russian practices and standards. Over a few years, this system fell into decay, owing to a lack of resources and the loss of the industrial structure in which it was embedded. A Federal Agency for Technical Regulation and Metrology is now in charge of all related matters.

There has been for some time renewed interest in this crucial topic, and a new policy has been formulated (Centre for Strategic Partnership, 2008). It is inspired by international good practices, which ensure a good balance between mandatory norms (called "technical regulations") and voluntary norms (called "national standards"). Committees have been formed in important fields such as production management, environment and ecology, health, ICT, and nanotechnologies. Harmonisation with ISO norms is occurring in certain sectors: *e.g.* in the environment field where 14 000 ISO standards, including for lifecycle management and greenhouse gas accounting, have been introduced as national standards.

Technology centres and technoparks

Innovation and technology centres (ITCs) bring together small innovative enterprises, provide them a set of technical, legal, commercial and other services in the same place, and facilitate their co-operation with surrounding research, educational or industrial bodies. Some also provide some form of funding support. The first pilot was established in Saint Petersburg (Svetlana project) (Box 3.21). There were 85 such structures at the end of 2008, 20 of which appeared in that year.

Box 3.21. The Svetlana ITC pioneering incubator

In 1995, the first innovation centre in Russia was created at the initiative of the St. Petersburg Regional Foundation for Scientific and Technological Development, with the support of the Federal Ministry of Science. It was located on the premises of Svetlana, the largest electronics company in Soviet times but which had lost most of its markets in the new economic environment. The idea was to use the land, premises and equipment to incubate new technology-based companies that would first exploit knowledge available on the site and in the region.

The impact of the ITC has been both national and local. It has been, and to some extent still is, a very influential policy experiment which has inspired further actions by the federal government. Locally it helped to reconvert some of Svetlana's assets and succeeded in nurturing a significant, although limited, number of new firms. Several companies grew to a respectable size after their incubation by ITC, such as Sveltana-Optoelectronics, Virial and Svetlana-Rost. There are currently more than 30 small innovative enterprises at the ITC working in the areas of opto- and micro-electronics, microwave engineering, chemistry and new materials, metalworking, and software.

ITC has also established itself as an important meeting place for many actors and proponents of innovation, as well as a reference point for would-be innovators.

Business incubators are also numerous and provide premises at special rates along with consulting, legal and other business services. There were 75 accredited incubators at the end of 2008, with about 11 000 working places.

Technoparks, which offer a visible image of modernity, have become popular. Russia had 83 registered technoparks in 2008 (up from 55 in 2006), some with ITCs and incubators. Technoparks are very diverse in terms of size and specialisation and their performance varies. Some are true success stories (see the example of Tomsk below), but a number are quite inactive. In order to raise the quality of the technoparks, the government plans a new series focused on high technologies with a dozen pilots located in several regions.

A large number of technology transfer centres (TTCs) have been established at RAS and university research institutes in order to facilitate the commercialisation of their inventions. There are currently over 100 such centres in Russia. In addition some 30 "collective use centres" provide would-be innovators with testing, measuring, modelling and other equipment.

Box 3.22. Regional distribution of technoparks, ITCs and TTCs (2006)

	Number				per 100 000 researchers		
	Research organisations	**Techno-parks**	**ITCs**	**TTCs**	**Techno-parks**	**ITCs**	**TTCs**
Total Russian Federation	3622	83	89	100	21.3	22.9	25.7
1. Central Federal District	1426	31	37	33	15.0	17.9	16.0
2. North-Western Federal District	531	3	16	11	5.5	29.3	20.1
3. Southern Federal District	312	6	6	12	36.6	36.6	73.2
4. Volga Federal District	547	11	7	16	20.6	13.1	30.0
5. Ural Federal District	225	12	2	6	54.3	9.0	27.1
6. Siberian Federal District	425	6	16	10	20.3	54.2	33.9
7. Far-Eastern Federal District	156	4	5	8	60.3	75.4	120.7

Source: Centre for Science Research and Statistics.

Box 3.22 shows how technoparks, ITCs and TTCs are distributed in the different federal districts of Russia and how their numbers relate to the level of research activities. It appears that the ratio of technoparks, ITCs and TTCs to researchers is lower when the regional research and technological potential is higher. There may be several explanations, such as the fact that the need for such structures varies depending on the availability of alternative solutions, or the fact that regional governments see these structures as tangible proof of their commitment to innovation as well as a way to attract federal support. But the federal government probably sees this inverse relationship between innovation potential and number of innovation support infrastructures mainly as an indication of the need to consolidate the system.

The most dynamic ITCs, technoparks and the like tend to be located in or associated with the leading universities that are now emerging as research and innovation hubs of national and, in some cases, global importance. The Moscow State University is a good illustration (Box 3.23).

Box 3.23. Moscow State University: An increasingly strong innovation platform

Moscow State University (MSU) is, with the Saint Petersburg State University, one of the two Russian higher education institutions that enjoy the status of national university, which entails not only prestige but also greater autonomy. As a very large multidisciplinary university (more than 40 000 students, more than 6 000 professors and lecturers), its main mission is to educate, including through research (5 000 researchers) that is funded 50/50 by own budget and contracts, including with an increasing number of foreign firms.

Its involvement in research and innovation has intensified in the last decade. For research, a telling example is the Super Computer Centre (250 persons) which performs world-class research (parallel computing) with applications in many domains (drug, crystallography, optics, etc.); foreign companies are funding advanced software development; and co-operation with German partners was planned to begin in mid-2010.

As for innovation through the commercialisation of research results, the university science park is taking shape. After five years of operation it hosts 85 companies: average of 13 staff per companies, average turnover of USD 300 000; and 40 of the companies work directly with the MSU incubator programme. A special incubator programme with several complementary elements has been developed for students: *i)* awareness and information; *ii)* education in high-technology entrepreneurship with a three-month programme provided by multidisciplinary teams; *iii)* business plan competition, with the support of FASIE; *iv)* START programme with two years of support. This incubator programme is being replicated in Zelenograd and Moscow State Technical University (Baumann).

Special economic zones

Like many dynamic emerging economies, Russia has created several special economic zones (SEZ). They have the same basic rationale – to spur the development of interrelated activities considered important by grouping them in places that offer more favourable conditions than those available in the rest of the economy. So far, four have been established with a technological focus to host both Russian and foreign firms. They are located in Dubna (100 km north of Moscow), Zelenograd (20 km north of Moscow), Tomsk in Siberia, and Saint Petersburg. The tax privileges offered to attract enterprises are moderate: the social tax is lowered from 26% to 22% and the profit tax is lowered from 24% to 20%; but eligible firms have very cheap access to basic infrastructures (telecommunications, heating, power, etc.). Custom clearance procedures are also simplified.

They are still too recent to be evaluated. The Tomsk zone, opened in 2006, attracted 45 companies in three years, with some 650 jobs. The total investment in infrastructure amounts to USD 170 million, 75% of it financed by the federal government, the rest by the city and regional governments. The Dubna zone had 27 companies employing some 500 persons in 2009, for a total investment in infrastructure of USD 200 million.

In addition, the government has established two industrial zones in which technology considerations are of secondary importance, in Lipestk west of Moscow and near the city of Alabuga in the Republic of Tatarstan. The major objective is to attract Russian and foreign manufacturing companies by offering them very attractive conditions for logistics, export/import (customs), and even employment (lower labour costs). The total investment in infrastructure amounted in 2010 to more than USD 350 million.

From a national perspective the economic rationale of creating manufacturing-oriented SEZs is not very clear, as they entail distortions in the allocation of resources, the costs of which cannot be compensated by the benefits of agglomeration. These are at best very small in the case of activities that are not knowledge-based.[37] The story is different for innovation-oriented SEZs within which localised technology spillovers can increase significantly the return on investment of resident firms. They can become reduced-scale innovation systems that function as "mega-incubators" of new firms and of new strategies of existing firms to the benefit of the whole economy and useful hubs for international technology transfers.

