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Foreword

The OECD Review of Kazakhstan's Innovation Policy is part of a series of OECD country reviews of innovation policy (www.oecd.org/sti/innovation/reviews). It was requested by the authorities of the Republic of Kazakhstan, represented by the Ministry of Education and Science and was carried out by the OECD Directorate for Science, Technology and Innovation (DSTI) under the auspices of the Committee for Scientific and Technological Policy (CSTP). It was part of the OECD-Kazakhstan Country Programme.

The purpose of this review is to obtain a comprehensive understanding of the key elements, relationships and dynamics that drive Kazakhstan's innovation system and the opportunities to enhance it through government policy. More specifically, the review:

- provides an independent and comparative assessment of the overall performance of the Kazakhstani innovation system
- recommends where improvements can be made in the system
- formulates recommendations on how government policies can contribute to such improvements, drawing on the experience of OECD and non-OECD countries and evidence on innovation processes, systems and policies.

The review is relevant to a wide range of stakeholders in Kazakhstan, including government officials, entrepreneurs and researchers, as well as the general public. It also aims to provide a comprehensive presentation of the Kazakhstani innovation system and policy to a global audience through the OECD communication channels.

Preliminary results were presented at the OECD special session of the Astana Economic Forum in May 2016. A draft version of the "Overall Assessment and Recommendations", containing key issues and recommendations, was presented for a peer review to the Working Party for Innovation and Technology Policy (TIP) of the CSTP in December 2016, with the participation and contribution as peer reviewers of Jan Kozlowski (Counsellor to the Minister, Ministry of Science and Higher Education of Poland) and Dirk Meissner (Deputy Head, Research Lab for Science and Technology Studies, Institute for Statistical Studies and Economics of Knowledge, National Research University Higher School of Economics, Russian Federation).

The review was led by Gernot Hutschenreiter, Head, Country Innovation Policy Reviews Unit, (Science and Technology Policy Division [STP], DSTI, OECD). The review report was drafted by Philippe Larrue (STP, DSTI, OECD) with contributions from Manfred Horvat (consultant to the OECD, Vienna University of Technology), Balázs Muraközy (consultant to the OECD, Hungarian Academy of Sciences) and Yana Vaziakova (STP, DSTI, OECD) under the supervision of and with contributions from Gernot Hutschenreiter (STP, DSTI, OECD). Maria Anokhina (STP, DSTI, OECD at the time of her contribution) provided valuable input, statistical support and web-based research.

The review draws heavily on the results of a series of interviews with a wide range of major stakeholders of the Kazakhstani innovation system during the two fact-finding missions (see the acknowledgement in Annex B). The review has also benefited from comments and additional information received from stakeholders in Kazakhstan.

The review owes much to the support of government officials of the Republic of Kazakhstan, in particular Mr. Aslanbek Amrin (Vice Minister, Ministry of Education and Science of the Republic of Kazakhstan), Mr. Takir Balykbayev (former Vice Minister Ministry of Education and Science of the Republic of Kazakhstan), Mr. Rashitdin Kokenov (Head of Science Committee division, Ministry of Education and Science of the Republic of Kazakhstan), Mr. Serik Irsaliyev (President, JSC Information-Analytic Center) and their respective teams. Marat Kamzoldayev (Vice-President, JSC Infomation-Analytic Center), Murat Sartbayev (Director, Department of Management of Business Process Systems Analysis), and their staff at the JSC Infomation-Analytic Center provided the Background Report to this study. The contributions of Ms. Marina Sirotina (Centre for Trade Policy Development, Ministry of National Economy of the Republic of Kazakhstan) were particularly valuable to ensure continuous interaction between the OECD team and various administration of the Republic of Kazakhstan.

The review benefited from interactions with various reviews conducted in the framework of the OECD-Kazakhstan Country Programme, in particular the OECD Multi-dimensional Review of Kazakhstan, the Review of Higher Education in Kazakhstan and the Proposal of Kazakhstan to adhere to the OECD Declaration on International Investment and Multinational Enterprises. Jean-François Lengellé (OECD Global Relations Secretariat) and his team (in particular Wouter Meester, Klaus Hachmeier, Pierre-Eric Trimouillas and Tierra McMahon) provided essential co-ordination across OECD activities in Kazakhstan.

Table of contents

Acronyms and abbreviations 11

Executive summary 13

Chapter 1. **Overall assessment and recommendations** 17

Main strengths, weaknesses, opportunities and threats of Kazakhstan's research and innovation system 18
Key issues and recommendations 19
References 40

Chapter 2. **Economic performance and framework conditions for innovation in Kazakhstan** 41

Macroeconomic performance and productivity growth 42
Globalisation and structural change 48
Framework conditions for innovation and entrepreneurship 54
The role of innovation in future development 61
Synthesis 62
Notes 63
References 64

Chapter 3. **Innovation performance in Kazakhstan** 69

Innovation inputs 70
Innovation outputs 80
Notes 90
References 91

Chapter 4. **Innovation actors in Kazakhstan** 93

Business sector 94
Public research institutions 117
Notes 137
References 138

Chapter 5. **The role of government in the system of innovation in Kazakhstan** 143

The legal, strategic and programmatic framework for science, technology and innovation policy in Kazakhstan 144
Main STI policy actors 150
Increasing public and private investment in research 153
Incentivising R&D investment 161
Raising the domestic business sector innovation capability 168
Providing equity and venture financing 178
Enhancing technology transfer 182
Building on local dynamics to enhance innovation and economic development 185
Weaving international knowledge linkages 189
Notes 195
References 198

Annex A. **List of institutions, laws, strategies and programmes** 205

Annex B. **List of people interviewed during fact-finding missions** 209

Tables

1.1. Strengths, weaknesses, opportunities and threats (SWOT) analysis of the research and innovation system in Kazakhstan 18
2.1. Share of exports by technology category, 2014 52
2.2. Different types of firms (legal persons only), January 2015 55
2.3. Financial indicators of firms 60
2.4. Achievements and challenges related to economic performance and framework conditions for innovation in Kazakhstan 62
3.1. Persons employed in R&D by staff categories, 2014 76
3.2. Achievements and challenges related to research and innovation inputs 80
3.3. Citation of publications in Kazakhstan and other EAEC countries 82
3.4. Global Competitiveness Report – innovation pillar indexes, Kazakhstan 88
3.5. Achievements and challenges related to research and innovation outputs 90
4.1. Number and share of firms (only legal persons) by size and ownership, 2015 94
4.2. Achievements and challenges related to the overall industry structure 98
4.3. Achievements and challenges related to the innovativeness of Kazakhstani firms 106
4.4. Main observations with regards to firms' co-operation in research and innovation 110
4.5. Location and identity of national universities in Kazakhstan 118
4.6. Regional distribution of higher education institutions in Kazakhstan, 2006/07-2014/15 123
4.7. Achievements and challenges related to the overall public research system 125
4.8. Number of doctoral candidates in Kazakhstan 126
4.9. Distribution of doctoral students by field of study 127
4.10. Top 10 Kazakh institutions by number of patents granted by the national patent office 128
4.11. Kazakh universities in the QS rankings 130
4.12. Top 10 universities according to 2015 national ranking 131
4.13. Achievements and challenges related to the activities and performance of higher education institutions 131
4.14. Achievements and challenges of higher education institutions in transferring and valorising knowledge produced in public research organisations 136
5.1. Achievements and challenges in building the legal, strategic and programmatic framework for science, technology and innovation 149
5.2. Achievements and challenges in building the architecture of the system of innovation and assigning roles between actors 153
5.3. Instruments to support research in Kazakhstan 153
5.4. Achievements and challenges in public policies aiming to increase public and private investment in research activities 160
5.5. Financial support instruments for business R&D and innovation in Kazakhstan 161
5.6. Achievements and challenges in public policies aiming to incentivise R&D investment 168
5.7. Instruments to support small and medium-sized enterprises in Kazakhstan 168
5.8. Types of innovation grants in Kazakhstan in 2015 170
5.9. Number of applications and approved NATD grants by type of grant, 2014 171
5.10. Achievements and challenges in public policies aiming to raise the domestic business sector innovation capability 178
5.11. Instruments for financing innovative start-ups in Kazakhstan 179
5.12. Achievements and challenges in equity and venture financing in Kazakhstan 181

5.13. Instruments to support incubation and entrepreneurship in Kazakhstan 182
5.14. Achievements and challenges in public policies aiming to enhance technology transfer in Kazakhstan 185
5.15. Place-based instruments to support innovation in Kazakhstan 187
5.16. Achievements and challenges in regional policies to support research and innovation 189
5.17. Achievements and challenges in the internationalisation of research activities 194

Figures

2.1. Gross national income per capita in Kazakhstan 42
2.2. Real GDP growth, 2000-14 43
2.3. Real GDP growth and forecasts (constant 2010 USD) 44
2.4. Decomposition of GDP per capita 45
2.5. Decomposition of growth of GDP per person 46
2.6. Labour productivity levels (2000) and growth rates (2000-15) 46
2.7. Labour productivity and its compound growth rate, 2010-13 47
2.8. Share of sectors in GDP and employment 48
2.9. Productivity and employment 49
2.10. Openness to international trade 51
2.11. Share of OECD countries in total and manufacturing exports, 2014 51
2.12. Revealed comparative advantage 52
2.13. Foreign direct investment inflow and stock 53
2.14. Average PISA scores in mathematics, science and reading 57
2.15. Domestic credit to private sector (average), 2010-13 58
2.16. Stock market capitalisation (average), 2010-12 59
2.17. Networked readiness ranking, 2005-16 60
3.1. R&D intensity and gross expenditure for R&D in Kazakhstan 70
3.2. Research and development expenditure: International comparison 71
3.3. Gross expenditure for R&D by performing sector in Kazakhstan 72
3.4. Share of gross expenditure for R&D by performing sector in Kazakhstan 72
3.5. Gross expenditure for R&D by performing sector in a sample of countries, 2013 73
3.6. Gross expenditure for R&D by source of funds in Kazakhstan 73
3.7. Gross expenditure for R&D by type of activity in Kazakhstan 74
3.8. Gross expenditure for R&D by field of science in Kazakhstan 74
3.9. Number of staff occupied in R&D and share of R&D staff in the population 75
3.10. Researchers in R&D (per million people) 76
3.11. Number and share of R&D personnel by type of R&D organisation 77
3.12. Age distribution of R&D employees 77
3.13. Number of PhD students in Kazakhstan 78
3.14. Gross enrolment in higher education 78
3.15. Average mean scores in reading, mathematics and science in Kazakhstan and OECD 79
3.16. Average scores in mathematics in a selection of middle-income countries, PISA 80
3.17. Total number of Kazakhstani publications in the Web of Science 81
3.18. World share of publications in the Web of Science international citation database, Kazakhstan and select Southeast Asian countries 81
3.19. Citation impact of publications by country/region in Web of Science journals by five-year period 82
3.20. Kazakhstan's rank in terms of number of citable documents and number of citations per document 83
3.21. Kazakhstan's top 10 co-publication partners, 2011-15 83

3.22. Patent applications in Kazakhstan by type of applicants 84
3.23. Patent applications by residents in Kazakhstan and selected countries 84
3.24. European patents filed, applied for and granted by residents in Kazakhstan at the European Patent Office (EPO) 85
3.25. Distribution of patent applications in Kazakhstan by region, 2007-14 86
3.26. Patents granted to residents in Kazakhstan by technology field, 2014 86
3.27. Licensing fee receipts, Kazakhstan 87
3.28. Royalties, selected countries (2014) 87
3.29. Trademark applications in Kazakhstan 89
4.1. Share of employment of manufacturing industries, 2014 95
4.2. Manufacturing employment by level of technological intensity of the industry, 2013-14 96
4.3. High-technology exports 97
4.4. Economic Complexity Index, Kazakhstan and selected countries 98
4.5. Expenses for product and process innovation, Kazakhstan and European countries 99
4.6. Business R&D spending by type of R&D, Kazakhstan and selected countries 100
4.7. Gross expenditure on R&D by type of ownership, 2014 103
4.8. Innovation expenditure per innovating company, 2012-14 103
4.9. Share of innovative firms in the manufacturing and services sectors, Kazakhstan and other selected countries 104
4.10. Share of firms conducting different types of innovation (only innovative firms), Kazakhstan and other selected countries 105
4.11. Innovative expenditures per innovative firm, 2012-14 105
4.12. Share of innovative firms, 2012-14 105
4.13. Source of business R&D expenditures, Kazakhstan 106
4.14. Share of innovative firms citing source as “highly important”, Kazakhstan and the European Union 107
4.15. Co-operation in innovation, Kazakhstan and the European Union 108
4.16. Share of firms introducing externally developed goods and services from product innovating firms, Kazakhstan and European countries 109
4.17. Share of Kazakhstani firms indicating innovation obstacles as “highly important” by type of obstacle, 2014 110
4.18. Obstacles to innovation in the European Union, 2010-12 (share of firms answering “highly important” for each question) 110
4.19. Regional shares of population and higher education institutions, 2014 123
4.20. Regional distribution of higher education institutions’ staff 124
4.21. Distribution of R&D personnel by type of organisation 125
4.22. Regional distribution of students in the academic years 2006/07 and 2015/16 126
5.1. Overall architecture of the science, technology and innovation policy framework in Kazakhstan 144
5.2. Timeline of the main laws regulating science, technology and innovation activities in Kazakhstan 145
5.3. Timeline of the main overarching development and innovation strategies in Kazakhstan 2000-20 146
5.4. Timeline of the main state programmes related to industrial and innovation policy in Kazakhstan, 2000-20 148
5.5. Main science, technology and innovation policy actors in Kazakhstan 150
5.6. R&D intensity and national spending targets in a sample of countries 154
5.7. GDP forecast 2014-20 and implicit GERD target in 2020 155
5.8. Breakdown of annual (internal) gross domestic expenditure for R&D to research organisations, by type of organisation 156

5.9. Breakdown of Committee on Science funding to research organisations, by type of organisation and type of financing, 2012-15 157
5.10. R&D financed from general university funds in a selection of OECD countries, Kazakhstan and Chinese Taipei 157
5.11. Functioning of the 1% subsoil user requirement 164
5.12. Number of NATD grants applied for and approved, and corresponding total amounts awarded, by year 171
5.13. National and local public funding of R&D 186
5.14. Breakdown of government expenditure on research and development by source of funds 187
5.15. Map of technology parks in Kazakhstan active in 2015 188

Acronyms and abbreviations

BERD	Business expenditure on research and development
CIS	Commonwealth of Independent States
DAMU	Entrepreneurship Development Fund
EAEC	Eurasian Economic Community
EAEU	Eurasian Economic Union
FDI	Foreign direct investment
FSSTD	Forecast Scheme for Spatial Territorial Development
GDP	Gross domestic product
GERD	Gross expenditure on research and development
GNI	Gross national income
GVC	Global value chain
EBRD	European Bank for Reconstruction and Development
EHEA	European Higher Education Area
EPO	European Patent Office
EU	European Union
HEI	Higher education institution
HSTC	Higher Scientific and Technical Commission
IP	Intellectual property
ISTC	International Science and Technology Center
JSC	Joint stock company
KazNTU	Kazakh National Research Technical University named after K.I. Satpayev
KazNU	Al-Farabi Kazakh National University
KMG	KazMunayGas
KZT	Kazakhstani tenge (currency)
MES	Ministry of Education and Science
MFP	Multifactor productivity
MID	Ministry of Investment and Development

NATD	National Agency for Technological Development
NCSTE	National Center for Science and Technology Evaluation
NCSTI	National Center for Scientific and Technological Information
NRC	National research council
NURIS	Nazarbayev University Research and Innovation System
OECD	Organisation for Economic Co-operation and Development
PhD	Doctor of Philosophy
PCT	Patent Cooperation Treaty
PISA	Programme for International Student Assessment
PIT	Alatau Park of Innovative Technologies
PRI	Public research institute
PZTM	Petropavlovsk Heavy Engineering Plant
R&D	Research and development
SEZ	Special economic zone
SK	Samruk-Kazyna
SME	Small and medium-sized enterprise
SPAIID	State Programme for Accelerated Industrial and Innovative Development of Kazakhstan
SPIID	State Programme for Industrial and Innovative Development of Kazakhstan
STI	Science, technology and innovation
TFP	Total factor productivity
TTA	Technology Transfer Alliance
TTO	Technology transfer office
TVET	Technical and vocational education and training
UPSTO	United States Patent and Trademark Office
VET	Vocational education and training
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

Executive summary

In the 2000s, the government of Kazakhstan made a concerted effort to increase research and development (R&D) activity. To narrow the persistent productivity gap and, in the longer term, move towards a growth model that is less dependent on commodity exports, it launched major legal reforms, strategies and programmes aimed at boosting science and technology. These initiatives helped to improve scientific output and have resulted in some successes in technology commercialisation. However, despite these achievements, the goal of greater innovation and value creation has not been fully realised, and new economic activities have not yet emerged. In addressing these challenges, Kazakhstan can draw upon its rich endowment of natural resources, its unique geographic position, bridging Europe and Asia, and a diverse population. Further reforms will be necessary, however, within organisations as well as at the level of the governance of the system of research and innovation, to make the most of these advantages in an uncertain economic environment due to the volatility of commodity prices

Enhance research capabilities in line with the national development needs

Independent Kazakhstan inherited a well-developed but dual science and education system, in which research was performed almost exclusively in public research institutes (PRIs) whereas the universities were in charge of higher education. As funding was sharply cut back during the 1990s, the country's research capacity and performance, as well as the educational standards in schools and universities, declined.

The gradual increase of the national R&D effort and the major reforms of the early 2000s resulted in profound structural and qualitative changes in the higher education and research system. Nazarbayev University, which was established in 2011, was endowed with unprecedented financial and human resources and granted a high degree of autonomy, with the expectation that it acts as a model for other higher education institutions (HEIs) aiming at research excellence and high innovation performance. The recent mergers between HEIs also have the potential for strengthening some of these institutions. A lack of information makes an assessment of the activities and performance of PRIs very difficult, although these institutes receive a substantial part of public R&D funding.

The absence of institutional funding for research activities at universities and their lack of autonomy have held back their transformation into research institutions. The bulk of university research is therefore financed through competitive schemes, which do not provide the level of financial stability needed for longer-term planning and more strategic research projects. Reinforcing domestic research capacity calls for an increase of non-competitive, pluri-annual resources dedicated to university research. In addition, adequate monitoring, as well as *ex post* evaluation mechanisms at institutional and individual levels, will be required to allocate these resources efficiently.