Science cities

At the end of the Soviet era, there were 60 science cities, usually closed to unauthorised citizens. Most were opened quite soon after the collapse of the Soviet Union, including to the international community, but few were able to maintain truly viable activity. At the turn of the new century the government decided to accelerate the selection process by creating formal science city (SC) status and granting it to 14 cities considered to have the potential to make good use of additional support to carry out important activities. Currently, 26 others have applied. The SC status gives access to significant budget support and entails investment by the federal government, which leads to matching efforts by regional and local authorities. The impact of this policy is sometimes impressive. The city of Zhukovsky, specialised in aviation technologies, is an emblematic example (Box 3.24). But not all science cities, including some of those with the official status, show the same dynamism. Their role in the renewal of the Russian innovation system needs to be seriously reviewed, in co-operation with the authorities in charge of social and regional development, who should consider the implications from their perspective.

Box 3.24. Zhukovsky: The rebirth of the Aviation City

Zhukovsky, located 30 km south of Moscow, was created in the mid-1930s to host the glorious Central Aero-Hydrodynamic Institute (TsAGI), initially established in Moscow in 1918. All civil and military aircraft developed in the former Soviet Union and Russia have been designed and tested in Zhukovsky. It used to be equipped with the world best and most sophisticated specialised equipment, notably wind tunnels.

The city, which had some 30 000 families and 107 000 inhabitants in 1995, suffered greatly in the early phase of the economic transformation. Up until 2000 it was largely left on its own, with little support from any authority. The city shouldered the social expenses of enterprises and R&D centres established on its territory. It survived through diversification due to the development of the SME sector and, above all, foreign contracts, which represented up to 50% of TsAGI income in the mid-1990s. (In December 1992, the OECD organised the first international conference to attract contractors and investors.)

The turning point came in 2000. The regional and federal governments decided to reinvest in the city, partly in response to the active lobbying of the mayor, now in his third mandate, and thanks to the strong support of the governor of the Moscow Region, and the city received the status of science city.

The average salary was multiplied by ten in ten years and is now above the national average. In recent years, birth rates exceed death rates; the stadium and other cultural equipment have been fully renovated. The city now attracts youth, even from Moscow.

In 2008 President Putin signed a decree establishing the National Aircraft Construction Centre, to be located in Zhukovsky by a consortium of three founders: Rostechnologii, United Aviation enterprises, and the regional government. It would be complemented by the creation of a (corporate) Technical College (university) to train technicians and specialists. In the long term, the future of the city will obviously depend on the capability of the Russian aviation industry to confront successfully competition from established Western producers, as well as from new ones, notably in China.

Some key data on TsAGI

- 4 000 employees, of which 1 000 researchers.
- 60% funding from federal budget and 40% from contracts, of which less than 10% from foreign sources.
- Working relationships with all major aviation R&D stakeholders throughout the world.
- 180 Russian patents; 20 foreign (USPTO, EPO, JPO, etc.)
- Diversification sought in design and innovation for high-speed trains, high buildings, bridges, etc.

The Skolkovo Innovation City

Many technoparks in Russia have not reached critical mass and operate in a regional environment that may prevent them from doing so. They lack international standing and will never become beacons that inspire and guide would-be innovators and attract foreign talent and investment to Russia. The decision to create one that would in Skolkovo was announced by President Medvedev in early 2010. Box 3.25 lists some of the privileges that residents of Skolkovo will enjoy. A multi-partner foundation was established to oversee the development of the overall project.[38] The Skolkovo Foundation was to receive RUB 19 billion in 2010 and RUB 15 billion in 2011. In the following three years (2012-14) budget appropriations for the Skolkovo project may reach as much as RUB 50-60 billion. The corresponding bills were submitted to the state Duma in the second quarter of 2010.

The total population of Skolkovo will be 25 000-40 000, of which 20 000 permanent residents. The city will have its own police and local administration. It is envisaged to build at least 1 million square metres of housing. The area of the R&D centres should be about 400 hectares. The project should be completed in three to seven years.

A novel feature of the project is the broad involvement from the beginning of international expertise through different mechanisms, such as an international advisory council,[39] a partnership with foreign foundations, such as the MIT Foundation, and the decision to host foreign firms and laboratories of world calibre among the first residents. Leading IT enterprises such as Microsoft, Cisco and Nokia have already signed memoranda of understanding.

The decision to create Skolkovo science city has prompted lively discussions in Russia, with arguments that are sometimes difficult for outsiders to fully appreciate. On the one hand, this decision was clearly dictated by a legitimate sense of urgency and by the realisation that existing innovation infrastructures, although useful, are unable to spur the necessary renewal of the high-technology sectors rapidly, if only because of their insufficient linkages with large firms, including foreign ones. On the other, if bold decisions to improve general business conditions are not taken very soon, Skolkovo could be seen as another disappointing attempt to bypass rather than remove generic obstacles to innovation at quite high opportunity cost, given the size of its budget and the need to upscale other instruments of Russian innovation policy.

It may be surprising that this innovation city is to be built from scratch, when Russia has many sites, *e.g.* some science cities with a developed infrastructure, which have demonstrated some dynamism and would probably have welcomed such a boost. However, it could have been more difficult to develop the international dimension of the project as easily in these locations. One may also note that the results of similar undertakings were disappointing in many countries, *e.g.* the Japanese technopolis. But that was in the past – when the risk was to build "a cathedral in a desert" rather than "a church in the global village" – and in contexts that already possessed strong competitors.

Skolkovo will certainly not become the advertised Russian Silicon Valley but one can reasonably hope that this is a slogan of political rhetoric rather than the expression of a real policy objective. More comparable perhaps to the Beijing's Zhongguancun science city because of its location near many of the nation's best universities and research organisations, Skolkovo has the potential to become an important hub in the innovation system. It could develop and implement a new open innovation model of science-based innovation in important fast-growing industries that fits the Russian context. It is however important for the Russian government to succeed in this project without crowding out others that are vital for the success of "Innovative Russia – 2020".

Box 3.25. Incentives for companies and organisations locating in Skolkovo

- Tax incentives for companies: ten-year exemption from profit, land and property taxes, lower rate for compulsory insurance (14% instead of 34%), customs privileges, etc.
- Simplified technical regulations.
- Simplified procedure for transferring land.
- Special sanitary and fire safety rules.
- Simplification of conditions for interaction with the government, with the establishment on site of special departments of federal bodies such as the Ministry for Internal Affairs, Federal Migration Service, Federal Tax Service, Federal Customs Service.
- Availability of the services of new R&D centres for the five "technological priorities": power industry, information technologies, telecommunication, biotechnologies and nuclear technologies.
- Establishment of special departments of RosPatent that will register and protect IPR more speedily.
- Attraction of foreign scientists and entrepreneurs by securing for them free arrival in Russia and movement throughout the territory of the country. They will benefit from the new legal regime that took effect on 1 July 2010 (see the section on international co-operation below).

Source: Gaidar Institute.

3.4.6. Harnessing global opportunities through international co-operation

International linkages played different roles at different stages of the transformation of the Russian research and innovation system. They were vital during the first decade of the transition for ensuring the survival of many good R&D institutes and research teams, and reached a peak of as much as 18% of total R&D funding in 1999. Later, they diversified to include foreign direct investment (FDI) in knowledge-based industries, although this has remained rather limited owing to the limited space open to private firms in these industries and a restrictive policy regarding FDI. Today foreign sources finance 7% of total R&D expenditures and are channelled through various institutional arrangements, mostly bilateral and multilateral government agreements.

Multilateral and bilateral S&T co-operation

The engagement of Russia in European programmes, notably the 7th Framework Programme of the European Union (EU FP7), is a prominent example of the intensification of international co-operation through a multilateral approach (Box 3.26). Russia is one of the most active countries involved in the EU FP7 under "third party" status. This is reflected in co-ordinated calls for jointly defined thematic areas.[40]

Box 3.26. Russia in the EU 7th Framework Programme

Russia is, among "third countries", the most active participant in FP7 in terms of funding and second in terms of the number of projects. Russia had more than 20% of successful applications to FP7. By the end of 2009, 134 contracts with Russian participation were signed (the United States was first with 248 projects). Russian participation in FP6 was already at the same high level; by both number of projects and funding Russia ranked first.

More generally, during the first two years of FP7 (2007-08) Russia participated in 110 competitions and made 25 419 applications, of which 5 520 were successful. The number of participating organisations from Russia was 235 (second place), following 340 for the United States.

Source: Gurova and Kiselev (2010).

A European review evaluated the quality of Russia's contribution as positive (CREST, 2008). It recognised the mutual benefits for the different parties. It recommended, however, a more co-ordinated approach by the participating organisations (on both the European and Russian sides), and suggested reviewing and streamlining visa procedures, notably on the Russian side, to facilitate exchanges and the circulation of scientists. It also suggested the need to better find and exploit the complementarities between Russia and European countries in basic research, to develop co-operation in more applied research and innovation-related programmes,[41] and to draw up a joint agenda for upgrading S&T infrastructure and large-scale equipment in Russia. As Russia desired, it recommended engaging in an association agreement, *i.e.* going beyond the "third party" status. The advantages for Russia, beyond the prestige and credibility it would give its science profile, need to be assessed against the increased costs that this status entails.

The Russian communities concerned generally value co-operation in the context of the EU FP, although two very different types of reservations are heard in some circles. The first is the difficulty for Russian researchers and research teams to comply with the procedures, given the complexity of the documents to be filed and the lack of familiarity with EU procedures. The second, which is less constructive, reflects the reluctance of some groups, particularly in the RAS sphere, regarding any evaluation involving independent, especially foreign, experts.

The INTAS programme was an important early European initiative.[42] Established in the early years of the transition, it provided financial support to Russian scientists and offered them networking opportunities. In its initial form, the programme provided support of USD 150 000 to selected teams; this was later complemented by another mechanism which offered USD 50 000 to individual projects. It is gradually phased out, but it was still disbursing USD 50 million in 2008; 800 Russian teams have benefited over the period 2002-08.

The International Science and Technology Centre (ISTC) was another multilateral scheme established very early during the most difficult phase of the economic transition. Its mission was to prevent the risk of proliferation of sensitive technologies by helping defence-oriented researchers to transfer their skills and experience to civil science. A consortium including the United States, the EU, Japan and Korea established the ISTC. The funding amounts today to USD 50 million a year funded at 50% by EU and the rest by the United States (40%) and the other partners.

In terms of bilateral co-operation, more than half of EU countries have S&T co-operation agreements with Russia; instruments include joint projects, fellowships, workshops, mobility grants and so on. Bilateral co-operation with the United States principally goes through private foundations and non-government organisations (Soros, CRDF), and now focuses on capacity building in universities. China has maintained significant links with Russia, co-operating in basic science in the framework of the Russian Foundation for Basic Research at a rather modest level (about 100 projects) and in the space programme, as well as with selected universities.

Not only are many Russian R&D centres renowned worldwide, but some are also platforms for multilateral scientific co-operation. This is notably the case of the Dubna research complex which hosts the Joint Nuclear Research Institute (Box 3.27).

Box 3.27. Dubna: A pole of international co-operation in nuclear physics

Located 120 km north of Moscow, along the Volga, the science city of Dubna has 70 000 inhabitants. It has grown to host large research centres developed in the 1960s and is specialised in nuclear physics, missile design and space telecommunications by two main organisations, MKB Raduga and the Joint Nuclear Research Institute.

The Joint Nuclear Research Institute (JNRI) is an international organisation involving 18 former CIS countries and 6 associated countries (including Germany and Italy). Its budget amounted to USD 83 million in 2009, of which 80% was funded by Russia. It pursues world-class research in nuclear physics, high-energy physics and condensed matter physics. It has an impressive scientific record and is world famous for several breakthrough discoveries, including "element 105" of the Mendeleev table, known as Dubnium. It hosts major particle accelerators, neutrino source equipment, the Heavy Ion Collider, and has been actively involved in the development of the Large Hadron Collider at CERN.

JNRI employs 5 000 persons, of whom 3 000 are supported by the budget of the institute, including 1 300 researchers, of whom 500 are from abroad, and 1 000 doctors of science and PhDs. It runs an extensive education programme (jointly with Dubna University) involving 300 students and postgraduates. Co-operation has been developed with Kazakhstan, the Slovak Republic, Uzbekistan and other places to install cyclotrons, especially for medical purpose.

Russia is also engaged in co-operative megascience projects, such as the creation of an X-ray-free electron laser. This project involves 14 countries, including EU countries and China, carries out research on new properties of matter, and covers various disciplines such as femtochemistry, plasma physics and biomedicine.

Because of its strong reputation in high-level scientific research Russia is offered many opportunities to co-operate with foreign countries. It has already accepted many of them, but can do more and more efficiently. In particular, restrictive and cumbersome procedures for visas and the remuneration of foreigners constitute a serious drawback for attracting foreign university teachers and academic exchanges, including for short stays. For instance, foreign professors cannot be paid for their lectures. To circumvent this obstacle, they receive research contracts, but this entails other problems for the parties involved and makes Russian auditors suspicious. The transfer of funds between foreign and Russian bodies is also often complicated, at times because of corruption. This delays the implementation of joint projects when it does do not render them impossible (CREST, 2008).

Recent measures, the new scheme to attract foreign scientists and the very open regime that will be tested by the Skolkovo project (see above) are therefore particularly welcome, since they will solve some of these problems for a part, hopefully the best part, of the research community. The new law to attract foreign scientists, a regulatory breakthrough, came into effect in July 2010.[43] The work permits for foreigners recognised as "highly qualified specialists" will be now issued for three years with the possibility of multiple renewals.[44] The selected foreign scientists will also be granted the tax regime of Russian residents, including notably an income tax rate of 13%.

Internationalisation of R&D and technology through the business sector

Co-operative R&D activities involving foreign firms are of crucial importance. In the future, investment in Russia by foreign technology-oriented firms and outward investment by their Russian counterparts should become the main vehicles of the internationalisation of the Russian innovation system. This is already the case in the most advanced countries, as well as in the most successful emerging ones, notably China.

There are many seeds of these new desirable patterns, but major obstacles that inhibit desirable developments also remain.

At present, practically all Russian research institutes with international standing that do not work exclusively for defence have developed strong linkages with foreign (multinational) enterprises.[45] These relationships take various forms: service contracts; joint research projects; entire labs funded by foreign partners. There is no doubt that foreign enterprises draw considerable benefits from their collaboration with high-level Russian researchers who, in return, can keep up more easily with the latest world developments, especially as regards scientific equipment and applications of scientific discoveries, in addition to enjoying access to additional financial resources.

In comparison, the Russian business sector does not yet profit from the opportunities created by the adoption of open innovation models by many foreign firms in the context of the rapid globalisation of R&D and technological activities. The main exceptions are sectors, such as software or scientific instruments, in which market structures have modernised faster, leaving more space to dynamic new-technology-based firms. Other significant co-operative ventures are negotiated at the government level and are part of large-scale programmes implemented by Russian "champions". The Sukhoi Super Jet project – a regional airplane seating 75-95 people – developed jointly with Italian and French aerospace and mechanical engineering firms – provides a telling example.[46]

A "quantum leap" is needed in this area. Two important changes on the horizon could, together, open new perspectives. The first is accession to the World Trade Organization and the OECD which, as mentioned in Chapter 1, would significantly increase the incentives for innovation in Russia by introducing additional competitive pressures from foreign firms, by easing the access of innovative Russian firms to foreign markets, and by facilitating co-operation and technology transfers between Russian and foreign firms. Complementary measures to remove other barriers to foreign investment would magnify the positive impacts. In this respect, the announced privatisation of large segments of the Russian industry and banking sector could offer huge opportunities.