Moreover, the competitive grant schemes currently in place are beset by the small size of the funded projects and their insufficient orientation toward national priorities. The Technology Commercialisation Project was launched in 2011 to serve as a real-scale demonstrator for developing a competitive, efficient and problem-oriented model for research funding. Its next programme phase, announced in 2015, should provide further opportunities to help solve some of the problems faced by competitive grant schemes.

Broaden the support for knowledge transfer in the innovation system

The legacy of the Soviet university system still has considerable bearing in terms of the mixed quality of universities' outputs and their limited ability to create value from them. The relationships between science and industry have increased and improved, but the model of knowledge transfer is still linear, with little consideration for the demand side of innovation, especially the capabilities of business firms and the market needs they convey ("technology pull"). In attempting to commercialise their projects, research organisations still face challenges related to excessive bureaucracy, a continued lack of autonomy, as well as researchers' limited managerial and entrepreneurial skills. Several promising initiatives for knowledge transfer have been set up in some universities, but their impact is low so far, because of a lack of visibility and adequate funding, and the absence of systematic relationships and interactions between them.

Since 2010, the government has launched several public support initiatives to enhance knowledge transfer, for example by setting up technology transfer offices at universities. However, even the most elaborate of these endeavours are facing tight resource constraints and an uncertain future due to unrealistic expectations regarding their financial self-sustainability. Further capacity building is needed to increase their staff's experience in innovation. Last but not least, knowledge transfer must be encouraged through a variety of channels, in addition to patenting and licensing.

Invest in and deliver on education and skills

During the transition period following independence, Kazakhstan's relatively well-developed education system deteriorated. While educational performance in schools has improved in recent years, Kazakhstan still lags behind not only the OECD average, but also Europe and Central Asia average for some key indicators such as reading. Tertiary education performance, in terms both of its attractiveness and the quality of educational programmes, is affected by low remuneration of teachers and the imbalance between students' research work and other university occupations. Further decentralisation of the governance of HEIs, with greater financial, academic and organisational flexibility is a key condition for their ability to cope with these problems. In recent years, the number of students enrolling in technical and vocational education and training (TVET) has also fallen. The government should take actions to improve the quality and relevance to industry needs of TVET and reinforce its attractiveness.

Since independence, Kazakhstan has made much progress in internationalisation, especially thanks to the Bolashak scholarship programme. However, quality gaps and language barriers have discouraged foreign institutions from building partnerships or joint programmes with Kazakhstani universities. Limits to academic autonomy are also a major barrier for internationalisation and, more generally, for enhancing the research and educational performance of higher education institutions (HEIs).

Strengthen business innovation

Kazakhstan's economy is in need of upgrading and diversification. Its industry depends heavily on primary products, especially oil, gas and minerals, as well as agricultural commodities. Meanwhile, its industrial base is largely composed of very small private firms and large state-owned enterprises. These structural factors explain why, although it is growing slowly, the share of innovative firms is low by international standards. Important innovation obstacles pertain to the low influence of private demand, a weak flow of potential projects and the scarcity of funds to finance research and innovation, especially in early stages.

The government has introduced a number of regulations and incentives to boost business R&D, such as the R&D tax credit and tax exemption. In particular, the 2012 amendment to the "Law on Subsoil and Subsoil Use" requires subsoil users to invest 1% of their annual income in R&D. While this initiative could, in principle, help Kazakhstan's effort to diversify, its effectiveness has been reduced by the lack of adequate bylaws, unclear eligibility rules and weak enforcement principles. The authorities have also expanded the portfolio of financial and qualitative instruments to support innovative small and young firms (innovation grants, loan guarantees, venture funds, training programmes, extension centres, etc.) but each of these instruments remain limited in scale and scope.

Improve the governance of science, technology and innovation

Greater investment of resources is needed to achieve the ambitious goals for research and innovation set at the highest political level. However, the effectiveness of these additional resources will be limited if not tied to further reforms. In particular, bold actions should be taken to improve horizontal and vertical policy co-ordination, solve the numerous implementation hurdles of the initiatives in place and enhance their monitoring and evaluation.

Subnational authorities could complement the central government's effort to support innovation actors and their networks, and in particular, innovative business firms and intermediary organisations.

Main recommendations

- Gradually increase the level of institutional funding for research at universities and PRIs.
- Evaluate the PRIs' missions, activities, results and governance.
- Intensify and broaden the support to knowledge transfer in research-performing organisations.
- Focus on developing the basic skills, knowledge and competencies of students which prepare them to integrate in rapidly changing and global markets.
- Ensure that the Subsoil User R&D requirement is functioning properly, channeling the expected amounts of funds towards R&D generating high returns to society, including outside the extractive sector.
- Improve communication, information exchange and co-operation between the main actors of the innovations system – Ministry of Education and Science, Ministry for Investments and Development, Ministry of National Economy, and sectoral ministries.

Chapter 1

Overall assessment and recommendations

This chapter presents an overall assessment of Kazakhstan's innovation system and policy, reflecting the key findings of the review. It identifies the strengths and weaknesses and key issues for innovation policy, and develops specific policy recommendations for improving the performance of Kazakhstan in science, technology and innovation.

After the demise of the Soviet Union, independent Kazakhstan experienced a deep transformational recession, characterised by a large drop in its economic output, rampant inflation and pressure on public finances. When the economy began to stabilise in the mid-1990s, the government started to launch ambitious plans to guide national economic development based on an open market economy, building the oil and gas extraction capacity, and constructing a modern infrastructure. In the aftermath of the Russian financial crisis in 1998, economic growth took off, mainly driven by the boom in the hydrocarbons sector. Gross national income (GNI) per capita doubled between 2000 and 2015, generating large revenues which were used to finance large national projects – such as the development of the new capital Astana – and strategically oriented industrial policy. The economy showed resilience and weathered the global financial crisis of 2008-09 better than other countries.

However, following a period of strong growth, the fall in commodity prices hit the economy in the mid-2010s, and exposed the vulnerability of a growth model which has continued to be largely based on commodity exports. Kazakhstan's productivity, notably outside the extractive industries, lags behind similar countries. Closing the productivity gap requires technological upgrading and improvements in skills. In response to this challenge, the government started to increase the national research and development (R&D) effort already in the 2000s, and launched major legal reforms, strategies and programmes aimed at boosting science and technology. While these efforts resulted in improved scientific output, this achievement has yet to be turned into more innovation and value creation, and does not yet contribute to the emergence of new economic activities. To achieve sustainable growth in the longer term, Kazakhstan needs to diversify its economy. Economic policy has supported diversification through a variety of instruments but employment remains concentrated in low-productivity sectors with low innovation activity. Significant effort is still needed to strengthen domestic innovation capabilities and shift to a more innovation-driven productivity growth.

Main strengths, weaknesses, opportunities and threats of Kazakhstan's research and innovation system

Table 1.1 presents a strengths, weaknesses, opportunities and threats (SWOT) analysis of Kazakhstan's research and innovation system.

Table 1.1. **Strengths, weaknesses, opportunities and threats (SWOT) analysis of the research and innovation system in Kazakhstan**

Strengths	Weaknesses
• Rich natural resource endowments • Unique geographic position • Growing young population with international experience • Cultural diversity • Genuine commitment to improve and expand the science, technology and innovation system • Comprehensive strategic plans and state programmes supporting economic development and innovation • Wealth of new legal and strategic initiatives and reforms to support R&D	• Insufficient quality of education and inadequate supply of skilled labour • Low attractiveness of research careers • Low research excellence in international comparison • Continued prevalence of the "linear model of innovation" in public research • Lack of interactive linkages between research institutions and business firms • Low business demand for new knowledge and research results • Low domestic business R&D and innovative capacity, especially of small and medium-sized enterprises (SMEs)

Table 1.1. **Strengths, weaknesses, opportunities and threats (SWOT) analysis of the research and innovation system in Kazakhstan** (*cont.*)

Strengths	Weaknesses
	• Low engagement of large state companies in innovation activities and emerging areas • Weak competition and high barriers to entry in many industries • Low level of integration into global value chains • Lack of entrepreneurship, management skills and venture capital • Lack of horizontal policy co-ordination • Problems of implementation of regulations and support measures • Lack of funding at overall and project levels • Large number of innovation policy tools which reach very few businesses • Underdeveloped evaluation culture and practice • Limited foreign language proficiency
Opportunities	**Threats**
• Raise awareness of potential innovation benefits and strengthen innovation capabilities within firms • Succeed in channelling income from oil and gas to R&D activities, including in other sectors (e.g. manufacturing) • Build linkages with and learn from foreign companies in Kazakhstan • Shift production and trade towards more knowledge-intensive goods/services • Increase the engagement of domestic SMEs in more innovation-driven strategies • Take advantage of the Silk Road initiative • Disseminate lessons learned from Nazarbayev University and other successful university initiatives • Use universities as providers of innovative services for domestic companies	• Unfavourable macroeconomic environment, over-reliance on oil and gas sectors • Increasing brain drain • Decreasing numbers of tertiary graduates and few completed PhDs • Increasing competition, especially from other Asian economies • Overly optimistic expectations of short-term impact and success of commercialisation programmes • Unrealistic or ill-suited programme targets • Lack of communication and co-ordination between actors of the innovation system • A tendency for "hyperactive" policy (too ambitious initiatives, too many programmes, rapid change)

Key issues and recommendations

Taking account of the SWOT analysis set out in Table 1.1 and the strategic tasks to be addressed by innovation policy, this review has identified a number of key issues and policy recommendations.

1. Improving the framework conditions for innovation

There are strong reasons why framework conditions are important for innovation: 1) innovation is a long-term investment, and, as such, it requires a stable environment; 2) the regulatory framework, including a level playing field for different firms,

encourages innovation and technology diffusion; and 3) good framework conditions also strengthen the impact of policies specifically designed to foster innovation.

Overall, Kazakhstan's framework conditions resemble those of countries with a similar level of development and have shown significant improvement in recent years. In the World Economic Forum's *Global Competiveness Report* 2016-17, for example, Kazakhstan was ranked 53rd, as compared to 72nd in 2010. Behind this headline result, there is considerable variation. On the positive side, Kazakhstani firms are subject to only light administrative burdens, including for opening a business or registering a property. Labour markets are also relatively flexible. In contrast, a number of factors work against a level playing field in product markets. Regulations and the large role of the state in the economy result in low domestic competition. Importing and exporting is also costly, limiting international competition and competitiveness. Another important weakness is the comparatively low level of skills, which limits innovation capabilities in Kazakhstani firms.

A prerequisite for innovation is access to finance. International comparisons show that Kazakhstani firms have limited access to financing for every kind of investment, including innovative investments. While this is partly the result of the inefficiency of the banking sector, non-bank sources, including the stock market, are also underdeveloped. These weaknesses were amplified by the recent financial crisis. Another key issue for SME financing by banks or venture capital funds is the limited transparency of the operations and ownership structure of these firms.

Recommendations - framework conditions

- Create a more level playing field on product markets, in particular in markets where state-owned firms play an important role.
  - Follow international good practice in competition policy and sectoral regulation.
  - Lower barriers for import and export activities.
- Promote transparency and trust in industry and trade.
  - Fight corruption and red tape by improving the transparency and predictability of public policy, and in public procurement.
  - Develop transparent information systems on the operations and ownership of firms.
  - Cut red tape on international trade.
- Support the development of financial markets to diversify innovation investment financing.
  - Promote the growth of the domestic stock market.
  - Strengthen banks' ability to access wholesale funding in order to improve their ability to provide credit.[1]
  - Focus the programmes supporting access to finance on targeted categories of firms (e.g. domestic SMEs, start-ups) and/or types of investment (e.g. early-stage innovation projects).

1. These two last recommendations draw on the results of OECD (2017a), *Multi-dimensional Country Review of Kazakhstan: Volume II - In-depth Analysis and Recommendations,* OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264269200-en.

2. Enhancing research capabilities in line with the national development needs

Significant effort to rebuild and restructure the public research system after a "lost decade"

Independent Kazakhstan inherited in many respects a strong research infrastructure, which was specialised in areas of high technology such as nuclear energy and space research. The Soviet-style science and education system was dual in character: research was performed almost exclusively in public research institutes (PRIs) specialised in certain technological fields or sectors, while universities were primarily in charge of higher education. There was insufficient connection between these two types of institutions. In subsequent years, the quality of both research and education deteriorated. In the science system, the quality of the equipment and, more generally, the whole research infrastructure, declined as funding dropped heavily. On the demand side, there was no equivalent to replace military procurement of R&D services and high-technology products from public laboratories and enterprises, and these were ill-prepared to supply such services and goods in the context of a market economy. The attractiveness of academic careers diminished as earnings decreased drastically as compared to the new opportunities arising during transition to a market-based economy and the pervasiveness of rents in Kazakhstan's economy. This led to an important "brain drain" from the research sector, with many leading scientists moving to research institutions abroad or to more lucrative positions in the domestic economy. This loss of talent affected both PRIs and the universities, which struggled to build the capacity to fulfil their new role as research-performing organisations. In parallel, educational standards in schools and universities, especially in engineering and the natural sciences, declined.

At the beginning of the 2000s, the government started to gradually increase the national R&D effort and initiated major legal reforms, strategies and programmes, resulting in profound changes of Kazakhstan's higher education and research system. The number of institutions increased strongly as many private universities were established, without an adequate system for accreditation and quality assurance. After this period of quantitative expansion, the last decade saw stronger emphasis on the quality of the delivery of educational and research programmes. Consolidation resulted in a significant decrease in the number of universities. Accreditation, quality assurance and the introduction of national rankings led to withdrawal of licences from low-quality private institutions. Although there is no systematic evaluation of Kazakhstan's higher education system, the fact that less than half of the 125 universities are accredited indicates that higher education is still in a process of normalisation and that further reforms are needed.

The government has made significant effort to structure the university system according to what can be seen as "labels of excellence": at the top of the pyramid is Nazarbayev University, which is endowed with unprecedented financial and human resources while ten planned research universities are expected to constitute the second tier in the future. Nazarbayev University was created in 2011 following the model of the world's most prestigious universities. It is intended not only to become a world-class research and education institution but also to act as a "role model" for other universities. The creation and ambitious development of Nazarbayev University is an initiative of central importance as shown by the key role it was assigned in achieving the government's objectives in all recent strategies and development plans. While the results in terms of publications, patents and, especially, start-ups are slow to emerge as the university was created almost *ex nihilo*, Nazarbayev University has already built new

structures and implemented new initiatives supporting science-industry co-operation and innovation that provide inspiration for other parts of the higher education system. However, the size of the funding gap between Nazarbayev University and the other leading institutions, including other leading universities, is such that the latter may find it difficult to replicate the pioneering practices of the former.

The recent mergers between universities and between universities and PRIs, and the resulting reorganisation of their educational and research activities (pooling of resources, specialisation, etc.), have the potential for strengthening some of these institutions. These restructurings are largely top-down initiatives, which will have to be taken up and implemented by the institutions involved. International experience indicates that there are multiple challenges which have to be overcome before intentions are turned into success and reflected in the institutions' performance.

The research institute sector also underwent significant reform. In the Soviet era, all research activities were concentrated in institutes of the Academy of Sciences and industrial research institutes. Some of them operated in "big science", related to space and defence projects, others were industry-oriented, developing new technologies for specific industrial sectors. After independence, the institutes of the Academy of Sciences were reorganised under the Ministry of Education and Science. Industrial research institutes were attached to different ministries. They are still numerous today and receive a substantial part of public funding for R&D. However, their share in resources is in stark contrast with the very limited information available on their activities, structures and, especially, performance.

Universities have gone through important transformations but performance is still low by international standards

Faced with the objective of becoming research institutions, Kazakhstan's leading universities have significantly changed in structure and practices. One key challenge is related to the management of human resources, both in quantitative and qualitative terms. On the qualitative side, it proved very difficult for an ageing staff – which had until then been confined to teaching – to engage in research and get acquainted with the operation of competitive funding schemes. Universities tried to recruit, as far as possible, personnel from PRIs as well as young researchers which were in short supply. On the quantitative side, new rules had to be set for the allocation of staff time between education and research activities, as well as with extra-university occupations that many teachers are taking up to compensate for low wages. Due to the absence of institutional funding for research at universities, the solutions were often ad hoc, depending to a great extent on researchers' success in attracting competitive funding, in particular grants of the Ministry of Education and Science. Successful researchers decide on the allocation of their time, and in some cases buy some time out of teaching with parts of the grant. This system has contributed to a situation where only a small fraction of the personnel performs significant research activities. The completion of the transformation of universities into research-performing organisations calls for a shift towards a funding model which reduces teaching obligations and leaves sufficient time for research. However, the increase in research capacity resulting from this reallocation of time will hardly be sufficient to tackle the transformational challenges faced by universities. The number of staff employed in R&D in higher education institutions (HEIs) and PRIs is lower than in most comparable countries. Achieving a gradual but significant increase of the research staff will require additional resources.

Universities have introduced incentives for their staff to engage more actively in research and, this way, initiate a virtuous circle of investment and successful applications in competitive funding schemes. The first type of incentives introduced consisted of potential salary increases and top-up related to successful applications. More recently, the government has included publications in impact-factor journals as criteria for academic promotion and career development. To accompany this process, researchers can now access bibliometric databases, and resources have been dedicated to improve the monitoring of researchers' performance. This type of incentive structure has impacted on staff remuneration and, in other cases, led to contract termination or teachers leaving their academic institutions. Some university personnel encountered difficulties due to a lack of time, funding, up-to-date equipment and necessary knowledge and transversal skills, including English language proficiency. At the same time, this incentive had positive effects on the scientific performance of those who did manage to fulfil the requirements. It also helped spread a research culture in the institutions concerned and led to active strategies by researchers to fill knowledge gaps through training and international co-operation. However, the prominence of bibliometric indicators in individual staff evaluation at the expense of other criteria such as partnerships with industry or consultancy services, result in researchers overlooking these knowledge transfer activities which are dearly missing in Kazakhstan. Moreover, these measures are hardly sufficient for strengthening the research capacity at institutional level. In order to bring Kazakhstan's universities to an internationally competitive level, substantial investments are required to upgrade and modernise research equipment and libraries. Proficiency in English is indispensable and cannot be compensated by editing or translation services.

The internationalisation of universities is essential to support their transformation. Kazakhstan's universities have for a long time engaged in many bilateral and multilateral initiatives to interact with their counterparts abroad. However, competition is also the norm when it comes to building linkages with the best foreign institutions or being taken on board of the strongest applications in, for instance, European programmes. Also, initiating a partnership is only the beginning; turning this endeavour into success will depend on the institution's ability to deliver according to plans and on its absorptive capacity in order to benefit from, and preferably also disseminate, the knowledge generated in a collaborative project.