3.4.7. Developing and mobilising regional innovation capabilities

The importance of the regional dimension of Russian innovation policy is discussed above, including the overall institutional and policy context for and trends in current regional/federal co-operation in innovation. This section looks more closely at three examples, with a view to gaining insight into how well this co-operation is working, and where authorities should look for improvement, focusing on the implications for the federal government, in accordance with the terms of reference of this OECD review.

Regional innovation systems do not generally coincide strictly with administrative regions, and this points to the need for interregional co-operation. Roughly speaking, there are in Russia, three main types of functional regional innovation systems, with several sub-variants:[47]

- The "metropolis" model built around the present and former capital cities, Moscow and Saint Petersburg, which have the bulk of the S&T effort, host most of the leading universities and undertake a large share of industrial and financial activities (30% in Moscow and 15% in Saint Petersburg).[48]
- The "high-technology island" model built around cities with a very high concentration of higher education and research institutes, in the middle of a vast territory

lacking any other knowledge-intensive activities, such as Tomsk in Western Siberia.

- The "reduced-scale NIS" model which has developed in regions enjoying greater autonomy and/or with a diversified economic structure, such as the Republic of Tatarstan and its capital Kazan.

Some headline indicators for the three models are set out in Figure 3.7.

Figure 3.7. Headline statistics: Saint Petersburg, Tatarstan and Tomsk

	Saint Petersburg	Tatarstan	Tomsk
Constitutional status	Federal City	Republic	Oblast
Area (km^2)	1 439	67 847	316 900
Population	4 600 000	3 780 000	1 035 000
of which capital city (%)	Saint Petersburg (100)	Kazan (31)	Tomsk (48)
Population density (per km^2)	3 200	56	3
GRP per capita (RUB, 2008)	337 000	246 000	232 000

Source: Background report and other sources.

The metropolis model: Saint Petersburg

Saint Petersburg is a major trade gateway and the location of strong and diversified financial and industrial clusters (Box 3.28). Possessing 10% of the intellectual capital of the country, it is one of the three largest scientific, educational and innovation centres of Russia, along with Moscow and the Moscow region. About 100 universities educate 8% of all Russian students. The city has well-developed innovation infrastructures:

11 innovation and technological centres, a technology-oriented special economic zone, venture funds, business incubators, etc. Some 23 000 PhDs work in 252 scientific institutes, and R&D-intensive enterprises employ about 300 000 people.

According to the "Concept of the socio-economic development of Saint Petersburg to the year 2025" the city's government is determined to make innovation a key pillar of its long-term development strategy. Saint Petersburg's innovation policy involves two types of measures, those implemented and financed exclusively by the local authorities, and those implemented with the financial, organisational and informational support of the federal government (Table 3.10).

Box 3.28. Saint Petersburg: A world cultural heritage and the second most powerful engine of Russian economic development

The Saint Petersburg federal city includes Saint Petersburg proper and 9 municipal towns as well as 21 municipal settlements. With 4.6 million inhabitants it is a large conurbation and a cultural, industrial, financial, educational and research centre of global significance. The industrial base is composed of many sectors, from resource-based to highly knowledge-intensive, notably: oil and gas trade, shipbuilding, aerospace, electronics and electrical engineering, software and computers, machine building, heavy machinery and transport equipment (including tanks and other military), professional instruments, ferrous and non-ferrous metallurgy, chemicals, pharmaceuticals, medical equipment, publishing and printing, food and catering, textile and apparel industries.

Table 3.10. Federal and regional government support to innovation in Saint Petersburg

	Financing (RUB million)	
	2009	2010
1. Measures implemented and financed exclusively by the government of Saint Petersburg		
1.1. Training of personnel for the innovation actors	20.70	35.60
1.2. Development of the innovation infrastructure	230.35	269.76
1.3. Development of clusters	13.50	9.00
1.4. Support to exports of and demand for innovation	44.00	34.20
1.5. Attraction of investments into innovation sectors	8.60	10.30
1.6. Promotion of innovation activities	65.80	77.30
1.7. Assistance to the implementation of federal goal-orientated programmes and projects	8.00	10.00
Total financing of part 1	390.95	446.16
2. Measures implemented with the support of the federal government		
2.1. Development of the technology-oriented special economic zone	1 457.30	3 138.80
2.2. Development of the technopark in Nevsky district	--	--
2.3. Development of Petergoff *naukograd* (science city)	--	--
2.4. Development of the Fund for support of the development of venture investments	100.00	100.00
Total financing of part 2	1 557.30	3 238.80
Grand total	1 948.25	3 684.96

Source: Committee for Economic Development, Industrial Policies and Trade, Government of Saint Petersburg.

Interim achievements are encouraging. In addition to the progress made in the development of the technology-oriented special economic zone and of the Petergoff science city, there are many other examples of new initiatives to accelerate the emergence of a functional regional innovation system: the launch of two additional innovation centres, Innovaciya and Technopolis Ventures; the agreement with Rusnano to implement major infrastructural and commercialisation projects in the area of nanotechnologies; the creation of innovative clusters in the fields of machine building and metalworking; the establishment of a fund to support the development of venture investments in small technology-based enterprises, and of a Russian-Finnish innovation centre; etc.

Cross-border co-operation has become a significant dimension of the regional S&T and innovation policy. The SPbInnoReg project epitomises this new orientation. It aims at promoting sustainable economic development and competitiveness in Saint Petersburg and north-west Russia by leveraging resources available in neighbouring countries. With the support of the European Union, it engages 12 partners in the Baltic Sea region.[49]

The high-technology island model: Tomsk

The Tomsk region is very well endowed in both natural resources and intellectual capital (Box 3.29). Over the last decade it has been for the federal authorities a policy laboratory in which, in co-operation with regional actors, new approaches to escape "Dutch disease" by promoting innovation-led sustainable development could be developed and tested.

The Tomsk city administration, with the support of the regional government, has been active since the mid-1990s in developing a vision of knowledge-based development. It created a Commission for Science and Innovation in 1997. Public procurement of innovative products is a common practice. A special fund for innovative activities was established by the city which is also helping firms to connect to national and global innovation markets and networks, *e.g.* by supporting their participation in exhibitions and fairs (six in 2009, including one in China).

But the region depends heavily on the considerable financial transfers from the federal government, which supports R&D and innovation activities through all available channels (Box 3.30). Co-ordinated actions by the regional and city authorities and the federal government, acting through FASIE, have allowed the development of a significant number of new technology-based firms, most as spin-off from universities. They are established in very active technoparks. A technology-oriented special economic zone has also been established.

Box 3.29. Tomsk city: A "knowledge-intensive island" within a vast territory rich in oil and gas

The Tomsk oblast population is about 1 million, half of whom reside in the city of Tomsk while the others are scattered across a vast territory (almost 90% of the surface of Germany). Initially developed as a trading place on the road from China to Moscow, Tomsk became an academic centre at the end of the 19th century with the opening of the first Russian university east of the Ural mountains. A polytechnic university was created soon after in 1900. In the 1950s, the decision to locate important facilities of the nuclear military-industrial complex, especially nuclear facilities, in Tomsk created an important new layer of activities. Later, in the mid-1990s, the expansion of the oil and gas extraction and processing industries had a profound impact on all regional economic parameters. Oil and gas production became the only profitable sector in a number of districts in the region and the source of almost one-third of the tax revenues for budgets of all levels.

In 2009 the regional GDP amounted to RUB 270 billion. The oil and gas industry employs 28% of the workforce and generates 60% of GDP. Nearly 200 large and medium companies form an industrial structure built around the exploitation of the oil and gas industry, petrochemicals, nuclear power, electro-mechanicals, metal working, woodworking and pharmaceuticals. The agriculture sector, located in the southern part of the region, employs 11% of the workforce and supports an agro-food industry specialised in meat, dairy and bakery products.

In both a short- and longer-term perspective, Tomsk's human potential is clearly a comparative advantage when compared to most other regions in Russia. Tomsk oblast has a strong concentration of students and substantial research capability (150 researchers and 18 doctors of science or PhDs per 10 000 residents). Tomsk hosts six state universities, two research institutes and 15 branches of universities headquartered in other cities and oblasts. It trains 85 000 students in more than 300 disciplines. Another 20 000 are trained by secondary vocational schools. Every fifth inhabitant of Tomsk is a student. The universities generate consolidated revenues from their educational services and scientific developments amounting to EUR 75 million a year.