Among the nine universities present in international university rankings, four have significantly improved their position in recent years. Having reached levels close to the ranks of some known European universities (such as the universities of Bonn and Loughborough) is a remarkable achievement for these few universities, considering the resources available to them. The vast majority of universities, however, are still in a process of transition from their former role of teaching institutions towards modern institutions integrating education, research and innovation activities.

Changing the funding model of universities

Apart from the problems rooted in established structures and practices, PRIs are confronted with a severe lack of financial and human resources. Achieving the ambitious goals set by the government for its public research system by 2020 will require changes in both the volume and type of public funding.

The amount of funds allocated to universities is extremely low by international standards. Despite the fact that the number of universities has been reduced in recent years, they are still numerous and funds per institution are very low. Moreover, in

contrast to international experience and recent trends, there is almost no basic funding for research. Currently, a small annual institutional funding only covers the cost of some scientific infrastructures and property as well as some other indirect costs. The bulk of university research is therefore financed through competitive schemes. Although there is no "optimal ratio" between competitive and non-competitive funding for university research, and competitive funding has been gaining in importance, OECD countries do have substantial basic funding. Moreover, the very low level of block funding in Kazakhstan appears remote from what seems to be necessary for achieving the ambitious goals set in government strategies, programmes and for transforming the country towards a knowledge and innovation-based society. International experience suggests that a certain level of institutional funding is essential to provide universities with: 1) a continuity and stable basis for planning, which is of particular importance for basic research, and for building and maintaining research infrastructures in particular; 2) strategic resources enabling universities to invest in new fields, themes and research methods up to the point where they can credibly persuade third-party funders to support their work; 3) the necessary financial autonomy that enables all academics to shape their research agendas and pursue a minimum level of "free" research. The need for strengthening domestic research capacity calls for an increase of non-competitive, pluri-annual resources dedicated to university research. In order to allocate these resources efficiently, adequate monitoring, including of outputs and results, as well as *ex post* evaluation mechanisms at institutional and individual levels need to be put in place.

Moreover, there is some evidence that the competitive grant schemes are suffering from structural problems that affect their performance. In particular, the Ministry of Education and Science's competitive research scheme tends to finance a large number of very small projects led by individual researchers or small teams. In addition, a majority of grants were awarded in the "Intellectual Potential" theme. The link of this theme to national priorities remains unclear as it mixes very different projects related to fundamental and applied research in the social sciences and the humanities and fundamental research in the natural sciences.

The World Bank Technology Commercialisation Project launched in 2011 has played an important role in providing additional opportunities for research teams to make scientific progress and commercialise their results. The selected projects benefited from unprecedented amounts of funding and non-financial support for conducting their research and valorising their results. Moreover, the World Bank project served as a real-scale demonstrator for developing a competitive, problem-oriented model for research funding which fulfilled high international standards while at the same time being user-friendly and not too complicated and burdensome for applicant scientists. However, insufficient direct participation of Kazakhstani public authorities in the governance and implementation of the project has reduced the scope and depth of the dissemination of these good practices in the relevant administrations. The extension of the Technology Commercialisation Project into a next programme phase announced in 2015, with more hands-on participation of national policy makers, would provide an opportunity to build on and extend these accomplishments.

Main recommendations - research capabilities

- Evaluate the PRIs' missions, activities, results and governance.
  - Enable those assessed favourably to develop their strengths by complementing their own revenues through a healthy mix of competitive and institutional funding, subject to regular evaluation.
  - For the remaining institutes, consider other options, including their merger, downsizing or discontinuation, if required.
  - Use these assessments to identify potential collaborations with universities.
- Gradually increase the level of institutional funding for research at universities and PRIs.
  - Consider including a performance-based component taking into account indicators related to research excellence and knowledge transfer, in line with the respective missions of universities and PRIs.
  - Support this initiative with adequate mechanisms and information systems to monitor inputs, outputs and results, as well as *ex post* evaluation mechanisms at institutional and individual levels.

Other recommendations

- Ensure sufficient consultation with universities and PRIs on challenges and opportunities of structural reforms (mergers, partnerships, etc.) of the HEI system.
  - Support the creation of a group of universities and PRIs to exchange good practices on how to handle structural reforms.
  - Participate in the activities of this group and allow an efficient dialogue between public authorities and the reformed organisations.
- Encourage the linkages between universities and PRIs in research and education while ensuring clear and distinct missions of these institutions.
  - In education, collaborative activities could take the form of joint formation of advanced human resources (PhD programmes and training).
  - In research, PRIs and universities could engage in research collaboration and share equipment. In certain priority areas, partnerships could extend to participation in joint research centres to reach critical mass and expand the scope of competencies from basic research to development and test with industry.
- Ensure synergies between Nazarbayev University and the other leading universities in Kazakhstan.
  - Support interactions and promote actual research and innovation partnerships between these institutions.
- Launch a thorough external evaluation of the NCSTE and NATD grant schemes supporting research and innovation in research-performing organisations and enterprises.
  - Assess their scientific and technological impacts and the extent to which they fulfil the needs of beneficiaries and with respect to national objectives.
- Make the development of human resources and skills for research, technological development and innovation a top priority.

3. Intensifying and broadening support to knowledge transfer in research-performing organisations

The traditional "linear" model of the research and innovation process is inadequate for knowledge transfer

The legacy of the Soviet university system still has considerable bearing on the quality and range of universities' output. This holds true for research outputs in the form of publications but also for the commercialisation of research results through patent licensing and other forms of knowledge transfer, such as the creation of start-ups, partnerships with innovative firms or the mobility of skilled personnel between research institutions and these businesses. Several promising initiatives for knowledge transfer are ongoing at universities. However, the "linear" model of knowledge transfer prevalent in Kazakhstan has clear limitations. It involves a series of distinct steps, from basic research and applied technology, to design, development and production, with little consideration of interactions and feedback loops, which are actually essential to its success. The relationships between science and industry, although increasing and improving, are still weak. Most universities are not well-acquainted with the task of collaborating with industry on innovation. In return, many business firms – partly because of their limited absorptive capacity – do not see universities as sources of useful research results or as trustworthy and promising partners for contract or collaborative R&D. As a consequence, there is little or no "technology pull" from the demand side. Companies which do get in contact with universities or PRIs often do so at a rather late stage. Linkages between universities, as well as between universities and PRIs, are still insufficient. The two actors are acting to a great extent separately, although there is now significant restructuring taking place to bring them closer. Kazakhstan would benefit from bringing its practices in line with modern approaches which pay attention to the fact that close collaboration between university and industry, "open innovation", co-creation and co-development practices are necessary to develop new products and services that respond to current and future market needs.

Since the early 2000s, the government has not only initiated bold structural reforms of the public research system and stepped up its financial effort, it has also put increased emphasis on qualitative aspects of the output and impact of research. Greater autonomy has been granted to HEIs. Provided they can secure the necessary resources, they are now entitled to build their valorisation infrastructure, in the form of incubators, science or techno parks, entrepreneurship programmes, mobility schemes, partnerships with industry, etc.

However, when attempting to commercialise their projects, research-performing organisations are still faced with challenges, some related to the excessive bureaucracy, some partly related to a continued lack of autonomy, as well as limited managerial and entrepreneurial skills of researchers.

The dissemination of good practices is an underutilised source of learning for research organisations and public authorities in charge. Universities such as KazNU Al-Farabi and Kazakh National Research Technical University (KazNRTU) Satpayev are already successful in research commercialisation. And the Nazarbayev University Research and Innovation System (NURIS) and the Alatau Park of Innovative Technologies (PIT) are promising experimental initiatives which will serve as national benchmarks, if successful. Overall, there is a wealth of initiatives, but their impact is

limited by the absence of systematic connections and interactions between them, a lack of visibility and adequate funding.

Support to the commercialisation of research results has increased but has yet to bear fruits

The government's strategies and development plans show a growing emphasis on the transfer and valorisation of public research results since about 2010. Several public support initiatives to strengthen commercialisation capabilities have been launched in recent years. Twenty-six research commercialisation offices were established at universities with the support of the innovation agency (NATD) and in the course of a World Bank project. The commercialisation offices at universities had mixed success, and expectations of becoming self-sustained in a very short period of time turned out to be unrealistic. As international experience shows, expectations of short-term success can be counterproductive. In Kazakhstan this led many of these offices to close down or carry out activities at a minimum level. The World Bank project led to some promising research results attracting interest from industry. However, its more transformative effect on the system of research and innovation, i.e. beyond the project grant beneficiaries, remain to be confirmed.

The leading universities themselves, in co-ordination with the Ministry of Education and Science, have set up intermediary organisations to support knowledge transfer through new processes, entrepreneurship and innovation management courses for master and doctoral students, and new channels to transfer knowledge and engage with business firms, such as new departments and internal organisations such as incubators and science parks, etc. However, even the most elaborate of these endeavours are hampered by resource constraints, unstable government support, and the limited innovation experience of support staff in university departments and intermediary organisations supporting commercialisation in research organisations.

Knowledge transfer is broader and more diverse than research commercialisation in traditional technology transfer offices

It is essential that technology transfer offices (TTOs) not only focus on promoting commercialisation through patenting and licensing but, even more so, that public support to the commercialisation of publicly funded research goes beyond TTOs. Other channels of technology transfer play an equally, if not more important, role. These include public-private collaborative research, student and faculty mobility, contract research, faculty consulting, and student entrepreneurship. Many governments have set up dedicated schemes to promote researcher mobility, for instance.

Some countries have experimented with new approaches to promote knowledge transfer, for instance the establishment by universities and PRIs, in complement to government funding, of their own proof-of-concept and seed funds. These are particularly important to close funding gaps in countries like Kazakhstan where venture capital focuses on later-stage, "lower-tech" deals. Other universities have sought to reform their TTOs or to create new models such as technology transfer alliances (TTAs), which bundle the resources and standardise the practices of some TTOs, Internet-based models, for-profit models or the "Free Agency" model.

Since many countries, including Kazakhstan, suffer from both a limited flow of research results for valorisation and a lack of demand from domestic companies, governments have supported research commercialisation from both ends, i.e. not only the supply but also the demand of research results. Several new and ongoing instruments share the common objective of creating demand for public research, using public-private partnerships, innovation vouchers and joint academia-industry initiatives/centres.

Main recommendation - knowledge transfer

- Intensify and broaden the support to knowledge transfer in research-performing organisations.
  - Structure interactions between universities to ensure exchange of experience and co-operation in the area of knowledge transfer.
  - Evaluate capacity and needs with regards to knowledge transfer in universities and PRIs.
  - Ensure the diversity of knowledge transfer channels by striking a better balance between intellectual property-based technology commercialisation and other channels, such as R&D collaboration and contract research for industry, training, technology extension services, two-way mobility of researchers or joint PhD programmes.

Other recommendations

- Develop universities as regional hubs for knowledge management and innovation and facilitators of regional innovation ecosystems.
  - Put in place specific business demand-driven support and mechanisms for universities to offer R&D services to enterprises, including SMEs (e.g. innovation vouchers for companies to purchase such services, dedicated platforms to host interactions, databases of experts from universities, etc.).
- Ensure the sustainability of the "business model" of knowledge transfer organisations.
  - Assess their financial needs and their portfolio of commercial and non-commercial activities.
  - Provide longer term funding for their non-commercial activities and monitor their performance against a realistic set of targets (not only intellectual property related).
  - Support the capability enhancement of the staff of these organisations.

4. Investing in and delivering on education and skills[1]

The quality and equity of the tertiary education system requires continued attention

A legacy of the Soviet era was a comprehensive and well-developed system of education which, at almost universal literacy, provided the country with a well-educated labour force. However, educational standards in schools and universities deteriorated, especially in engineering and natural sciences. Although educational performance in schools has improved in recent years – as shown by the 2012 OECD PISA survey – Kazakhstan still lags behind the OECD average. Research also shows that schools prepare

pupils only imperfectly for their future integration in an economy. This is partly due to the academic and superficial type of learning they receive, which does not provide them with the skills needed to deal with real-life situations, and to low levels of public expenditures on education.

In tertiary education, the enrolment rate dropped, partly due to demographic developments. PhD programmes are affected by structural problems which limit their attractiveness. These include low remuneration, restrictive conditions, and the balance between students' research work and other university occupations. As a result, the overall number of doctoral researchers in Kazakhstan has increased, but remains low by international standards. They are not in line with what is needed to supply the research system with new skilful talent.

The quality of tertiary educational programmes is a major issue. Kazakhstan has to pay attention not only to technical but also to transversal skills, i.e. literacy, problem solving, teamwork and adaptability. These skills are crucial for innovation development and social well-being. The issue of equity of access to affordable higher education is also an important challenge. It needs to be addressed, for instance, via competitive student loan programmes, improvements of primary and secondary education quality and technology-enabled learning, and better linkages between vocational education and training.

Technical and vocational education and training (TVET) is essential to complement schools and universities in developing the specialist skills which Kazakhstan needs for its economic development and shift towards more innovation-driven growth. However, over the past years the number of students enrolling in TVET has decreased. There are also concerns about poor co-ordination and interaction between TVET schools and business, and about poor quality assessment and certification processes. The measures to encourage enrolment through a free tuition scheme recently announced by the government are laudable but will have to be complemented with reforms of the organisation and overall governance of the TVET sector.

Universities have undergone a comprehensive reform of their educational activities but still suffer from limited resources and autonomy

During the last decade Kazakhstan has made important efforts to improve the governance of HEIs and provide them with more flexibility to strengthen the quality of their tertiary education programmes. HEIs have become more independent in principle but in practice are still subject to centralised command-and-control by public authorities, characterised by cumbersome financial regulations and limited academic and organisational autonomy. Public funding for higher education, which mainly consists of state grants, is relatively low and often does not adequately address fundamental weaknesses of the higher education system. The reforms in this area are very challenging, but would be key for the system's overall progress.

Kazakhstan has made impressive strides towards the internationalisation of its tertiary education system but important obstacles remain

Since independence, Kazakhstan has made huge progress in internationalisation, especially thanks to the Bolashak scholarship programme. This programme enabled the emergence of a new generation of scientists and managers. They are motivated, ambitious, with a growing entrepreneurial and international mindset which is necessary to overcome the inertia which can still be found in some places. However, obstacles such as

limited academic autonomy and quality gaps still limit the number and the interest of foreign institutions in building partnerships or joint programmes with Kazakhstani universities. In order to improve the situation, a whole-of-government approach that aligns the effort with broader development goals is needed, as well as additional efforts to encourage collaboration across HEIs, broader use of digital technologies to expand in-country "internationalisation through the curriculum".

Finally, limited command of English is considered to be a major barrier for awareness about international developments, for co-operation and mutual learning with international partners, and efforts towards becoming members of global research and innovation communities. In that respect, the three-language policy (Kazakh, Russian and English) initiated in the frame of the Kazakhstan 2050 strategy is very promising.

Main recommendation - education and skills

- Focus on developing the basic skills, knowledge and competencies of students which prepare them to integrate in rapidly changing and global markets.
  - Ensure better linkages between classroom instruction and work experiences.
  - Increase the interactions between HEIs and the business community, for instance by systematising the involvement of business in the development of curricula.
  - Improve the system of labour market information that reports on the outcomes of higher education graduates, and use this information to steer the reforms of the curricula and teaching practices in schools and universities.

Other recommendations

- Broaden the access to technical and vocational education and training (TVET) and improve its quality and relevance to industry needs.
  - Further develop mechanisms that widely recognise and provide credit for VET qualifications.
  - Promote and reinforce the attractiveness of TVET (including through government communication campaigns).
  - Reinforce the relationship between vocational and higher education (including by creating pathways for students between the two systems) as well as between TVET and the labour market (better integrate labour market actors and employers in the governance and operation of the TVET system).
- Further decentralise the governance of higher education, with greater financial, academic and organisational flexibility and freedom for the operations of HEIs.
  - Enhance the autonomy of HEIs by reducing the level of financial regulation and control by central authorities and increasing academic freedom to engage in international partnerships and joint programmes.
  - Enhance the academic quality of HEIs with increased autonomy by developing and implementing a robust system of accreditation and a national qualification framework.

Other recommendations (*cont.*)

- Take a whole-of-government approach to international higher education to enhance and diversify the international experiences of Kazakhstani students.
  - Expand the current international scholarship scheme and introduce new forms of financial support for study abroad.
  - Disseminate good practices of successful national institutions (Nazarbayev University) and programmes (Bolashak scholarships).
  - Establish internationally comparable indicators on mobility at student, programme and institutional levels.
- Establish a task force to increase the capacity and attractiveness of the PhD pipeline and postdoctoral career paths.
  - Engage the HEIs in the task force to ensure implementation.
  - Review the requirement of new PhD graduates to serve in the national administration for a certain number of years.

5. Strengthening business innovation

Upgrading and diversifying the economy requires more innovation

Kazakhstan's economy is in need of upgrading and diversification. Its industry heavily depends on primary products, especially oil, gas and minerals, and agricultural commodities, and the high value-added segments in services and the small manufacturing sector are very limited. Low productivity in most industries outside the extractive sector points at a high potential for catching up. While the manufacturing sector has experienced some upgrading of its exports in recent years, this has had little effect overall due to the minor role of this sector in the economy. At the aggregate level, the analysis of the structure of the export product basket shows that Kazakhstan has not yet been able to integrate global value chains (GVCs) with a more diversified portfolio of increasingly complex products. There are indications that its capacity to diversify its production structure through technology upgrading has declined steadily and significantly since the 1990s, while that of most relevant comparable countries but the Russian Federation has remained stable.

The agricultural sector, too, presents opportunities for upgrading. Several initiatives are aimed at improving the productivity in this sector, in particular through extension services put in place by the Ministry of Agriculture. Some new experiments in that field originate from non-governmental organisations. Their results could be used and disseminated to improve the more traditional public training programmes.

Reallocation of resources from the agricultural sector has mainly benefited the service sector, which accounts for a far greater share of employment and gross domestic product (GDP) than manufacturing. However, unlike other emerging economies, labour force reallocation had a limited impact on aggregate productivity as the service sector is dominated by low-productivity service industries. Despite the recent growth and rise of productivity of industries such as the financial and insurance services, the share of employment in knowledge-intensive services remains far below that of developed economies. This has consequences beyond the service sector, as the development of

services of higher productivity and knowledge content supports the upgrading of other sectors (including manufacturing) and is facilitating countries' participation in GVCs. Currently, few Kazakhstani firms are integrated in GVCs which have been a key enabler of export-driven growth (in manufactures) of successful emerging economies, notably in East Asia. GVC integration has also been an important source of learning through forward and backward linkages, which some countries were able to tap into very successfully by upgrading their skills base and innovation capabilities. Failing this, other countries became locked into low-value added segments of GVCs.

Business investment in research and innovation is insufficient for transformative upgrading

Kazakhstan's industry is largely composed of very small private firms, characterised by low productivity, little innovation activity and a concentration on the domestic market. Large state-owned enterprises, which still contribute a high share of GDP despite waves of privatisations, have some internal research capacity, in particular those active in the oil and gas, mining, energy and telecom sectors. The sovereign wealth fund Samruk-Kazyna (SK) which holds many of these enterprises in its portfolio has introduced management tools to incentivise, monitor and, when relevant, bundle their research and innovation activities. However, the innovation efforts of these enterprises alone are not sufficient to generate sustained growth at the level of the economy. The intermediary segment of medium-sized enterprises, which in some advanced countries plays an important role in the national innovation capacity, is very small in Kazakhstan. This illustrates that the business community has experienced little success of small firms growing by improving their product and process and conquering markets abroad.

The business sector in Kazakhstan accounts for a lower (and less stable) share of total research activities than other upper middle-income countries. Given the limited number of partnerships with public research organisations it is also a less important source of funds for R&D than in most comparable countries. More broadly, levels of both business innovation inputs and outputs are comparatively low in absolute terms. The dominant form of innovation is non-R&D based, mainly related to the purchase of advanced machinery and equipment from foreign suppliers. The acquisition of external knowledge and machinery still represents one of the main opportunities for technological upgrading. Although knowledge embedded in equipment has been instrumental to fuel the development of many emerging economies before in some cases endogenous innovation capabilities took over, Kazakhstani firms tend to choose turn-key technology, which requires little adaptation, offers less opportunities for learning (beyond mastering processes) and therefore has limited potential with respect to upgrading domestic innovation capabilities.

Another characteristic of the innovation effort of Kazakhstani firms is the fact that product and process innovation is rarely complemented by management and marketing innovation. New markets, however, can only be entered successfully if new products are marketed in efficient and innovative ways. The lack of emphasis on non-technological innovation in Kazakhstani firms can to some extent be ascribed to the very limited role of this kind of innovation in the former socialist system and a neglect of associated skills lack informal education. Creating awareness of and strengthening capabilities in these kinds of innovation in management training and providing support for their adoption would increase the opportunities for firms to enter new and more sophisticated markets.

High obstacles to innovation result in low innovativeness of firms

Although slightly increasing, the share of innovative firms in Kazakhstan is very low by international standards and business innovation capabilities are very limited. According to firm perceptions, weak demand for innovative products is the most important obstacle for innovation. Available case studies indicate that the public sector is frequently involved to some degree as a direct or indirect customer of innovative products. Private demand is not yet a powerful driver of innovation, which implies that firms are not exposed to strong market signals. Consequently, the awareness of industry managers with regard to innovation opportunities is limited.

Another important obstacle is the limited availability of funds to finance research and innovation. Firms seem to face constraints in accessing external financing for innovation. Some of the reasons are asymmetric information, the underdevelopment of financial markets, the focus of venture capital on later-stage investment and the low propensity of banks to finance risky projects.

While financing young, innovative firms is a key issue of innovation policy in every country, it is especially the case in Kazakhstan given the limited availability of funding instruments provided by market actors. Kazakhstan is characterised by its very limited availability of early-stage finance, resulting in minimal transactions for early-stage and technology-based companies. Kazakhstani policy makers realised early on that suitable financing of start-ups is key for creating and maintaining an innovative economy and have therefore supported the emergence of several venture capital and private equity funds. However, the vast majority of projects in the portfolio of these funds relate to the expansion or modernisation of existing firms operating in relatively low-tech manufacturing.

Several reasons for this "funding gap" pertain to inadequate framework conditions, from the lack of experts with a working knowledge of the functioning of these markets and the limited number of strategic investors to the minor role of stock markets in providing exit options for potential investors.

However, Kazakhstan is also struggling with a weak flow of potential projects which, as discussed earlier, finds its roots in a limited number of research results developed in collaboration with – and therefore suited to the needs of – industry. Potential "deals" deriving directly from the industries and services are also small in number due to the still underdeveloped entrepreneurship culture and support infrastructure, despite an increasing number of courses in universities dedicated to would-be entrepreneurs.

The effectiveness of R&D incentives and requirements is limited by design flaws that could be easily corrected

Fiscal R&D incentives address one of the major weaknesses of Kazakhstan's national innovation system: the low propensity of business firms to commit resources to research and innovation activities beyond the purchase of new equipment. To complement tax incentives to attract investment, in particular foreign investment (e.g. exemptions from customs duties on imported equipment or a tax holidays), specific measures such as tax credits and tax exemptions were therefore introduced to specifically promote innovative business investment.

The introduction of fiscal incentives for R&D in Kazakhstan is in line with the observable trend in innovation policy. Over the past decade, the availability, generosity and accessibility of incentives for R&D, in particular R&D tax credits, have increased in

the OECD area and beyond. As regards Kazakhstan, no quantitative information, let alone evaluation, is available on what type of firms benefit from the R&D tax credit, what its total cost is for the state (mainly foregone revenue but also administrative costs), and what effect it has in terms of additional firms' R&D expenditure and innovation and, in the long run, economic performance. However, it appears that so far few firms are able to benefit from this scheme in Kazakhstan. Efforts have been made to better specify the R&D tax deductions. But there still seems to be a lack of clarity on some conditions and the definition of eligible expenses which contribute to the administrative burden of using the incentive. The tax credit excludes capital expenditure and external R&D acquired from firms for which research services are not the main activity.

The 2012 amendment to the Law "on Subsoil and Subsoil Use" requires subsoil users to invest 1% of their annual income in internal or external R&D.[2] This regulation could, in principle, contribute to achieving Kazakhstan's diversification objective, by reallocating parts of the rents accruing in the extractive sector to financing the research-based development of this and other sectors of the economy. However, the restricted flow of projects originating from research organisations or other companies proves here also to be an important limiting factor, together with various legal uncertainties and design flaws similar to those that affect R&D tax incentives and exemptions. Consequently, despite the lack of data, the available evidence suggests that the amount of funds channelled from extractive industries to R&D has been far below the expected "1% of extractive industries income". Moreover, it seems that the "forced" investment of subsoil users has naturally favoured research projects related to extractive sectors, in stark contrast with the priority to use innovation to support the diversification of the national economy. Similar schemes have been put in place in resource-rich countries such as Brazil, Colombia and Norway. They offer important lessons for a successful implementation, in particular the need to define the rules very precisely and apply them in a consistent and transparent way, and the importance of monitoring and evaluation.

Combining technical and financial support is key for improving innovation capabilities in firms

The authorities have progressively expanded the portfolio of instruments to support innovative small and young firms. The national innovation agency, the NATD, managed several of these schemes, in particular a set of nine grants responding to very precise needs faced by small firms when engaging in innovation projects. However, in practice only a few firms have benefited from these instruments, to such an extent that their impact on the upgrade of innovation capabilities can only be negligible. Policy makers and the NATD reacted to these problems by reforming significantly the grant system, including by introducing co-financing, cutting the administrative burden, easing sectoral restrictions and speeding up the process. Furthermore, the consolidation of grant types from nine to three will most likely increase take-up in future calls for applications.

The recently introduced the JSC Entrepreneurship Development Fund (DAMU) grants complement the NATD grants by reaching out to smaller firms across the country. These small grants can provide important support for incremental innovations which can contribute a lot to competitiveness. An interesting feature of this programme is that it is linked to business training and other services provided by DAMU.

Four industry design bureaus offer to companies, including low-tech ones, a wide range of services to support their attempts to introduce new products. As for several other support schemes, one limitation lies in the scale and scope of this initiative. The

four centres have, up to 2016, conducted less than 20 projects. Additional uncertainty was created by the NATD announcement in 2015 that these design bureaus will be privatised. In many countries, technology extension service organisations of different types have been set up to respond to the need of domestic companies which, in most cases, represent a vast untapped potential to mobilise. These international experiences suggest that such organisations necessitate some public funding, under the form of annual funding for them and innovation vouchers for their beneficiaries, since a significant share of their activities has the nature of a public service. Another notable lesson learned from these services is the role that universities and PRIs close to industry can play to offer diagnostics and solutions to companies in order to address specific innovation-related problems.

The limited scale and scope of these programmes reflects the previously discussed factors behind the weak flow of innovative projects. Innovation policy tools themselves could aim at increasing the deal flow by linking financial and technical support to build up innovative capabilities and absorptive capacity. Indeed, the DAMU network and World Bank programmes are good examples for steps forward in this direction. Such an approach could be extended to several innovation policy tools.

Main recommendation - business innovation

- Ensure that the Subsoil User R&D requirement is functioning properly, channelling the expected amounts of funds towards R&D generating high returns to society, including outside the extractive sector.
  - Complete the regulation with the necessary bylaws.
  - Monitor and enforce the regulation.
  - Review eligibility conditions that apply to external R&D.

Other recommendations

- Ensure the sustainability of intermediary organisations dedicated to supporting business innovation.
  - Avoid unrealistic expectations of short-term success and “return on investment”.
  - Start initiatives only when a sufficient amount of resources is secured.
- Evaluate and improve the leverage effect of the R&D tax deduction and exemption, following international best practices.
  - In particular, review the underlying definition of R&D, the exclusion of capital investment related to R&D, the rules concerning the deduction in case of unsuccessful innovation, the list of eligible costs.
  - Examine the options for cutting red tape further, including through providing *ex ante* eligibility assessment.
- Enhance the outreach of business innovation support grants.
  - Pursue and monitor closely the effects of the current reforms of the NATD grant schemes and procedures.
  - Combine financial and technical support in order to allow a sufficient flow of grant applications.

Other recommendations (*cont.*)

- Enhance monitoring and evaluation of the effects of the grant schemes (including the profiles of beneficiaries, their needs and challenges, etc.).

- Implement an accessible, effective and coherent set of public support measures designed to best meet the needs of SMEs.
  - Draw upon a network of industry extension services that would provide the hands-on information and expertise needed by low-tech SMEs to upgrade their production technologies and initiate innovation projects.
- Enhance programmes in formal and life-long education that aim at developing basic business, financial and innovation management skills of managers.
  - Enable managers to complement technological innovation with management and marketing innovation to become more competitive in international markets.
- Improve and focus the instruments to finance innovation.
  - Aim at adequate funding for all investments in innovation, including incremental innovation by established firms.
  - Focus venture capital vehicles which receive public funds on their original mission to provide financing to high-tech firms, especially at the early stage, and reach appropriate scale.

6. Improving science, technology and innovation governance

The government has implemented bold reforms to achieve the ambitious objectives set for research and innovation at the highest political level

During the last decade a strong commitment has been expressed at the highest level of policy making to develop a new model of development based on innovation and the recent growth slowdown has reinforced the determination of the authorities to work towards diversifying the economy. The priority the President and the government of Kazakhstan are giving to strengthening the country's innovation system is demonstrated by the significant effort towards developing the legal, strategic and programmatic framework for science, technology and innovation policy. Legislation has been overhauled and developed over the past few years to cover all phases of research and innovation activity, from funding to implementation and commercialisation of research results. A number of challenges persist in the implementation of these laws, which entails a degree of additional uncertainty facing public and private innovation actors. This has, for instance, reduced the impact of the 2012 amendment to the Law "on Subsoil and Subsoil Use". Such problems will require rapid diagnostic and action to solve them.

The government has launched multiannual overarching development strategies, such as the Kazakhstan 2050 strategy. These are bold initiatives which serve as roadmaps for government reforms over the long term. Although they were initially focused on economic and social affairs, they quickly addressed a broader portfolio of actions, including research and innovation policy which has become a priority for the nation. Dedicated research and innovation strategies, such as the Concept of Innovative Development of Kazakhstan till 2020 and the State Programme on the Development of Education and Science for the Republic of Kazakhstan 2016-19, have complemented the

overarching development strategies. While the reform process started soon after independence, important legal acts and most changes in the science, technology and innovation system are of very recent origin. The Law "on Science", which provides the legal foundations for research activities performed at universities and PRIs, was only passed in 2011. Even more recent is the Law on "Commercialisation of Results of Scientific and Technical Activities", which provides the autonomy and incentives for universities to commercialise research; it was passed at the end of 2015. The institutions concerned are still in the process of adapting to these new regulations.

The ambitious objectives set for research and innovation are not matched by actual investment in R&D

The government has set ambitious objectives, including the target of reaching an R&D intensity of 2% by 2020. Despite a significant increase in volume, the low level of R&D expenditures in Kazakhstan, at about 0.17% of GDP in 2014, is in stark contrast with this target. While setting ambitious targets for R&D expenditures can have a mobilising effect, they also need to be realistic and achievable to be credible. Based on the International Monetary Fund's GDP projections, the 2% target implies that gross domestic expenditure on research and development (GERD) at constant price increases by a factor 12 by 2020 relative to the level of 2015. During the last decade, a period of significant R&D effort, GERD increased by a factor of just 3.2.

The achievement of objectives is hampered by weak implementation

The overarching government strategies and related programmes are, in most cases, well designed, grounded in an assessment of the situation, including, for instance, analyses of strengths, weaknesses, opportunities and threats by sector. They all contain precise targets for different points in time and at sectoral/thematic levels as well as on cross-cutting issues. However, some of the targets appear overly ambitious. Other targets are difficult to monitor, by their nature or due to a lack of statistical information. Some key STI indicators are not available for Kazakhstan.

The implementation of the strategies and programmes is negatively affected by an underdeveloped evidence base and a lack of "strategic intelligence" for policy making. For example, a dedicated foresight exercise was conducted in 2010 and its results used in the design of the Inter-sectoral Plan for Scientific-Technological Development of Kazakhstan until 2020 – but in all other cases the strategies and plans have made very limited use of foresight and are still developed top-down. An important lesson from international experience is that research and innovation policy needs time, stability and feedback from "reality" obtained through consultation with stakeholders, monitoring and evaluation, preferably making use of external expertise. In Kazakhstan, monitoring, which is mostly performed internally, focuses mainly on implementation processes and budget allocation, but is rarely extended to address results and impacts. At present, only limited evaluation is provided, most often in preamble of new strategic or programmatic document. Policy implementation would gain from the use of external monitoring and evaluation to assess the success or failure of strategies, programmes and initiatives. The findings of such assessments provide valuable information for improving current and future plans and initiatives. The multiplicity of strategies and plans may also lead to difficulties in implementation and reduces their impact in as far as it blurs main messages and signals.

Another example for the difficulties in implementation is the (previously mentioned) R&D requirement introduced in the Law "on Subsoil and Subsoil Use". Partly due to the lack of adequate bylaws, definitions, weak enforcement and a lack of actors which are able to implement it, this regulation has had little effect on firms' R&D expenditure since it was amended in 2012.

Insufficient horizontal and vertical co-ordination reduces the effectiveness and efficiency of government interventions

There are a number of reasons why the need for better co-ordination has been growing. In recent years, a variety of organisations have been established in support of innovation in Kazakhstan. Other organisations' roles have shifted to the implementation of new priorities for research and innovation. These changes, together with the introduction of new policy instruments – which have in many cases been supported or at least inspired by international good practices, have resulted in a more advanced and complex landscape of STI policy. The multiplicity of strategies and programmes also indicates a strong need for co-ordination and co-operation among and between the main government actors and affiliated institutions.

Bureaucracy and red tape is another factor that reduces the ability of administrations to work together. While funds are scarce, the administrative rules are heavy and very often not in line with the requirements of flexibility, transparency and responsiveness that effective research and innovation policy requires.

While co-ordination appears to be a challenging task for many countries, including in advanced innovation systems, it seems particularly pronounced in Kazakhstan. One reason for this is the absence of an effective inter-ministerial co-ordination body. The planned Council for Technological Development could take the role of co-ordinating the policy actors involved in research and innovation activities, thus ensuring the consistency of plans and adequate division of labour, as well as co-operation, where appropriate. This council has been mentioned in several documents but it seems that it has not been activated so far.

The central government does not take full advantage of subnational authorities to complement and support the implementation of its interventions "on the ground"

Research shows that innovation is a major factor affecting regional economic performance and regional policies and, more generally, "place-based" policies can be instrumental in supporting diversification and growth through innovation. Based on their intimate knowledge of the regional challenges and opportunities and proximity to local actors, public authorities and intermediary organisations are in a favourable position to support non-conventional forms of innovation originating from SMEs, including "low-tech" firms, as well as start-ups and entrepreneurs by offering them customised services. These target groups often require tailored support schemes that combine financial and non-financial (qualitative) measures. Regional authorities are also well-suited to play the role of a facilitator and broker to expand the scope, density, fluidity and sophistication of linkages, networks and other forms of co-operation.

Despite large cross-country diversity, regional governments account for a growing share of public spending on R&D and innovation-related matters in the OECD area and beyond. The situation in Kazakhstan differs from this international trend, at least partly due to the centralised approach to policy making, where all key competencies remain in

the hands of the national government. Although the former 2012 Law "on State Support of Industrial Innovative Activity" committed the subnational authorities (cities, oblast) to "ensure the co-ordination of the implementation of branch programmes in the sphere of industrial and innovative activity within the relevant territory", subnational funds still account for a very low and even decreasing share of total R&D expenditure. Qualitative studies confirm that local and regional institutions in Kazakhstan do not provide sufficient incentives for entrepreneurship and innovation, and therefore do not contribute sufficiently to economic diversification.

Regions should therefore be given a more prominent role to complement the central government "on the ground" in its effort to support innovation actors and their networks, in particular, innovative business firms and intermediary organisations.

Main recommendation - governance

- Improve communication, information exchange and co-operation between the main actors of the innovations system – Ministry of Education and Science, Ministry for Investments and Development, Ministry of National Economy, and sectoral ministries.
  - Consider establishing a dedicated strategic co-ordination body involving high-level representatives of the main ministries, agencies and stakeholders involved in science, technology and innovation policy (or reactivating an established one).
  - Provide resources for this body to operate effectively and ensure that it meets regularly.
  - Provide this body with the authority to coordinate the specific research and innovation strategies and plans in order to avoid the multiplication of redundant and/or conflicting signals.
  - Monitor the actual implementation of the decisions and strategic plans developed by this body and make the monitoring information available to the wider public.