The Tomsk higher education system is organised around complementary high-quality organisations: a research pole with Tomsk State University (TSU), an academic innovation pole with Tomsk Polytechnic University (TPU) and an entrepreneurial pole, Tomsk University of Control Systems and Radio-electronics (TUCSR). Each university has a technology transfer office. A number of incubators have been set up relatively recently: there are now three at TPU and one at TSU. TUCSR organises a business plan competition prior to integrating new firms in its incubator. It also manages a network of spinoffs (106 in 2009, expected to increase to 150 in 2012).

Box 3.30. Federal support to science-based innovation development in Tomsk

The Russian Federation provides the bulk of the support for R&D (about 90% of the volume of grants). The total number of grants of the Russian Foundation for Basic Research (RFBR) and the Russian Foundation for Humanities (RFRH) rose from 269 in 2002 to 470 in 2007. Combined with the regional support, RUB 35 million were invested in basic R&D in 2007. Tomsk research organisations and R&D-based firms also benefit from the FTP, and 39 projects are being supported for 2007-12 with funds amounting to more than RUB 0.5 billion, a large share of which for nano-industries.

Another important objective of federal support to the Tomsk oblast is to encourage the formation of high-technology firms. FASIE is the key instrument. Its START programme supports 12 projects in the Siberian region, of which 5 in Tomsk. Its UMNIK programme, which targets young scientists developing innovative R&D, has provided grants to 80 projects involving 220 students and researchers of the Tomsk Polytechnic University. FASIE has also already facilitated the creation of 20 companies, of which 10 by TPU in IT technologies, new materials, medicine and machine building.

Given the relatively small number of large innovative firms, the central government has tried to attract more international firms to the region, primarily through its tax incentives policy. A special economic zone was established in 2005, which had 45 resident companies in 2010, including several firms with foreign participation. More than 650 jobs have been created, and it supports 140 projects annually, mainly in the fields of ICT, new materials, nanotechnologies, biotechnology and medicine. The federal government and the municipalities have invested in the SEZ on a 74%/26% basis.

There are also weaknesses. Many established companies continue to use outdated technologies. Some restructuring has taken place in large businesses, but it does not yet seem sufficient to make them dynamic leaders of viable innovative clusters. The oil business is not yet committed to change and diversification in other sectors is slow. FDI remains modest. Therefore, under current circumstances, innovation-driven growth prospects depend largely on the ability of the emerging new-technology-based firms to expand.

There is obviously a critical mass of competences and there are many would-be innovators. The challenge is to speed up a virtuous growth and cluster process among the many start-ups and spin-offs that are burgeoning in technoparks and around higher education establishments. This process should be linked to an accelerated restructuring and strategic re-orientation towards innovation of the large firms that have the potential to become anchors of the regional innovation system. There are many projects, but too few seem to reach the stage at which they become attractive to venture capitalists; this points to a gap in development funding. There is also a need to develop marketing channels and skills to sell new services and products to the rest of the Russian Federation and abroad. Connections with foreign enterprises and networks are crucial in this respect and the growing number of partnerships established by higher education institutions with foreign counterparts should help.

The reduced-scaled NIS model: Tatarstan

Located some 800 km to the east of Moscow, the Republic of Tatarstan is one of the most economically developed of the Federation, ranking in the top five in terms of GDP per capita. Its GDP reached RUB 930 billion in 2008, distributed as follows: 46% in manufacturing and primary industries, 8% in agriculture, 9% in construction and 13% in retail. Oil is a main source of its wealth (with production of 32 million tons of crude a year and estimated reserves of more than 1 billion tons), but it also has a large manufacturing base. Among the particularly noticeable enterprises are Kamaz, which builds big trucks and employs one-fifth of the industrial workforce, and Tupolev, the producer of passenger and military airplanes and helicopters, with one of the world's largest helicopter plants. The territory of Tatarstan also has highly developed transport networks with major railways lines, is irrigated by four navigable rivers (notably the Volga), and is crossed by the main gas and oil pipelines supplying the western part of Russia and further European countries.

The development of SMEs has helped to diversify an economy that is dominated by large industries. The share of SMEs in GDP now exceeds 25%, *i.e.* significantly above the Russian average. In 2009, a difficult year, 4 700 new SMEs were set up, increasing their number in Tatarstan by one-quarter, as compared to only 9% on average in Russia. However few are innovative or operate in high-technology sectors with strong growth potential. A priority for the regional government has therefore been to enlarge the role of SMEs in the local economy by stimulating entrepreneurship and innovation and by favouring clustering processes around technoparks, some of which are quite dynamic (Box 3.31).

Box 3.31. Regional and local support to innovative SMEs in Kazan (Republic of Tatarstan)

A top priority of the economic strategy of the government of Tatarstan is to enlarge and renew the stock of firms, giving priority to those that are knowledge-based. To stimulate and support entrepreneurship a number of initiatives have been implemented recently.

Created in 2004 and located in the centre of the city of Kazan, the Idea Technopark hosts 28 new innovative companies and actively supports 150 others. The Idea park is a member of the European Business Network. Major foreign companies (Siemens, Honeywell, DHL and GE) are established as anchor residents.

Another new innovation infrastructure is the Kamsky Industrial Park Master, which was created in 2004 as a joint initiative by Kamaz and the local and regional authorities. It already hosts 127 enterprises. In the chemicals sector, the Technopolis Khimgrad project was launched in 2007 to build a complete innovation platform, including an industrial park with the necessary infrastructure for producing and shipping petrochemical products, a corporate university, a business incubator, as well as pilot petrochemical facilities and petrochemical research laboratories.

The region, with federal support, has also created a VC fund, which is relatively active. It has invested in 180 start-up projects over the last five years for a total of USD 250 million. Two-thirds of the enterprises funded have survived. However, most of the enterprises which have benefited from the investments are very small (three to five persons) and do not grow much. Moreover, less than 20% of the deals can be considered real VC investment.

The higher education sector is fairly well developed. The 93 higher education institutions train some 200 000 students a year. Four institutions rank among the top 50 Russian universities: the Kazan State University, the Kazan Institute of Finance and Economics, the Kazan State Technological University and the Kazan State Technical University, named after Tupolev. The last two of these have gained the status of national research universities. Tatarstan, however, suffers from a serious brain drain: each year about 25 000 students find jobs in Moscow and Saint Petersburg.

The links between higher education institutions and established industries are unevenly developed and there is little spin-off of new technology-based firms from education establishments. Another weakness concerns foreign investment. At USD 2 billion in 2008, foreign investment was not negligible, but it has largely been concentrated in real estate, transport equipment and construction. To attract foreign investment a special economic zone was created near Abaluga, the second city of the region; so far ten companies have located there (see above). But as noted in the section on innovation infrastructure, this zone is a manufacturing platform and thus unlikely enrich the surrounding economy from an innovation and technological viewpoint.

The future of the economy of Tatarstan may depend largely on an active and diversified policy to exploit the various assets which the republics have accumulated over the years: its heavy manufacturing industries of world reputation (Kamaz and Tupolev) need to innovate more to expand further in export markets; the consolidation of the innovative small-scale sector located so far in a few technoparks requires further support; a strong university sector needs to become more dynamic and more open to new economic trends; and it needs to exploit its cultural heritage and geographical opportunities with the active development of the tourist industry.

To face these challenges and exploit clearly important opportunities, it is important for the government of Tatarstan to remain committed to the innovation agenda that its Ministry of Economy developed a few years ago in collaboration with the business and scientific communities and which is outlined in the "Innovation Memorandum of the

Tatarstan Republic for 2008-2010". It is also important to implement this agenda in an adaptive manner, enriching and fine tuning it as experience is gained in a policy field that is quite new to most actors in the region.