Other recommendations

- Develop a clear plan for the gradual increase of public R&D funding in accordance with the targets set in strategies and development plans.
- Develop domestic capacities for foresight and use them in the policy-making process.
  - Integrate the results of these exercises in agenda setting and strategic initiatives.
  - Ensure wide and active participation of actors and stakeholders.
- Make strategic evaluation an integral part of the policy-making cycle.
  - Prepare legal, monitoring and evaluation frameworks when introducing new support initiatives and ensure relevance to national priorities.
  - Operate new initiatives during a sufficient period of time and carry out *ex post* evaluation before terminating them.
  - Follow principles of good practice in policy evaluation (robustness, independence, transparency, public dissemination of evaluation findings, etc.) and develop an annual evaluation plan.

Notes

1. This last recommendation partly draws on the results of OECD (2017b).
2. Full references for all institutions, laws, strategies and programmes are provided in Annex A.

References

OECD (2017a), *Multi-dimensional Country Review of Kazakhstan: Volume II – In-depth Analysis and Recommendations*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264269200-en.

OECD (2017b), *Higher Education in Kazakhstan*, Reviews of National Policies for Education, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264268531-en.

Chapter 2

Economic performance and framework conditions for innovation in Kazakhstan

This chapter provides an overview of Kazakhstan's macroeconomic performance and framework conditions for innovation. The first section presents macroeconomic developments of Kazakhstan since its independence, with a focus on the period of Kazakhstan's strong growth which extended from about 2000 to the recent slowdown. The second section looks at changes in the production structure and the country's insertion in global trade. The final section addresses the current state of framework conditions as they relate to entrepreneurship and innovation.

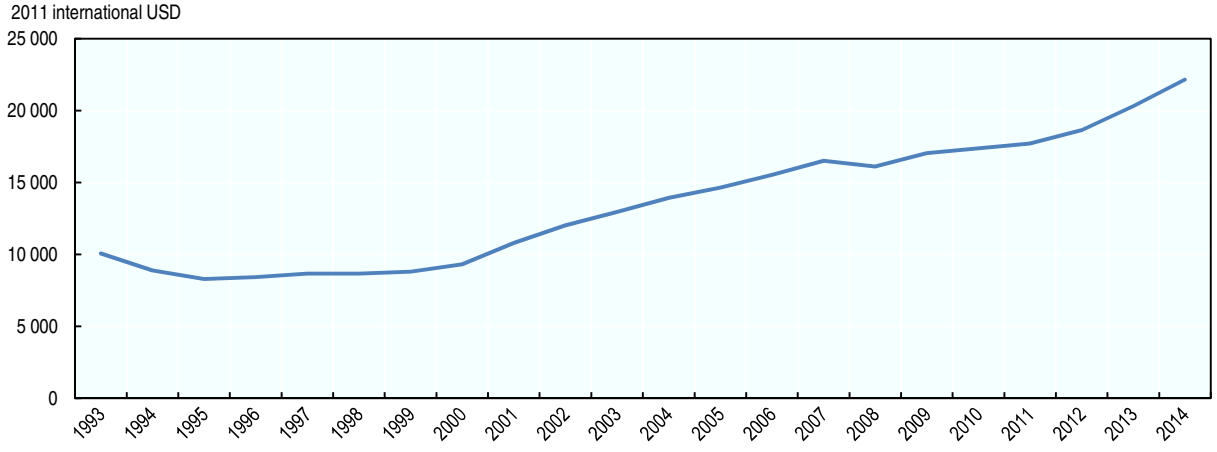
Macroeconomic performance and productivity growth

It is widely acknowledged that success in innovation is a major determinant of a country's macroeconomic performance and overall macroeconomic environment in the long term. In particular, innovation is an important key driver of long-term growth of productivity and aggregate output as measured by gross domestic product (GDP). At the same time, macroeconomic conditions are critical for the evolution of a well-performing innovation system. Sound and stable macroeconomic conditions are important in decisions regarding long-term investment and experimentation, including decisions on research-and-development and ambitious innovation projects. Favourable macroeconomic conditions also facilitate the speed of the diffusion of knowledge throughout the economy, which again depends on high levels of entrepreneurial activity and investment.

Macroeconomic developments

Following the dissolution of the Soviet Union, independent Kazakhstan experienced a large drop in its economic output. As other transition economies, Kazakhstan went through a deep transformational recession. Policy focused on nation building, stabilisation, transition to a market economy, employing shock therapy-type reforms, and promoting foreign direct investment (FDI) between 1990 and 1993 (Cohen, 2008). The large drop in output and rampant inflation led to a lack of resources to fund government initiatives and reinforced the withdrawal of the state from the economy. Following that period, the economy finally began to stabilise in the mid-1990s. It was under these conditions that the Kazakhstan 2030 programme was announced in 1997. This strategy contained a long-term vision for the future development of Kazakhstan. In addition to national security and political stability, it emphasised economic growth based on an open market economy with limited government intervention, oil and gas exports, and the development of transport and communication infrastructure (Akorda, 2016).

Figure 2.1. **Gross national income per capita in Kazakhstan**



Source: OECD (2016a), *Multi-dimensional Review of Kazakhstan: Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on World Bank (2015a), *International Comparison Program* (database), http://icp.worldbank.org.

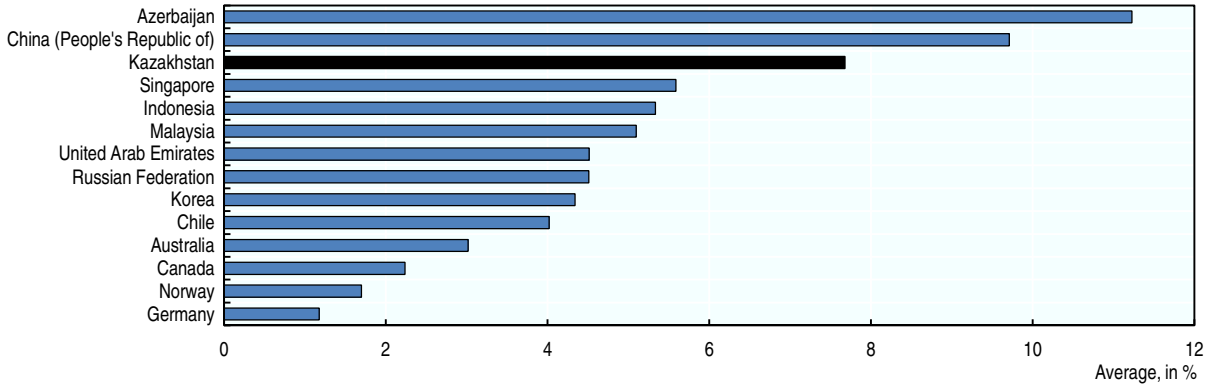
However, soon after the announcement of the Kazakhstan 2030 programme, the country was affected by the 1998 Russian financial crisis; nevertheless, Kazakhstan's economy started to grow vigorously after it rebounded, mainly driven by the boom in oil and gas production and related price hikes. Growth in gross national income (GNI)

accelerated at the turn of the millennium. As a matter of fact, GNI per capita doubled between 2000 and 2015 (Figure 2.1). Economic growth generated unexpectedly large resources, which became available for financing a more activist and strategically oriented industrial policy. Government-owned firms, which accounted for more than 50% of GDP, were consolidated into the Samruk and Kazyna holdings, and investment funds were created by making use of increasing commodity revenues. The state initiated large projects, the most prominent of which was the development of the new capital, Astana, which took off at a high pace. Numerous institutions were created to facilitate this policy, including development institutes and special economic zones (Pomfret, 2014).

As many countries around the world, Kazakhstan was affected by the global financial and economic crisis of 2008-09. Unlike others, Kazakhstan weathered the crisis well and rapidly returned to a path of GDP growth. However, the financial sector was hit hard in the aftermath of the crisis. The share of non-performing loans increased from about 3% to 30% between 2007 and 2011 (The Global Economy, 2016). This development was accompanied by a drop in lending and high interest rates for private firms, curtailing the growth of many smaller firms. The recent fall in commodity prices seems to have had a pronounced negative effect on economic growth.

In a long-term perspective, Kazakhstan has been among the best-performing economies in terms of average real GDP growth during the period 2000-14 (i.e. before the recent growth deceleration reached its low) behind neighbouring resource-rich Azerbaijan and the People's Republic of China (hereafter "China"), ahead of the often cited Southeast Asian "Tiger economies" including Singapore, Indonesia and Malaysia (Figure 2.2).

Figure 2.2. **Real GDP growth, 2000-14**



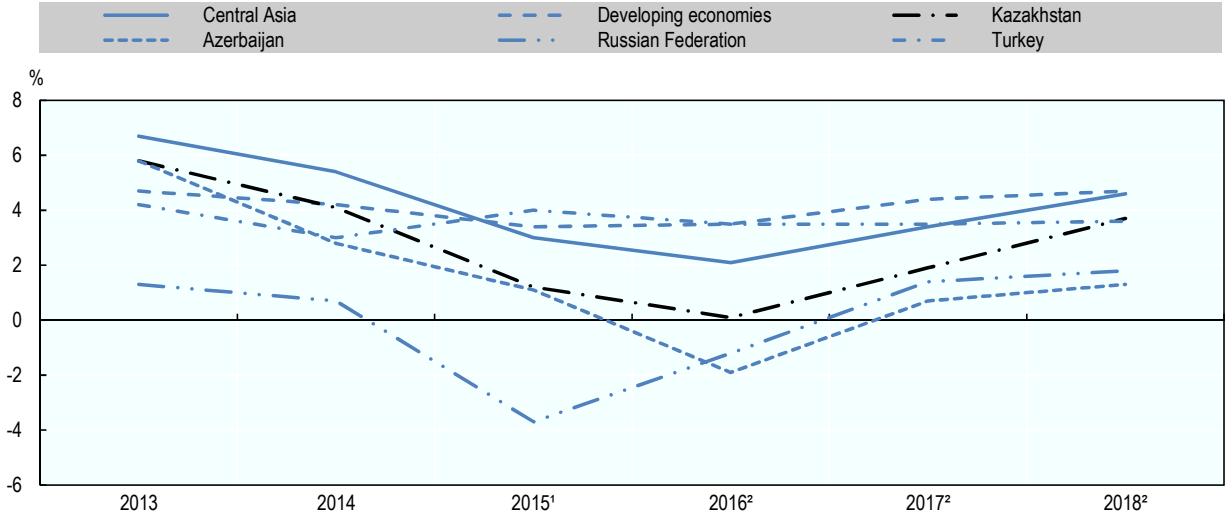
Source: OECD (2016a), *Multi-dimensional Review of Kazakhstan: Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on World Bank (2016e), *World Development Indicators* (database), http://data.worldbank.org.

A second long-term strategic document, Kazakhstan 2050 (Linn, 2014), was announced during the post-crisis high-growth phase in 2012. This programme aims at Kazakhstan becoming one of the 30 most-developed economies by 2050. The programme focuses on the diversification of the economy by building on market-based concepts such as profitability, return on investments and competitiveness as well as comprehensive support for entrepreneurship and modern skills (Kazakhstanlive, 2012). The long-term strategy has been supported by a number of medium-term strategy documents. These include a strategy for developing agriculture and the food industry (Alibekova, 2013). Two strategic programmes, called the State Programs for Accelerated Industrial and

Innovative Development (SPAIID) 2010-14 and 2015-19, respectively, were initiated to foster structural transformation. While the main focus of both programmes is diversification, the second programme has a sharper focus on some industries based on "smart specialisation" as opposed to a more general increase in the role of manufacturing in the first SPAIID. It also uses fewer instruments in a more co-ordinated way than the first SPAIID (OECD, 2016a). As will be described in Chapter 5, a number of institutions and initiatives were set up to help manufacturing industries and innovative firms.

In 2015, both economic growth and government revenues were squeezed by the fall in commodity prices. The growth rate of GDP dropped from double digit levels reached in some years in the 2000s to less than 1% in 2015. Forecasts suggest sluggish growth to extend in the medium term (Figure 2.3). Kazakhstan is on the way to a long recovery (World Bank, 2016d). Slow growth may affect the ambitious goals of active government policy, including the levels of investment in education, science and innovation, unless precautions are taken to preserve the latter.

Figure 2.3. **Real GDP growth and forecasts (constant 2010 USD)**



1. Estimate.

2. Forecast.

Source: World Bank (2016b), *Global Economic Prospects database*, http://data.worldbank.org/data-catalog/global-economic-prospects (accessed 14 October 2016).

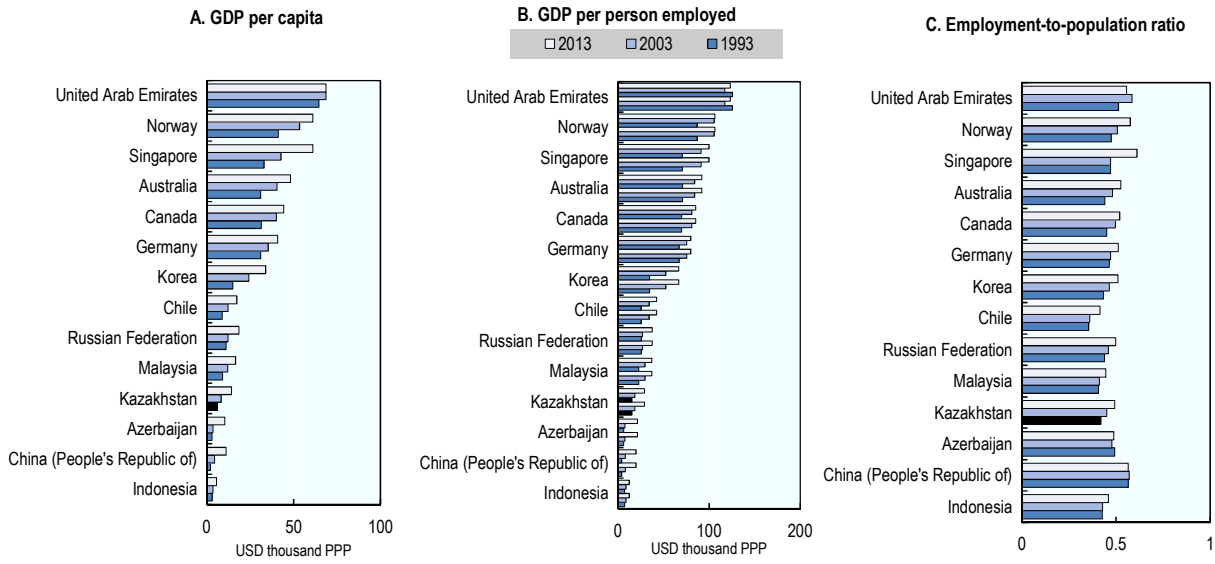
Kazakhstan has shown high growth performance for over more than a decade, starting from a comparatively low initial level of GDP per head (Figure 2.4). Due to this initial condition, its GDP per capita is still significantly lower than many countries: below Malaysia and the Russian Federation but above Azerbaijan and China.

Productivity growth

A decomposition of GDP per capita into GDP per person employed (a measure of labour productivity) and the employment-to-population ratio (or labour participation rate) (Figure 2.4) shows that Kazakhstan performs better than some comparable countries in the sample in terms of the labour participation rate. In fact, the labour participation rate has reached a level which is rather typical for more developed economies. At the same

time, labour productivity lags behind most countries in the comparison group. Hence low productivity accounts for Kazakhstan's comparatively low GDP per head. As a result, the key to increasing income per capita is improving productivity, including through productivity-enhancing innovation.

Figure 2.4. **Decomposition of GDP per capita**



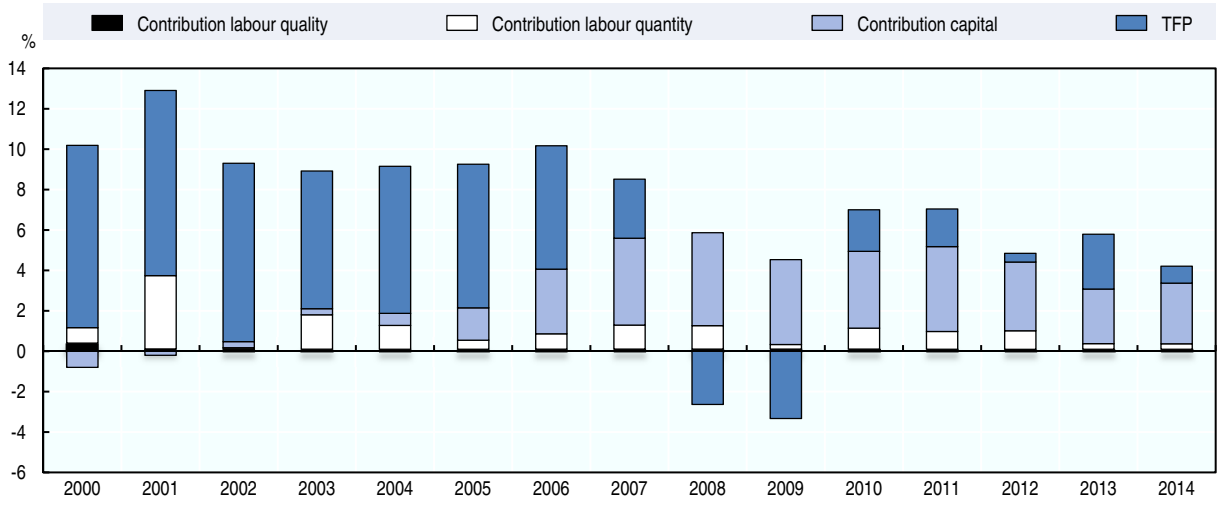
Source: OECD (2016a), *Multi-dimensional Review of Kazakhstan: Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on data from The Conference Board (2016), *Total Economy Database*, www.conference-board.org/data/economydatabase.

As Figure 2.4 suggests, labour participation varies less across countries than labour productivity. While to some extent changes in the employment-to-population ratio can be expected to increase in certain developing countries – and hence contribute to raising GDP per head – thanks to the demographic dividend resulting from falling birth rates (e.g. in the case of India), most of such dividends have already been consumed in Kazakhstan. As mentioned above, labour force participation is already very high in Kazakhstan (80% in 2013) while unemployment has been low (4% in 2013) (OECD, 2016a).

Labour productivity, in turn, can be decomposed into capital intensity (capital stock per employee) and total factor productivity (TFP), the joint efficiency of labour and capital inputs. The literature on economic growth has shown that in general, TFP, rather than capital intensity, is the main determinant of labour productivity growth (Hall and Jones, 1999; Inklaar and Timmer, 2008; Johansson et al., 2013). Kazakhstan is not an exception to this overall tendency: before the global financial and economic crisis of 2008-09, labour productivity growth was mainly driven by TFP growth (Figure 2.5). TFP growth, however, temporarily turned negative during 2008 and 2009, and has remained low since 2010, suggesting a fall in the rate of technological upgrading. Meanwhile, increasing capital intensity has become the main driver of productivity growth. For sustainable growth in the longer term, Kazakhstan needs to find a way to return to TFP-driven growth by mobilising innovation and structural change.

Figure 2.5. **Decomposition of growth of GDP per person**

Contributions of capital, labour and total factor productivity (TFP)

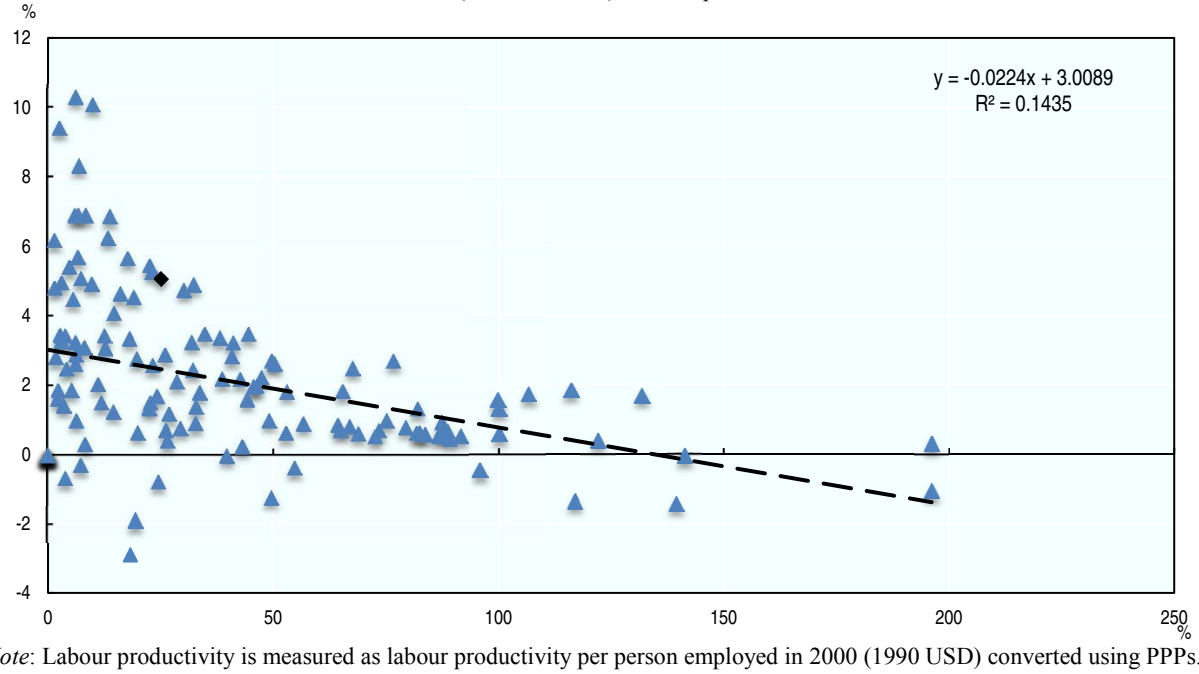


Source: The Conference Board (2016), *Total Economy Database*, www.conference-board.org/data/economydatabase (accessed 30 March 2016).

Labour productivity growth is determined to a significant extent by the initial level of productivity: countries close to the productivity frontier tend to show slower growth than countries further away from it. The main explanation for this fact is that the latter can catch up by adopting technologies widely available at the frontier (the "advantage of backwardness").[1] Hence, when assessing a country's productivity growth performance, it is reasonable to compare it with countries with a similar initial level of productivity.

Figure 2.6. **Labour productivity levels (2000) and growth rates (2000-15)**

Kazakhstan (black diamond) and comparable countries



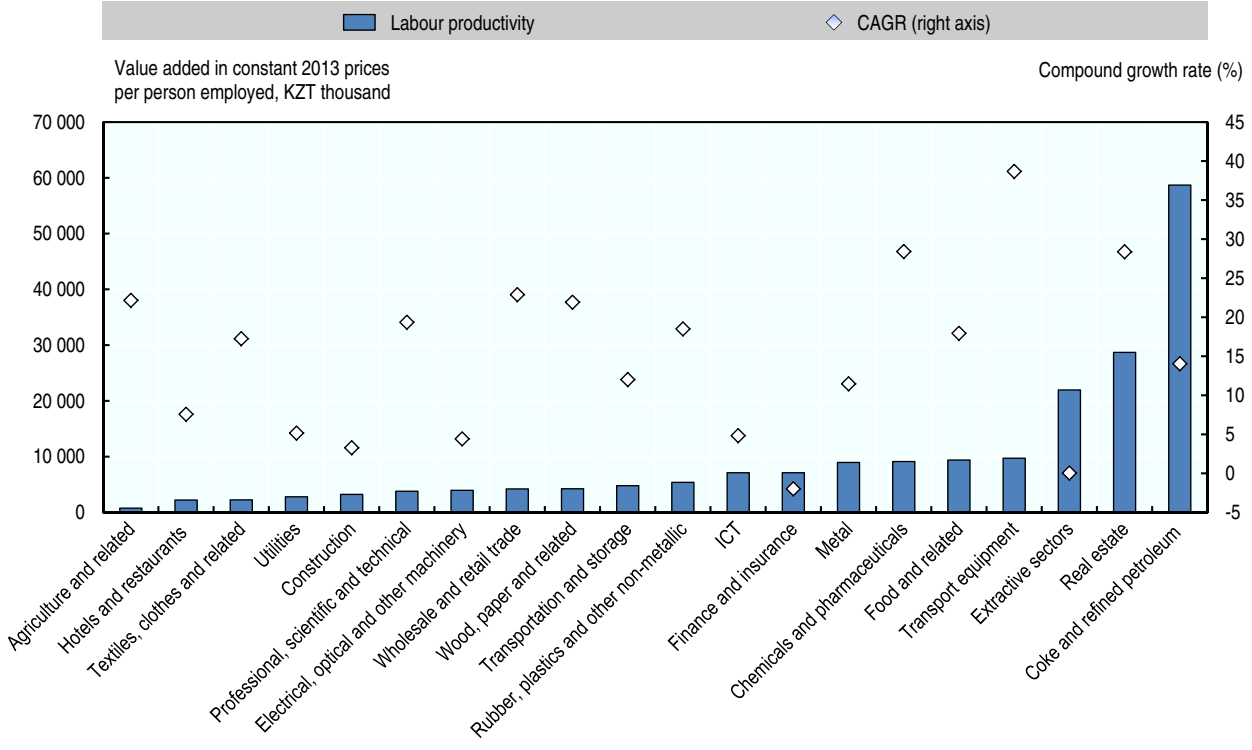
Note: Labour productivity is measured as labour productivity per person employed in 2000 (1990 USD) converted using PPPs.

Source: The Conference Board (2016), *Total Economy Database,* www.conference-board.org/data/economydatabase (accessed 30 March 2016).

Figure 2.6 shows the relationship between labour productivity in 2000 and its average growth rate between 2000 and 2015. The black dashed line is the best-fit straight line, or expected productivity growth for countries at different productivity levels in 2000. The figure suggests that Kazakhstan's productivity growth was outstanding even when taking into account its initial level of development. The country succeeded to increase its productivity level about twice as fast as the average of countries with similar levels of initial productivity.

As in many other emerging economies,[2] very large productivity differences can be observed across sectors of Kazakhstan's economy (Figure 2.7) (Lewis, 2005; Herrendorf and Valentinyi, 2012). In particular, productivity tends to be very high in mining, petroleum and other extractive industries (where capital intensity and rents are high), while it is typically very low in agriculture and in some low-tech services (with limited international tradability), with manufacturing industries falling between these two extremes. Figure 2.7 also shows that some manufacturing industries – including chemicals, pharmaceuticals and transport equipment – have become more productive recently, showing signs of increasing competitiveness of manufacturing relative to the extractive sectors.

Figure 2.7. **Labour productivity and its compound growth rate, 2010-13**



Notes: CAGR stands for compound annual growth rate. Sectors are ordered from the least productive (left) to the most productive sectors. The labour productivity levels and growth in labour productivity of (mostly non-commercial) public and social services are not included in the figure. Raw data for 2014 were not available. However, productivity growth figures for 2014 for some sectors were provided by the Ministry of National Economy: food and related (-13%); transport equipment (-35%); basic pharmaceuticals (-32%); coke and refined petroleum (-21%); chemicals (+13%); textiles, clothes and related (+15%); electrical equipment (+12%); iron and steel (+19%).

Source: OECD (2016a), *Multi-dimensional Review of Kazakhstan*: *Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on data received from the Ministry of National Economy.

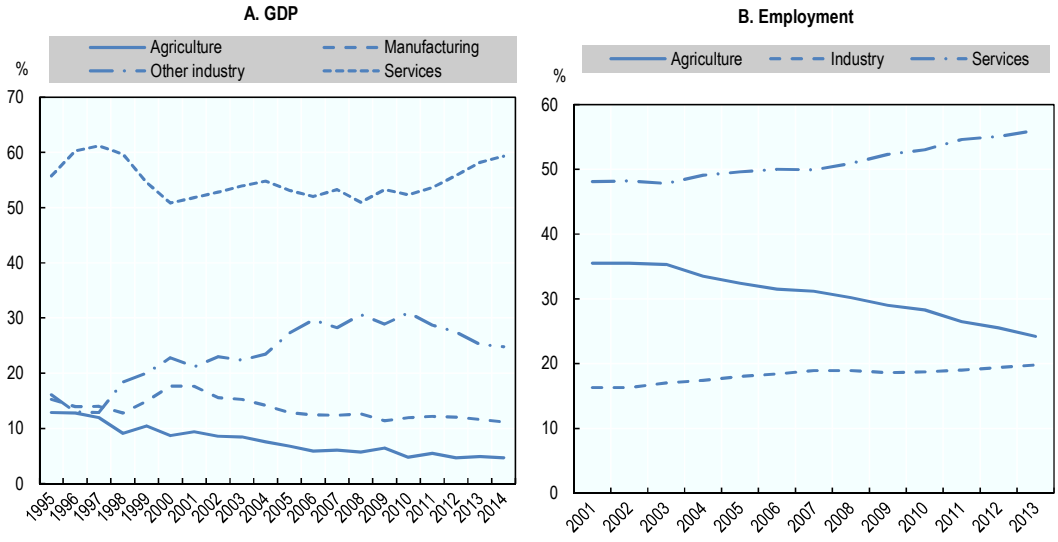
To sum up, Kazakhstan's strong growth, which extended from about 2000 to the recent slowdown – and was only briefly interrupted by the global financial crisis – was mainly driven by the resource boom, but was also accompanied by a rapid increase in productivity. Slowing economic and productivity growth in recent years, and subdued growth projections for the near future, are a challenge for Kazakhstan's economy. The slowdown has raised uncertainty, and less abundant government funding – including for research and education – may impact on long-term investment levels and experimentation both in the public and the private sectors. These developments, however, make the case for diversification and growth based on the more innovation-driven, productivity-enhancing economic activities even more compelling.

Globalisation and structural change

Structural change in production

A main driver of growth and development in many emerging economies is structural transformation, i.e. the reallocation of labour from agriculture to manufacturing and services (Herrendorf, Rogerson and Valentinyi, 2014). Such a process is under way in Kazakhstan (Figure 2.8): both employment and value added have fallen in agriculture, while employment has increased in services.

Figure 2.8. **Share of sectors in GDP and employment**



Source: World Bank (2016e), *World Development Indicators* (database), http://data.worldbank.org/datacatalog/world-development-indicators.

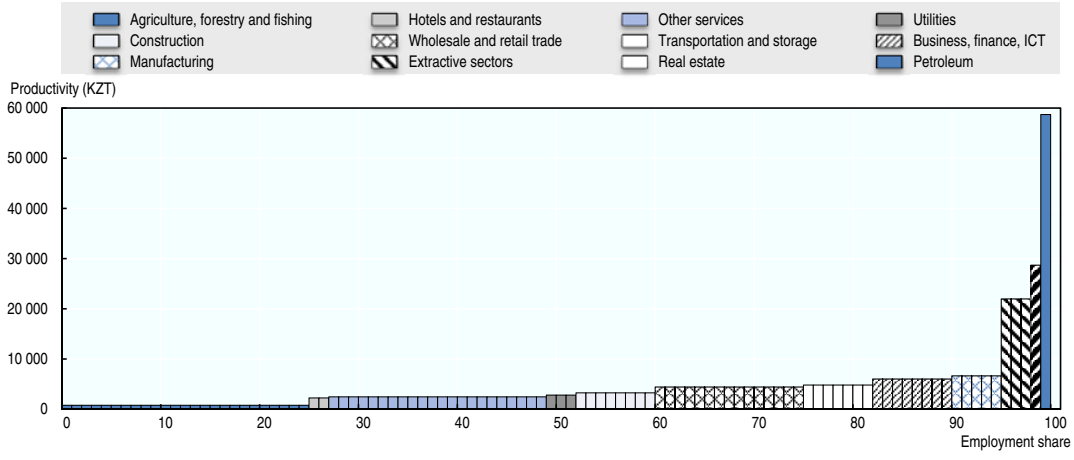
One important aspect of structural transformation is the positive association between the level of development and the share of manufacturing in emerging economies (which may be reversed at high levels of development) (Herrendorf, Rogerson and Valentinyi, 2014). While the share of industry was indeed increasing in Kazakhstan, this can mainly be explained by a relative increase in the oil and mining industries, while the share of manufacturing in GDP actually declined. At about 5%, the share of manufacturing employment is very low (OECD, 2016a). In other words, economic activity shifted towards the extractive industries and to some extent away from manufacturing. This pattern of structural change, which can also be observed in other resource-rich economies (McMillan and Rodrik, 2011), can lead to productivity increase in the medium term (because extractive sectors are indeed characterised by comparatively high levels of

productivity), but are likely to generate challenges in the long term. Consequently, options for innovation-based development of manufacturing (and services) need to be carefully considered.

As in many other emerging economies, the share of people employed in agriculture (17 %) is still much higher than the contribution of agriculture to GDP (5%). This shows in parallel the very low productivity of agriculture but also the potential productivity gains of the reallocation from agriculture to other sectors. The large area and relatively low level of urbanisation of Kazakhstan, however, work against a swift reallocation from agriculture to services and manufacturing.

While the employment share of services is high and increasing (reaching 55% in 2013), a majority of the service workforce works in low-productivity service industries (Figure 2.9). The employment share of knowledge-intensive services, such as: ICT; finance and insurance; and professional, scientific and technical services is about 8%, much lower than the 20% in more advanced countries such as Australia, Canada or Germany (OECD, 2016a).

Figure 2.9. **Productivity and employment**



Note: Productivity for the public sector based on wages and other input measures.

Source: OECD (2016a), *Multi-dimensional Review of Kazakhstan: Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on data from the Ministry of National Economy.

At a more disaggregate level there are encouraging signs of labour mobility into some non-primary industries. Between 2010 and 2013, job creation was fastest in the transport equipment, finance and hospitality sectors and there was also some job creation in the chemicals industry (OECD, 2016a). Also, labour productivity has increased in some of these sectors. By 2013, these sectors were competitive with comparable countries in terms of labour productivity (OECD, 2016a). Continuing such reallocation into manufacturing and knowledge-intensive services would be an important step in the structural transformation of the economy in Kazakhstan.

Structural transformation can contribute to a significant, but limited, extent to development in the long term. The OECD calculates that reallocation across sectors (so that labour distribution becomes similar to what is observed in the OECD) could lead to about a 30% increase in GDP per capita (OECD, 2016a).[3] In other words, this reallocation would close about one-fifth of the GDP per capita gap between Kazakhstan

and OECD countries. Closing the remaining four-fifths of the gap requires innovation and technology upgrading within the different sectors of the economy.

As in other emerging economies, structural change will remain a potentially important driver of the diversification and increasing sophistication of Kazakhstan's economy. Similar to other resource-rich economies, the predominance of extractive industries represents a challenge as these industries have "very limited capacities to generate substantial employment" (McMillan, Rodrik and Verduzco-Gallo, 2014). While the specialisation in natural resource-based, extractive activity tends to reduce incentives to diversify towards "modern manufactures", there is a continued need for increasing competitiveness of high value-added sectors engaging in international trade, with some encouraging signs, for example in chemicals and transport equipment.

International openness: Trade, global value chains and FDI

In addition to general macroeconomic conditions, openness to international trade and investment is another important factor constituting an innovation-friendly environment. Trade openness lets firms expand their scale of production and learn from competitors and buyers in foreign markets. Serving the larger, more competitive and potentially more sophisticated international markets may provide higher incentives to introduce innovations (Costantini and Melitz, 2008). Preparation to exporting may lead to quality upgrading (Iacovone and Javorcik, 2008; Iacovone and Smarzynska Javorcik, 2012). Similarly, increased imports can lead to the use of higher quality inputs and to quality upgrading (Amiti and Khandelwal, 2013; Halpern, Koren and Szeidl, 2015). FDI flows and the entry of foreign multinational enterprises can also generate sophisticated demand and knowledge spillovers (Görg and Greenaway, 2004) for domestic firms.

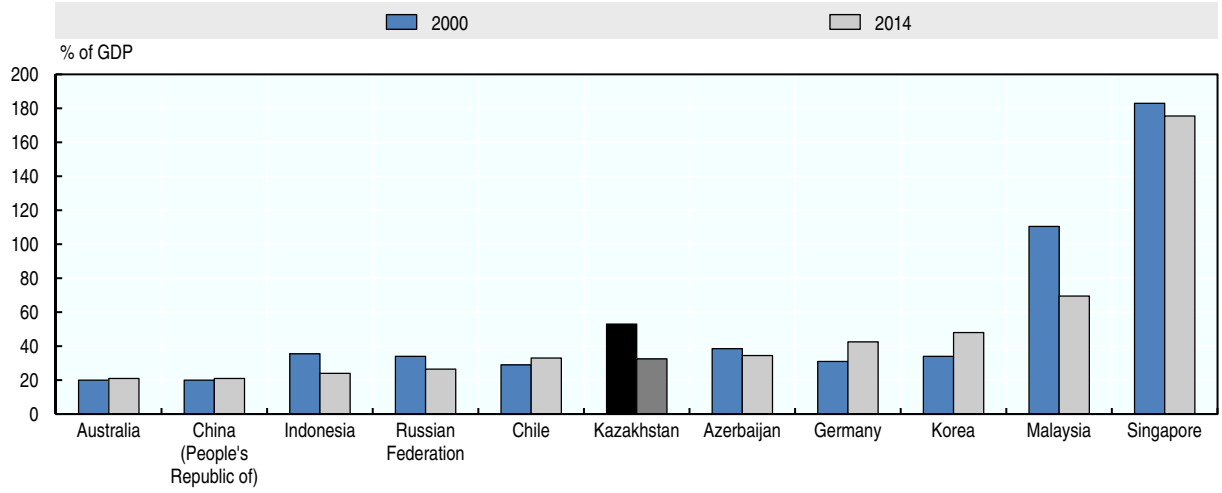
On the other hand, tariffs and other trade costs are potentially important obstacles for the expansion of trade. In this regard, Kazakhstan is in an advantageous position being a partner in 12 trade agreements (APTIR, 2015). Kazakhstan's recent accession to the Eurasian Customs Union (which took place in phases between 2010 and January 2015) and the World Trade Organisation (WTO) in November 2015 may give a boost to its exporters. According to one estimate, relative to the recent level of consumption, the WTO entry of Kazakhstan could yield 6.7% in the medium and 17.5% in the long run (Jensen and Tarr, 2007). An initial empirical assessment of the formation of the Eurasian Union on trade found small increases in Kazakhstan's imports from Belarus and the Russian Federation and some trade diversion from China-Kazakhstan trade (Isakova, Koczan and Plekhanov, 2015).