Common issues

Beyond their specific characteristics, the description of these models highlights the importance of some common drivers of and obstacles to innovation-driven regional development, as well as related issues regarding the articulation of regional/local and federal policies:

- Many initiatives result from a combined and concerted approach by federal and local/regional authorities. This co-ordination is essential for the funding and deployment of any significant project.
- The small-scale firms, and more particularly new-technology–based firms, are an essential source of dynamism in local economies. They are a key contributor to the regeneration of the economic fabric of cities and regions.
- The higher education sector plays a pivotal role, as a source of knowledge, competence and entrepreneurship. If higher education institutions are insufficiently engaged, no economic development strategy can be sustainable.
- There are serious difficulties for linking the education and research structures, as well as the small business sector, with established industries, which are not interested in such links; federal policy therefore has an important role to play to support local and regional objectives.
- International linkages of various forms are an important element of dynamism for both the higher education and the enterprise sectors.

It is clear that regional and local policies (see the case of Zukhovsky above) can play a decisive role in rejuvenating the Russian economy while preventing excessive concentration. However, the strong dependence of regional and local policies on the orientations of and funding from the central government raises some issues.

There is a serious risk that local investments may be oriented towards technologies in which the region does not necessarily have the right competences, simply because these are government priorities and a means to obtain funds. Concomitantly, the current "high-tech myopia" of the federal innovation policy entails the risk that local assets – including in traditional industries or in non-science-related sectors (*e.g.* tourism, culture) – will be neglected. Yet, if appropriately exploited, they can be areas in which non-technological innovation creates jobs and wealth.[50] Excessive dependence on federal bodies is also not very conducive to initiatives by those concerned, whether in government organisations, education institutions or business firms. Finally, without sufficient financial and other means, local and regional authorities are largely dependent on locally based but federally driven enterprises as sources of employment and lack the means to propose alternatives strategies. It would therefore be appropriate for the federal government to consider giving more autonomy to regional bodies in their choice of investments and projects.

At an Innovation Forum held in Tomsk in May 2010 the leaders of eight Russian regions decided to establish an Association of Innovative Regions. The founding regions are the Tomsk oblast, the Republic of Tatarstan, the Novosibirsk oblast, the Republic of Mordovia, the Perm krai, the Krasnoyarsk krai, the Kaluga oblast and the Irkutsk oblast.

The Academy of National Economy of the Government of the Russian Federation and Rosnano have joined the agreement. This initiative is very welcome, as it will provide a platform for exchange of experience among regional policy makers. It will foster a learning process that will be beneficial to all actors, including the federal authorities, and can lead to a better understanding of the different regional development dynamics and their policy implications. In this regard, international initiatives with similar aims, *e.g.* the EU's Regional Innovation Monitor (Box 3.32), could be useful reference points for international policy learning.

Box 3.32. The European Union's Regional Innovation Monitor (RIM) initiative

Launched in 2010, the Regional Innovation Monitor (RIM) is an EU-funded initiative to describe and analyse innovation policy trends across EU regions. It sets out to provide policy makers and other innovation stakeholders with the analytical framework and tools for evaluating the strengths and weaknesses of regional policies and regional innovation systems. It provides several tools:

A "knowledge base" on regional innovation policy measures, policy documents and organisations. Each region covered by RIM has a baseline profile, which gives the user a quick overview of the socio-economic situation, research and innovation performance, innovation governance and policy trends.

A benchmarking tool that enables the user to conduct an online quantitative comparison of innovation policy approaches and trends at the regional level.

A single point of access for knowledge sharing and good practice dissemination on regional innovation policy in Europe. Each year, thematic papers and policy workshops of high relevance for the design, delivery and evaluation of regional innovation policies will be undertaken, bringing together communities of policymakers, experts and academics.

A new platform of communication for innovation stakeholders. Registered users can contact each other through an integrated messaging service. Users can also share via their RIM profiles blogs on regional innovation issues as well as their Linked-In or Twitter account details.

Source: Regional Innovation Monitor web site (*www.rim-europa.eu*), accessed January 2011.

3.5. Concluding remarks

Over the past few years, the Russian government has made innovation a national priority. This chapter has shown that Russia now has a rather sophisticated mix of policy measures to tackle a host of market and systemic failures associated with its relatively weak innovation performance. These failures, many of which have their origins in the legacy of the Soviet and transition eras, are often more extensive and intractable than those found in most OECD countries. This implies the need for sometimes extraordinary policy measures that would be difficult to justify in other economies. Furthermore, with many strategic sectors of the Russian economy dominated by large state-owned enterprises, the government has more scope than most to actively promote industrial innovation. Nonetheless, much of the "heavy lifting" of modernisation will still have to be done by the private sector, which should be provided with appropriate resources and incentives to innovate.

Along these lines, perhaps the most important failure that requires urgent redress is the continuing lacklustre innovation performance of Russia's largest firms, both public and private. The key question is how to stimulate demand for innovation in large firms. This requires a broad change in policy orientation, away from a supply-side dominated science policy towards a more balanced innovation policy that pays equal attention to the demand side, as well as the creation of more favourable framework conditions for innovation. As this review shows, such reorientation is already under way, though much remains to be done. The primary goal should be to shift the national innovation system's "centre of gravity" away from the publicly owned R&D system and towards production firms, whether public or private.

Various organisational and institutional arrangements have hindered the emergence of a more firm-centric national innovation system. In particular, the continuing organisational separation of industrial R&D from production – a legacy of the Soviet branch system – needs to be tackled as part of a wider programme of reform of public research institutes. But the main obstacle lies with firms themselves, which have too few capabilities to innovate, little absorptive capacity, weak linkages with existing knowledge infrastructure (which has itself been progressively weakened) and, above all else, too easy access to economic rents that provide few incentives to innovate. These conditions offer formidable challenges to policy makers but few quick-fix solutions.

Improving the framework conditions for innovation – a gargantuan task in itself – will be a necessary undertaking. But a full-fledged innovation policy will need to be more expansive and will need to pay particular attention to extending and deepening innovation capabilities in firms and other actors of the innovation system. It will also require significant means of co-ordination to ensure its coherence and will have to perform careful balancing acts along a number of critical dimensions:

- First, policy needs to support innovation in both large firms and SMEs, as both play crucial, often complementary, roles in innovation systems.
- Second, there should be stronger recognition of the scope and benefits of innovation in low-technology and service industries. Innovation policy is currently overly focused on high technology and thus neglects large parts of the Russian economy, particularly in regions in which low-technology industries dominate.
- Third, the innovation system needs to open up more extensively to foreign sources of knowledge, as complements, not as substitutes for Russian knowledge. Russian research policy is increasingly geared to greater international co-operation and a similar openness is now needed in support of learning and accumulation of innovation capabilities in firms.
- Fourth, policy should pay greater attention to the knowledge demand side, particularly given the problems highlighted above. Until now, innovation policy has overly emphasised the supply side and has been strongly framed by a technology-push philosophy. It thus has serious limitations in a market economy, as the knowledge of users can be critically important in shaping innovations.
- Finally, policy should find an appropriate balance between the need for competition and consolidation in industry. Both have benefits for innovation, but too much of either will be inhibiting.

In carrying out these balancing acts, policy needs to create and empower agents of change. The federal government cannot, and should not, try to do everything itself through directives but should instead enable others to take more initiative through appropriate incentives. In some instances, this will mean nurturing a great deal of capacity building, *e.g.* in regions, as regional authorities often lack the necessary capabilities to formulate and implement a bespoke innovation policy. Policy makers also need to be aware of the opportunity costs associated with any intervention. For example, the Skolkovo initiative looks set to provide an important boost to efforts to attract major overseas technology-based firms and promises to function as a useful demonstrator and incubator for policy experiments. But it is also an expensive initiative and one that colonises much of the innovation discourse in Russia. It therefore risks diverting attention and resources away from much-needed reforms in other critical areas.