However, even after these moves towards trade liberalisation, international trade remains costly and time consuming (see below) and further measures to reduce this burden would be beneficial. In addition, trade liberalisation could be complemented by institutional change to implement a trade policy based on a more strategic vision, co-ordination and on human capital. Reduction of tariff barriers may also be more effective by complementing them with easing regulations that affect trade (World Bank, 2015b).

In general, Kazakhstan is as open to trade as comparable countries (Figure 2.10), especially when taking into account its large size and geographic position as a landlocked country. Its level of openness, measured by the average of imports and exports over GDP, was comparable to Azerbaijan or Chile. It was significantly more open than large or remote countries such as Australia or China, but less open than highly open economies like Malaysia or the city state of Singapore. Measured openness decreased significantly between 2010 and 2014, but this was mostly due to the impact of the fall in commodity prices.

Figure 2.10. **Openness to international trade**

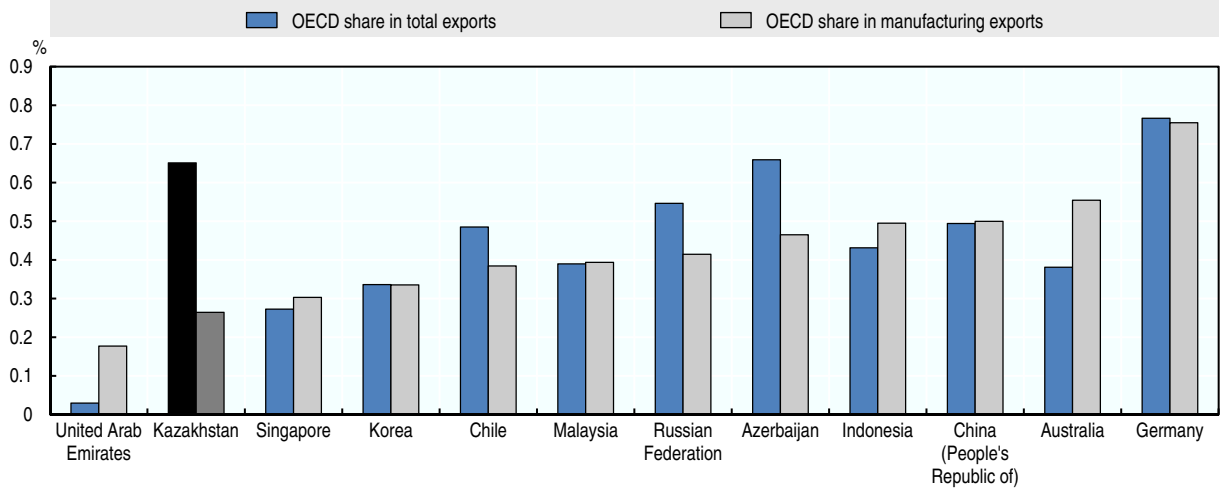
Average of the sum of imports and exports over GDP



Source: World Bank (2016e), *World Development Indicators* (database), http://data.worldbank.org/datacatalog/world-development-indicators.

When assessing the trade performance of a country, a crucial question concerns the type of markets it is able to compete on. More developed and sophisticated markets are more likely to provide firms with learning opportunities (De Loecker, 2007), and also signal a high level of competitiveness of the firms successfully serving these markets (Crinò and Epifani, 2012). In the case of Kazakhstan it is important to distinguish between total and manufacturing exports. Sixty per cent of total exports are destined to developed countries, mainly in the European Union, but are mainly made up of minerals exports (Figure 2.11). In contrast, less than 30% of Kazakhstan's relatively low manufacturing exports are aimed at developed countries, while the remaining 70% are primarily shipped to China, the Russian Federation and Central Asian countries. Productivity and quality upgrading is needed in order to reach more demanding markets for manufactures.

Figure 2.11. **Share of OECD countries in total and manufacturing exports, 2014**



Source: World Bank (2016f), *World Integrated Trade Solution* (WITS) (database), http://wits.worldbank.org (accessed 30 March 2016).

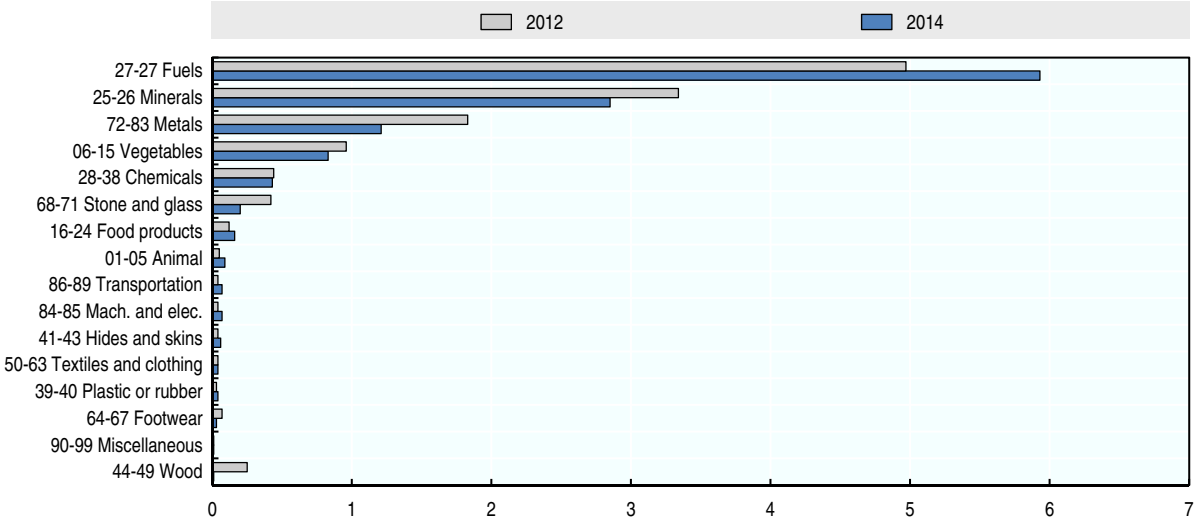
Primary and resource-based products made up more than 90% of Kazakhstan's exports in 2014 (Table 2.1). This is an exceptionally high share even for resource-based economies, suggesting a strong need for diversification. This diagnosis is in line with data on revealed comparative advantage, which show that the share of Kazakhstan in world exports of different product groups relative to total exports from the country. Kazakhstan has comparative advantage mostly in fuels, minerals, metals and chemicals as well as in a few manufacturing products. The composition of its trade reflects its very strong specialisation in exporting primary products. Kazakhstan's participation in global value chains (GVCs) is relatively low owing to its high export specialisation in minerals. In 2014, 17% of its imports and 18% of its exports consisted of intermediate goods (APTIR, 2015). A stable and open trade and investment policy combined with capacity building in enterprises might play a key role in opening up trade opportunities for other industries and helping firms to benefit more from international relations (World Bank, 2015b).

Table 2.1. **Share of exports by technology category, 2014**

	High technology	Low technology	Medium technology	Primary products	Resource-based
Australia	0.04	0.03	0.07	0.29	0.57
Azerbaijan	0	0	0	0.9	0.09
Chile	0.01	0.03	0.06	0.59	0.31
China (People's Republic of)	0.34	0.34	0.21	0.03	0.08
Germany	0.18	0.15	0.48	0.06	0.14
Indonesia	0.08	0.23	0.21	0.24	0.25
Kazakhstan	0.02	0.02	0.04	0.83	0.09
Korea	0.3	0.11	0.39	0.03	0.17
Malaysia	0.39	0.12	0.17	0.11	0.21
Russian Federation	0.03	0.04	0.09	0.46	0.38
Singapore	0.44	0.08	0.18	0.02	0.28
United Arab Emirates	0.06	0.1	0.12	0.43	0.29

Source: World Bank (2016f), *World Integrated Trade Solution* (WITS) (database), http://wits.worldbank.org (accessed 30 March 2016).

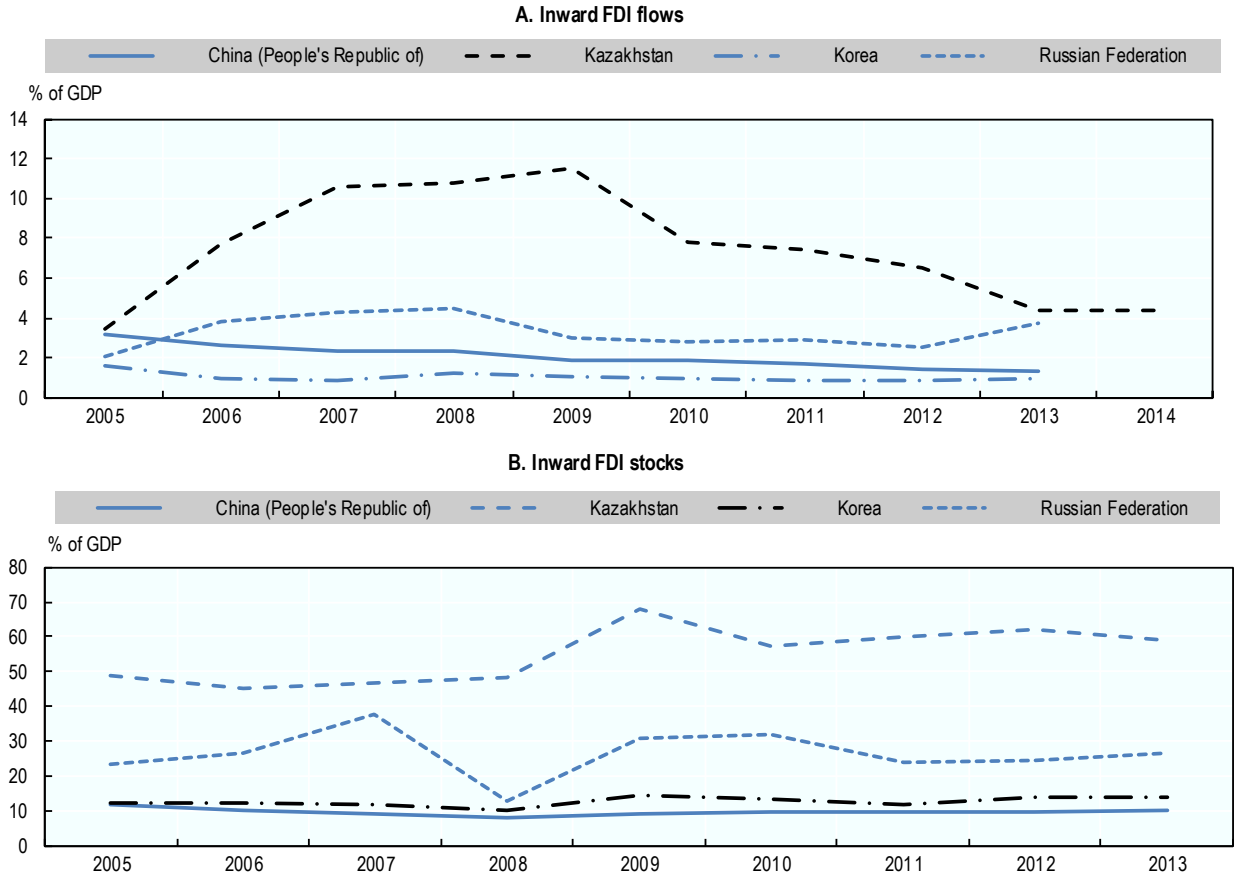
Figure 2.12. **Revealed comparative advantage**



Source: World Bank (2016f), *World Integrated Trade Solution* (WITS) (database), http://wits.worldbank.org (accessed 30 March 2016).

Kazakhstan is clearly the most important FDI destination in the region, receiving 85% of the inflows to Central Asia, and 42% of all inflows to the Commonwealth of Independent States (CIS) in 2012 (ITC, 2015). FDI inflows reached an all-time high in 2009 (representing nearly 12% of GDP); they have since been decreasing with falling commodity prices (Figure 2.13). Similar trends have taken place in neighbouring countries. Much of the FDI stock is associated with a few developed countries such as the Netherlands and the United States (OECD, 2012a) and over two-thirds of FDI stocks are in extractive industries (OECD, 2016a). While FDI projects can play a very important role in exploiting national resources and potentially generate spillovers to the domestic economy, these may be fewer than in the case of some manufacturing FDI. Consequently, diversifying FDI inflows to manufacturing and other innovative industries – including those related to the resource base – should be a priority for the future.

Figure 2.13. **Foreign direct investment inflow and stock**



Notes: Panel A shows net investment from abroad as a percentage of GDP. For Kazakhstan, FDI data used are from the National Bank of Kazakhstan and GDP data were received from the Ministry of National Economy. The rest of the data are from UNCTAD. Data used in Panel B are from UNCTAD, including for Kazakhstan.

Sources: OECD (2016a), *Multi-dimensional Review of Kazakhstan*: *Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on National Bank of Kazakhstan (2015), *Official Internet Resource of the National Bank of Kazakhstan* (database), www.nationalbank.kz/?docid=127&switch=english, data received from the Ministry of National Economy and UNCTAD (2015), *UnctadStat* (database), http://unctadstat.unctad.org/ReportFolders/reportFolders.aspx.

Framework conditions for innovation and entrepreneurship

The role of framework conditions

There is a broad-based consensus on the importance of framework conditions – including macroeconomic stability, strong competition, open trade in goods and services, and an open investment policy – for a country's innovation performance. In addition, recent developments and policy lessons have emphasised the important role of tax policies, innovation financing, enabling experimentation and growth among young firms and GVCs in enabling innovation (OECD, 2015). There are several reasons for the strong relationship between framework conditions and innovation (OECD, 2014):

- Innovation is a long-term investment, and as such, it requires a stable environment.
- The regulatory framework, including a level playing field for different firms, encourages innovation and technology diffusion.[4]
- Good framework conditions also strengthen the effect of policies specifically designed to foster innovation.

In general, Kazakhstan's framework conditions resemble those of comparable countries. According to the World Economic Forum's *Global Competiveness Report 2016-17*, Kazakhstan's position moved from 42nd to 53rd place, with scores similar to Costa Rica, Mexico, Slovenia and Turkey (World Economic Forum, 2016a). This decline was mostly caused by the decline in oil export revenues, which exerted strain on the public finance category. Nevertheless, the average score of Kazakhstan is still ranked significantly higher than in 2010 when it held 72nd place. Behind the headline number, there is important variation. The strongest point is the efficient labour market (20th). However, Kazakhstan ranks rather low in terms of innovation performance (59th) and business sophistication (97th), in line with other measures of innovation performance (see Chapter 3). According to the World Economic Forum, health and basic skill levels (94th) are lagging and it is still underperforming in terms of higher education and training (57th), which indicates that human capital is a major constraint for innovation. Finally, the low efficiency and trustworthiness of the financial sector (104th) can also be expected to affect the financing of innovative activities.

The OECD *Multi-dimensional Review of Kazakhstan* (OECD, 2016a) provides a similar overall diagnosis by emphasising the need for high-quality and flexible skills, good governance and a boost in private, public and foreign investment as requirements for building a more diversified and innovative economy.

Stylised features of entrepreneurship

Robust evidence from many countries shows that entrepreneurship and the formation and growth of young firms is critical for the creation and implementation of new ideas (Lerner, 2010; OECD, 2013) and spread their application throughout the economy. Recent empirical research has confirmed that the level of entrepreneurship is strongly related to (the quality of) framework conditions, especially to product market competition and regulation (Andrews and Cingano, 2014).

In this respect, emerging or transition economies may differ in three key respects from more developed countries. First, as these economies are likely to have inherited a population of large and often not very innovative (but from a political economy

perspective important) incumbent firms, smaller firms may play a relatively even more pronounced role in implementing and adopting new technologies and thereby rejuvenating the economy than in more developed economies. Second, especially during the transitional recession, the lack of formal work opportunities may have forced many people to become entrepreneurs. This type of "forced" entrepreneurs is more likely to try to eke out a living as "subsistence" entrepreneurs rather than innovative or transformative ones. Hence, a large number of entrepreneurs in such economies may indicate the lack of possibilities for formal work rather than a vibrant innovation ecosystem (Schoar, 2010). Third, in (former) transition economies, entrepreneurs often have to fight negative stereotypes either coming from the socialist past or formed during the early phases of transition when some entrepreneurs adopted dubious practices (Hübner, 2000).

As reported by the Committee of Statistics,[5] very small firms dominate Kazakhstan's economy in terms of their numbers. Of firms with legal personality, about 95% are small, 4.2% are medium-sized and 0.7% are large (Table 2.2).[6] An even more detailed picture of the role of small economic units can be obtained from the SME survey of the Committee of Statistics. This involves every kind of economic entity with less than 50 employees, rather than just legal persons. It turns out that legal person firms represent only a minority (13.8%) of all such entities, while entrepreneurs (72.1%) and farmers (14.1%) are much more numerous. All in all, more than 1.3 million small and medium-sized enterprise (SME) units operated in Kazakhstan in 2014, providing work for 27% of all employees and generating 16.3% of GDP.

Table 2.2. **Different types of firms (legal persons only), January 2015**

	Number	Share of total	State	Domestic private	Foreign
Total	353 833		7.82%	86.98%	5.19%
Small	336 422	95.08%	5.45%	89.28%	5.27%
Medium	14 936	4.22%	55.84%	40.77%	3.39%
Large	2 475	0.70%	40.48%	53.25%	6.26%

Source: Data provided by the Committee of Statistics of Kazakhstan.