Pursuit of the dual goals of excellence and relevance should lie at the heart of Russian innovation policy. Too much R&D funding is still allocated without adequate accountability or reference to performance, and this leads to waste. Furthermore, prioritisation and selectivity should be used to focus public R&D resources in centres with a critical mass of research excellence while recognising that other quality criteria, *e.g.* around teaching in HEIs, commercialisation links in industrial R&D institutes, etc., should also be included as a basis for rewarding good performance.

Finally, the necessary transformation of Russia's innovation system outlined in this report will not happen overnight, but it must be achieved in the medium term if Russia is not to fall further behind its international competitors. Many initiatives will take time to bear fruit and transitory imbalances in the innovation system will have to be, where possible, counterbalanced by transitory measures. At the same time, transitory measures should not postpone longer-term solutions indefinitely. The new Innovative Russia 2020 strategy of the Ministry of Economic Development recognises the risk of this happening and sets out a two-stage implementation process to avoid it. A first stage proposes significant direct intervention in firms to develop greater willingness and capacity to innovate. The proposal for the second stage sees this intervention being gradually withdrawn and resources being redirected towards more indirect support. Some bold decisions will be necessary if this is to happen, but if they are taken, Russia will have reached an important turning point in exploiting its remarkable innovation potential.

Notes

1. Ministerial report on the OECD Innovation Strategy: Innovation to Strengthen Growth and Address Global and Social Challenges: Key Findings, OECD, Paris, 2010.
2. See the *OECD Review of Science, Technology and Innovation Policies: Russian Federation* (OECD, 1993).
3. In 2007, government-financed R&D in business, as a percentage of R&D performed in the business sector, amounted to 55.3%, compared to an average of less than 7% in the OECD area.
4. In China, the combination of a gradualist approach to the transformation of the overall politico-economic framework has been accompanied, in a context of rapid industrialisation, by faster and more radical microeconomic structural reforms, notably in the admittedly less developed S&T and R&D corporate and public sectors.
5. They were subsequently dismantled in 2010.
6. This was confirmed at the conference held in Yaroslavl in September 2010, under the chairmanship of the president and with the participation of a number of foreign heads of state or prime ministers.
7. Precise figures are unavailable as much of the defence R&D budget remains classified.
8. This is the case of science cities such as Dubna and Zhukovsky.
9. A somewhat similar body, the Finnish Committee for Research and Innovation Policy (formerly Committee for Science and Technology Policy), which is an important reference in any international policy benchmarking, used to meet every month.
10. Checking tenders is currently the job of the Federal Anti-Monopoly Service, which has the authority to cancel them — and often does so.
11. The 51 programmes cover very diverse areas, including (according to the Ministry of Economic Development website): "the support for reforms in education and health care; reform of the judicial system; the formation of a market of affordable housing; agricultural modernisation and the creation of conditions for its sustainable development; construction and improvement of the country's transportation facilities of strategic importance; state support for the implementation of major transport infrastructure projects; implementation of innovative projects and programmes of a technological profile; support for sectors of the economy with high potential for innovation (aerospace, information and communication technology); etc."
12. Data from the Ministry of Economic Development.
13. Including some RUB 30 billion for the FTPs, RUB 10 million for RFBR and FASIE, and RUB 5 billion for internal RAS competitive allocations.
14. For instance, the number of budget places in popular specialties in Moscow-based universities in 2010 were: Finance and credit: 538; Law: 1 546; Psychology: 486, Management: 601; Software: 166; Computer systems and networks: 180.
15. In 2009, RUB 1 billion were allocated to this programme.
16. This applies to bachelor and master degrees; the adaptation of the PhD has been postponed.
17. The Presidential Grants for Young Researchers is a smaller programme with comparable objectives that has been in place for ten years. The competition is open to candidates of sciences less than 35 years old, and to doctors of sciences less than 40 years old. The

programme provides two-year grants of RUB 600 000 for the latter and RUB 1 million for the former. It has benefited 500 candidates of sciences and 100 doctors each year since 2005, but the number was reduced to 400 and 60, respectively, in 2009.

18. The institutes of the Russian Academy of Science and of the Russian Academy of Medical Sciences are excluded from the schemes, as are the other public research centres.

19. 60% of the project leaders are scientists from the United States, Germany and France, and 52% have a (second) Russian citizenship.

20. It is possible to join technology, business and design together even more boldly. Finland has recently created Aalto University by merging the Helsinki University of Technology, the Helsinki Business School and the Finnish Art and Design School.

21. A systemic evaluation is particularly necessary to explain why the productivity of the Russian science system, as measured by bibliometrics indicators, does not seem to improve.

22. Switzerland is a rare example, but also a country in which the business sector, at least large firms, does not need much support, as it is already exceptionally active in innovation (OECD, 2006b).

23. Decree No. 218 "About measures of the state support to develop co-operation between the Russian higher education institutions and organisations (enterprises), carrying out complex projects aimed at establishment of high-technology manufactures".

24. A co-ordination council was established at the Ministry of Education and Science to oversee the administration of the scheme and monitor project implementation and outcomes. RUB 280 million will finance the organisation of calls for tenders.

25. Andrey Klepach, Deputy Minister of Economic Development, Press conference of October 2010 announcing the creation of the platforms.

26. It should be also noted that an anti-crisis fund in support of SMEs, with USD 300 million, was established in 2009.

27. The foundation is, however, currently facing a legal issue. According to the Russian budget and civil code for (public non-profit) foundations, it is not supposed to allocate money to organisations that are not under its supervision. This is precisely the case of all beneficiaries of FASIE support.

28. According to the Gaidar Institute, by the end of 2009 116 business entities had been established by 44 higher education institutions.

29. The implementation of the law is made difficult, notably owing to a lack of clarity regarding property issues, e.g. the need to lease premises at market prices, even when the premises are located on the academic campus. Such rules, imposed by the Ministry of Finance to prevent corruption, increase the cost of operations and reduce their potential interest. The premises need to be negotiated with the Russian Property Agency. In addition the IPR regime is still unclear.

30. A high-technology entrepreneur interviewed by the OECD review team put it bluntly: "There is a reasonably good support provided by government schemes, the tax burden is not heavy, there is even a regulation to reserve 20% of procurement contracts to small businesses, but all that counts little when it takes months to get clearance for our imported equipment, and when one of those newly state corporations comes and captures my export markets, in collusion with the Russian agency in charge of armament trade."

31. Tcheliabinsk and Orenburg regions and the Khanty-Mansi autonomous area.

32. About 200 companies of the industrial-military complex belong to the Rostechnologii holding.

33. The Russian rocket industry experienced double-digit growth in 2005-08, prior to the economic crisis. The number of spatial experiments grew yearly by 20%.

34. Notably the firm NT-MDT, created in Saint Petersburg in the late 1980s by researchers of the Ioffe Institute, and which has about 10% of the world market of scanning probe microscopes, a key instrument for nanotechnology research.

35. The poultry industry is one example. In a context wide open to the domestic and foreign competition, Russian producers offer good quality goods, at competitive prices, thanks to rationalised production chains, efficient logistics, and well-designed and enforced safety regulations.

36. Important issues that only a cluster approach would make tractable relate to the development of open networks of innovative suppliers providing materials, components, research and engineering services, etc.

37. The experience of China is not really a counterexample, since the good performance of Chinese SEZs did not create but resulted from the competitiveness of China as a low-wage manufacturing platform.

38. The Foundation of the Centre of Development and Commercialisation of New Technologies, registered in Moscow as a non-profit organisation, have as founders the RAS, the state corporation Bank of Development and Foreign Economic Relations (Vnesheconombank), Rosnano, the Moscow State Technical University, the Russian Venture Company, and FASIE.

39. The Council is chaired by the Academician Alferov, Nobel Laureate (physics, 2000). The foreign co-chairman is Roger Kornberg, Nobel Laureate (Chemistry, 2006), Professor at Stanford University.

40. Co-ordinated calls have been agreed in the following areas: aeronautics; food, agriculture and biotechnology; energy; health; nanotechnology and new materials. Discussions on co-ordinated calls are ongoing in the fields of nuclear fission (within Euratom and the ITER project) and space research (with the European Space Agency).

41. Russia already participates in some Eureka programmes, but to a very limited extent.

42. International Association for the Promotion of Co-operation with Scientists of the New Independent States of the Former Soviet Union.

43. The Federal Law *On making changes to the Federal Law on the legal status of foreign citizens in the Russian Federation* (from 19.05.2010 No 86-FZ).

44. A "highly qualified specialist" is defined as a "foreign citizen having experience, skills or achievements in a particular field if the conditions of his work in the Russian Federation envisage a remuneration of RUB 2 million or more over a period not exceeding one year."

45. As noted in most places visited by the OECD review team. In Zukhovsky, TsAGI works for Boeing and Airbus; at Moscow State University a German firm finances the computer lab; at Saint Petersburg State University, Schlumberger funds the geological research lab; at the State Mining Institute, Total funds research work, etc.

46. Design and manufacturing are led by Sukhoi Civil Aircraft in which Italy's Finmeccanica owns 25% plus one share. Finmeccanica owns 51% of SuperJet International, which is responsible for marketing, sales and aircraft delivery in Europe, North and South America, Africa, Japan and Oceania. The engine is developed by PowerJet, a 50/50 joint venture between France's SCNECMA and Russia's NPO Saturn. The first deliveries of the aircraft are expected in 2011.

47. There are also regional innovation systems that are not really functional in areas facing serious difficulties, such as mono-industrial cities or depressed regions, and those distant from main urban centres and being deserted by their populations.

48. The resources used by these regions and cities are very substantial. For instance the City of Moscow has a programme with a budget of RUB 12.2 billion for 2009-11 (Programme on applied scientific research and projects in the interest of the city of Moscow) (ERA Watch, 2010).

49. The Baltic Institute of Finland (lead partner), The City of Helsinki, Culminatum Ltd (Finland), Hermia Business Development Ltd (Finland), Seinäjoki Technology Centre Ltd (Finland), Lappeenranta Innovation Ltd (Finland), University of Tampere (Finland), TZW Technology Centre Warnemunde (Germany), Innovation and Trendcenter Bentwisch GmbH (Germany), WISTA Management GmbH (Germany), Saint Petersburg Foundation for SME Development (RU), and City of Saint Petersburg.

50. In this perspective, it is worthwhile noting the effort of the Ministry of Economic Development to promote regional branding as well as support traditional industries.

References

Burger, R. (2008), "Russian Federal Targeted Programme for Research & Development in Priority Fields for the Development of Russia's S&T Complex for 2007–2012: An outside view", PowerPoint presentation, RUSERA-EXE training course: Opportunities & Challenges for EU-Russian RTD Co-operation, 30 January-1 February.

Center for Strategic Partnership (2008), *New Economy, Innovation Insight into Russia*, published by the Center for Strategic Partnership, under the auspices of the Committee for Education and Science of the Federation Council, and the Committee for Science and Science-intensive Technologies of the State Duma, Moscow.

Cooper, J. (2010) "Military Procurement in Russia", unpublished presentation.

Crane, K. and A. Usanov (2010), "The Role of High Technology Industries", in *Russia after the Global Economic Crisis*, Petersen Institute, Washington, DC.

CREST (2008), "Internationalisation of R&D, Country Report Russia, An Analysis of EU-Russia cooperation in S&T", CREST/OMC Working Group, Brussels.

Edler, J. (2007) "Demand-based Innovation Policy", *Manchester Business School Working Paper*, Number 529.

ERA Watch (2010), "Inventory Report: Federation of Russia", European Commission, Brussels.

Gaidar Institute (2010), *Russian economy in 2009. Trends and outlooks*, Issue 31, Gaidar Institute, Moscow

Gijsbers, G. and J. Roseboom (eds.) (2006), *The Russian Innovation System in an International Perspective: A Critical Analysis*, Science and Technology Commercialisation Project, EuropeAid, Brussels.

Gokhberg, L. and Sokolov, A. (2011) "Evolution of Technology Foresight in Russia: Rationales, Implementation and Policy Implications", *International Journal of Foresight and Innovation Policy*, forthcoming.

Government of the Russian Federation (2008), *Concept of Long Term Social and Economic Development of the Russian Federation until 2020*, Moscow.

Guinet, J. (2003), "Drivers of Economic Growth: The Role of Innovative Clusters", in *Innovation Clusters and Interregional Competition*, Springer, Berlin.

Guinet, J. (2010), "The Changing Role of Role of Government Research Institutes in Innovation Systems", *STI Policy Review*, Inaugural issue, STEPI, Seoul.

Gurova, A. and V. Kiselev (2010), "The opportunity for Russia to join the 7h Framework Programme", CSRS Bulletin, Moscow.

Ivanova, N. and J. Roseboom (eds.) (2006), *A Functional Analysis of the Russian Innovation System: Roles and Responsibilities of Key Stakeholders*, Science and Technology Commercialisation Project, EuropeAid, Brussels.

Ministry of Education and Science of the Russian Federation (2009), "Background Report prepared for the OECD Review of the Russian Innovation System and Policy", Moscow.

Mowery, D. (2009) "National Security and National Innovation Systems", *Journal of Technology Transfer*, Vol. 34, pp.455-473.

OECD (1993), *Review of Science, Technology and Innovation Policies: Russian Federation*, OECD, Paris.

OECD (2001), *Innovative Clusters: Drivers of Innovation Systems*, OECD, Paris.

OECD (2004), *Fostering Public-Private Partnership for Innovation in Russia*, OECD, Paris.

OECD (2006a), "Evaluation of Publicly Funded Research: Recent Trends and Perspectives", Chapter 6 in *OECD Science, Technology and Industry Outlook 2006*, OECD, Paris.

OECD (2006b), *OECD Reviews of Innovation Policy: Switzerland*, OECD, Paris.

OECD (2007), *15 Years of Reforms - What Has Been Achieved*, OECD, Paris.

OECD (2008), *OECD Reviews of Innovation Policy: China*, OECD, Paris.

OECD (2009), *Learning for Jobs: OECD Policy Review of Vocational Education and Training*, OECD, Paris.

OECD (2010a), Ministerial report on the *OECD Innovation Strategy: Innovation to strengthen growth and address global and social challenges; Key Findings*, OECD, Paris, 2010.

OECD (2010b), "Collusion and Corruption in Public Procurement", Contribution from Russia, OECD Global Forum on Competition, 29 January, Paris.

PricewaterhouseCoopers (2010), *Innovation by Large Companies in Russia*, PricewaterhouseCoopers, Moscow.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where governments work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Union takes part in the work of the OECD.

OECD Publishing disseminates widely the results of the Organisation's statistics gathering and research on economic, social and environmental issues, as well as the conventions, guidelines and standards agreed by its members.

OECD PUBLISHING, 2, rue André-Pascal, 75775 PARIS CEDEX 16
(92 2011 06 1 P) ISBN 978-92-64-11312-1 – No. 58135 2011

OECD Reviews of Innovation Policy

RUSSIAN FEDERATION

How are a country's achievements in innovation defined and measured, and how do they relate to economic performance? What are the major features, strengths and weaknesses of a nation's innovation system? How can government foster innovation?

The *OECD Reviews of Innovation Policy* offer a comprehensive assessment of the innovation system of individual OECD member and non-member countries, focusing on the role of government. They provide concrete recommendations on how to improve policies that affect innovation performance, including R&D policies. Each review identifies good practices from which other countries can learn.

CONTENTS

More information about the *OECD Reviews of Innovation Policy* series is available at: ***www.oecd.org/sti/innovation/reviews***.

Please cite this publication as:

OECD (2011), *OECD Reviews of Innovation Policy: Russian Federation 2011*, OECD Publishing.
http://dx.doi.org/10.1787/9789264113138-en

This work is published on the *OECD iLibrary,* which gathers all OECD books, periodicals and statistical databases. Visit ***www.oecd-ilibrary.org***, and do not hesitate to contact us for more information.

OECD*publishing*
www.oecd.org/publishing

ISBN 978-92-64-11312-1
92 2011 06 1 P

9 789264 113121