While the share of SMEs in terms of number of firms is similar to that of developed countries, their employment and value added share lag behind those countries. The average small business share in employment in some advanced European countries[7] (OECD, 2014) is 46.3%, which is more than 70% larger than what the data show in Kazakhstan.[8] Kazakhstan's SMEs are very small compared to those of more developed countries: as in many emerging economies, the firm size distribution is shifted to the left, which is a sign of tight constraints on growth (Hsieh and Olken, 2014). Kazakhstan's SMEs are not only small, but have very low productivity at about 60% of the average productivity of the economy. In OECD countries, by contrast, SMEs are only about 15% less productive than the economy as a whole.[9] The very small average size and low productivity of SMEs suggests that most of these firms are unlikely to become engines of innovation and growth. Many of them engage in subsistence entrepreneurship rather than in transformative entrepreneurship.

Policy environment affecting entrepreneurship

One key determinant of entrepreneurship is the administrative burden small firms face. In this regard, Kazakhstan has made great progress thanks to such initiatives as Digital Kazakhstan (Zerde, 2016). Smart Astana or simplified taxes for SMEs (Teal, Toxanova and Izzo, 2011). According to the World Bank's 2017 Doing Business Survey (World Bank, 2017), Kazakhstan is ranked 35st overall, that is 16 positions higher than in 2016 (World Bank, 2016c). More detailed data suggest that, in general, it is rather easy to deal with state administrators (often digitally) in Kazakhstan. Importantly, it is quite straightforward to open a business (45th place), which is not very costly, includes five procedures and takes nine days. Similarly, it is easy to register a property (18th) or enforce contracts (9th). Until recently it was relatively complicated to get a construction permit or electricity access (78th and 102nd in 2016), however the 2017 results show an important progress in the both areas (22nd and 75th in 2017 accordingly). This positive shift allowed Kazakhstan to become one of the 10 best economies in business regulation development. In line with the relatively low administrative burden when dealing with the state bureaucracy, utilities also seem to be somewhat flexible: getting electricity, for example, takes 77 days, which is comparable with the OECD average of 77.7 days. One great exception from this rather positive picture is the very high cost of trading internationally. In this respect, Kazakhstan comes in at 119th place with staggeringly high trade costs. The number of hours involved in preparing documents and complying with customs is 128 compared to 3 in the OECD high income economies. These costs incur a heavy burden, especially on SMEs, and may be a factor behind the very low export ratio of such firms (see above). However, membership in the WTO may improve the situation to some extent.

A second important policy dimension that affects entrepreneurship is whether product markets are competitive, e.g. whether they provide a level playing field enabling productive young firms to grow (Wölfl et al., 2009; OECD, 2016b). The goods market efficiency pillar of the Global Competitiveness Index provides a summary of product market competition. Overall, Kazakhstan takes the 62nd place based on this pillar. This is the average of two contrasting types of factors. On the one hand, as shown in the previous paragraphs, entry is relatively easy from an administrative perspective. On the other hand, large local incumbents, some state-owned, are dominant in many markets and trade is limited: in terms of the intensity of local competition Kazakhstan takes 106th place. This suggests that further reforms might focus on providing a level playing field for existing firms, and supporting productive small firms to expand.

Third, a dynamic business sector also relies on a well-functioning labour market. According to the Global Competitiveness Index 2016-17, Kazakhstan performs very well in this respect, its overall ranking is 20th and its labour market is both quite flexible (39th) and productive (38th). These rather positive conclusions can be further qualified by the observation that, similar to other emerging economies, informality is high (about 24.3% in 2013), excluding many people from the regular labour market (OECD, 2016a). Also, the employment sector plays a larger role in wages than education. For instance, the wage premium of working in the mining sector (96%) is twice as high as the university wage premium relative to high school. This suggests that labour mobility between these sectors is limited, which may reduce the efficiency of the labour market. Similarly, regional differences in wages are higher than in OECD countries, suggesting limited geographical labour mobility. Policies helping labour mobility across sectors and firms, for example by providing opportunities to acquire flexible knowledge and making hiring more competitive in state-owned enterprises, may help in reducing such disparities.

Social capital and trust

Recent research has demonstrated the importance of trust in many dimensions of dynamic economic activity, including finance, innovation, the organisation of firms, the labour and the product market (Algan and Cahuc, 2014). This research mostly focuses on "generalised trust", which can be measured, for example, by the share of people who say that "most people can be trusted". Trust is one of the dimensions of the more general concept of "social capital", which can be defined as "networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (OECD, 2007). There are empirical studies that show that social capital in general also helps in innovation (Akçomak and Ter Weel, 2009), but with some qualifications (Welter, 2012; Westlund and Adam, 2010).

Similar to many transition economies, people have relatively small social networks in Kazakhstan, which represent low potential social capital and possibilities for co-operation. On the other hand, generalised trust is much greater than in other post-Soviet countries. Such trust may be an important building block of a strong innovation system.

Apart from generalised trust, innovation and other types of long-term investment require trust in the state, a key dimension of which is the prevalence of corruption. In corrupt societies people tend to fear that the fruits of their investment will be stolen or expropriated by corrupt officials. While the situation in Kazakhstan has greatly improved in this regard, perceived corruption is still high: from the comparison group, only in Azerbaijan and the Russian Federation was perceived corruption higher in 2014.

Human capital

According to the *Global Competiveness Report 2015-16* (World Economic Forum, 2015), one of the key challenges of Kazakhstan in terms of competitiveness is the lack of human capital. While many reforms have been carried out and the enrolment rate has increased (OECD, 2016a), the low level of basic skills of the workforce remains a key challenge (Figure 2.14). According to the PISA survey, Kazakhstan's students' achievements are at the bottom of the scale relative to comparable countries.

Figure 2.14. **Average PISA scores in mathematics, science and reading**

Note: 2015 data for Kazakhstan and Malaysia is not included, because the coverage is too small to ensure comparability.

Sources: OECD (2012b), "PISA 2012 results in focus: What 15-year-olds know and what they can do with what they know: Key results from PISA 2012", https://www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf; OECD (2016c), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264266490-en.

By now, a strong empirical consensus has emerged that the level of these basic competencies, rather than only differences in enrolment and attendance, have a strong positive effect on the wage levels and economic growth of nations, both developed or developing (Hanushek and Woessmann, 2008; 2011; 2012). Consequently, the lack of these basic skills may be an important bottleneck when firms try to adopt advanced technologies either from home or abroad. Furthermore, the return to innovation can also be lower when basic skills are inadequate.

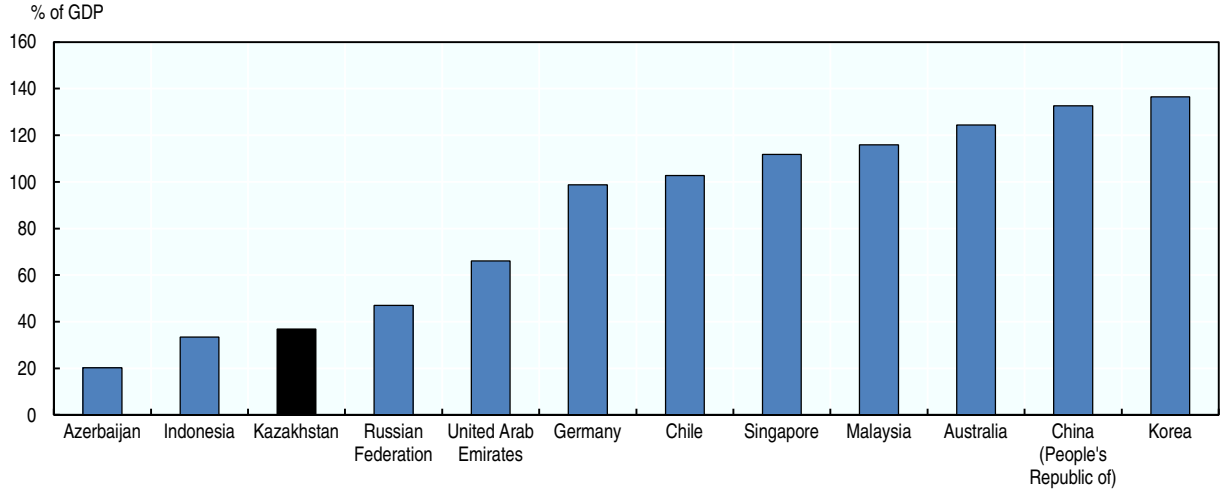
This insight is also confirmed by the perceptions of Kazakhstani firms. According to World Bank Enterprise Surveys, an inadequately educated workforce is a key problem for 11% of small (5-19), 15% of medium (20-99) and 21% of large enterprises (OECD, 2016a), showing that large firms, which are more likely to adapt advanced technology, are more sensitive to the lack of skills of their workers.

Finance

Financial markets are important in allocating funds across firms. Efficient financial systems are able to allocate the necessary funds to more productive firms and promising ideas at reasonable costs or collateral. While larger incumbent firms can often work efficiently even when the domestic financial sector is underdeveloped, efficient financial intermediation is key for many small and young firms (Levine, 2005; OECD, 2015).

Enterprise financing can come from two main sources: bank lending and the stock market. Figure 2.15 shows the amount of domestic credit relative to GDP, an often-used measure for the role and development of the banking sector. In this respect, with a share around 40%, Kazakhstan is behind comparison countries; only Azerbaijan and Indonesia have less private lending than Kazakhstan. This low level of financial intermediation may generate financial constraints for SMEs when investing in more advanced technologies or experimenting with risky innovations.

Figure 2.15. **Domestic credit to private sector (average), 2010-13**

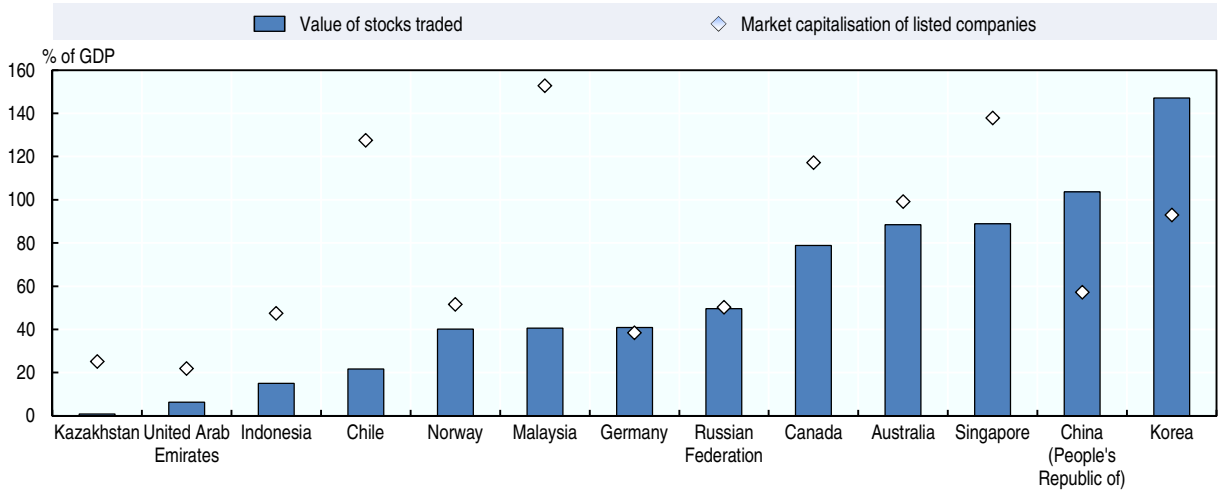


Note: The average for the United Arab Emirates is based on 2010-12.

Source: OECD (2016a), *Multi-dimensional Review of Kazakhstan*: *Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on World Bank (2016e), *World Development Indicators* (database), http://databank.worldbank.org/data.

For larger firms, the stock market may provide an important opportunity for equity financing. In this respect, Kazakhstan is underdeveloped relative to its peer group (Figure 2.16) with very low levels of trade and market capitalisation. These comparisons are in line with the already mentioned negative ranking of Kazakhstan (91st place) with respect to the efficiency of its financial system by the World Economic Forum.

Figure 2.16. **Stock market capitalisation (average), 2010-12**



Notes: Market capitalisation (also known as market value) is the share price times the number of shares outstanding. Listed domestic companies are the domestically incorporated companies listed on the country's stock exchanges at the end of the year. Listed companies do not include investment companies, mutual funds or other collective investment vehicles.

Source: OECD (2016a), *Multi-dimensional Review of Kazakhstan*: *Volume I. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en based on World Bank (2016e), *World Development Indicators* (database), http://databank.worldbank.org/data.

Furthermore, in the past few years, corporate lending was especially weak. This may partly be explained by the low profitability of enterprise loans relative to residential loans. As a result, lending to small businesses was hit hard by the banking crisis, but has already started to recover. This lending environment also led to much larger collateral requirements then in similar countries (OECD, 2016a).

These general observations are confirmed by the World Bank Enterprise Survey. Kazakhstani firms seem to be much less able to rely on external sources of finance than firms in similar countries. For example, only 19.2% of firms have a bank credit line compared to 36.5% in comparable countries; similarly, 83% of investment was funded internally compared to 73% in comparable countries. Also, the importance of equity or stock sales was about half as large as in comparable countries, in line with the very small stock market capitalisation in Kazakhstan (Table 2.3).

Besides traditional bank credit and equity financing, risk finance can be critical for early-stage projects and start-ups. The available evidence suggests that private risk financing not only plays a large role in Kazakhstan, but various government-owned entities provide risk financing through different intermediaries, often partly owned by foreign and domestic owners. These will be discussed in more detail below.

Table 2.3. **Financial indicators of firms**

Indicator	Kazakhstan	Eastern Europe and Central Asia	All countries
Percentage of firms with a checking or savings account	92.2	88.3	87.1
Percentage of firms with a bank loan/line of credit	19.2	36.5	35.1
Proportion of loans requiring collateral (%)	86.7	82.7	78.9
Value of collateral needed for a loan (% of the loan amount)	196.4	206.7	202.7
Percentage of firms not needing a loan	52.7	51.1	46.1
Percentage of firms whose recent loan application was rejected	30.7	8.5	12.1
Percentage of firms using banks to finance investments	16.3	24.2	25.3
Proportion of investments financed internally (%)	83.4	73	71.3
Proportion of investments financed by banks (%)	8.8	13.7	14.6
Proportion of investments financed by equity or stock sales (%)	2.9	6	4.7

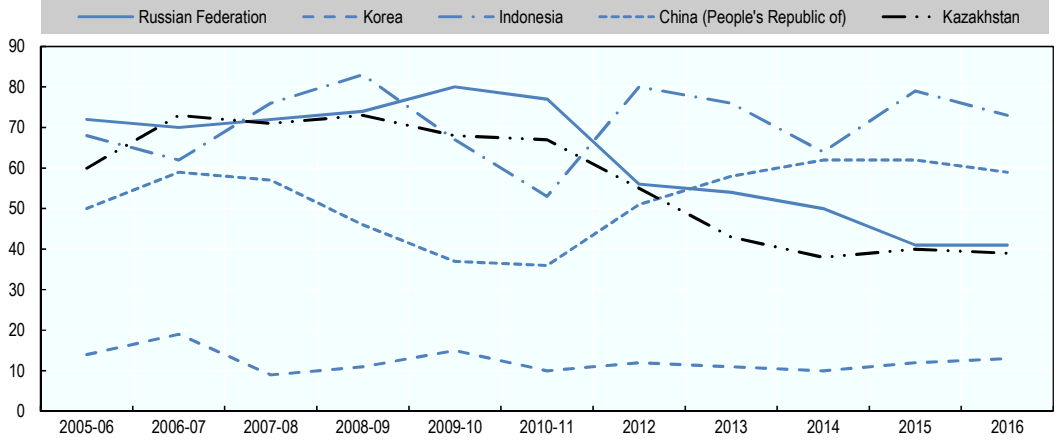
Source: World Bank (2016a), *Enterprise Surveys Data* (database), www.enterprisesurveys.org/data/survey-datasets.

ICT and transport infrastructure

Kazakhstan inherited an undeveloped ICT infrastructure from the Soviet Union. Recently, however, ICT infrastructure development was given a priority both by the government (including initiatives like "Digital Kazakhstan" and "Informational Kazakhstan") and by service providers. As a result, Kazakhstan's ICT infrastructure has improved rapidly in recent years.

Kazakhstan has "leapfrogged" the fixed-line telephony phase, and mobile penetration reached 187% in 2015, the fourth highest in the world. Similar to voice, Kazakhstan seems to partly leapfrog the phase of fixed-line broadband Internet (13% penetration in 2015) in favour of mobile broadband (60% penetration in 2015, 56th in the world) (World Economic Forum, 2016b). As a result, ICT infrastructure is rapidly developing, and providing access to information to many Kazakhstani citizens. Similar trends are indicated by the more broad-based Networked Readiness Index also published by the World Economic Forum (Figure 2.17).

Figure 2.17. **Networked readiness ranking, 2005-16**



Note: Until 2011 the *Global Information Technology Report* was biannual.

Source: Word Economic Forum (2016b), *The Global Information Technology Report 2016*, https://www.weforum.org/reports/the-global-information-technology-report-2016.

According to the World Bank Enterprise Surveys (World Bank, 2016a), Kazakhstan firms seem to be using Internet technologies to a similar degree as firms in comparable countries. About 44% of surveyed firms have a website, and 88% of them use email to keep in contact with business partners.

According to the Global Competitiveness Index (World Economic Forum, 2016a), Kazakhstan ranks 63rd in terms of infrastructure. While the railroad and air transport infrastructure are relatively advanced, the quality of road infrastructure is weak (108th place). This is partly a consequence of the large size of the country paired with low population density, and may present an obstacle for firms to reach remote domestic as well as foreign markets. Recently, plans were announced for comprehensive infrastructure development, including all modes of transportation (Alibekova, 2013). One priority of these plans is to participate in the "New Silk Road" proposed by China, which is aimed at creating an efficient inland transportation network from China to Europe through Kazakhstan, the Russian Federation and Belarus (The Economist, 2014). Such developments, especially if coupled with less red tape, can boost the transport sector and international trade, and hence increase the effective market size of competitive Kazakhstani firms.

The role of innovation in future development

Productivity growth is the most important determinant of economic growth in a long-term perspective. It is also key in achieving non-economic development goals, including the eradication of poverty or providing world-class healthcare for the population. In countries which are not operating at the technology frontier, there is much scope to increase productivity by adopting and adapting foreign-developed technologies and facilitating structural change by increasing the competitiveness of industries using advanced technology. This also applies to Kazakhstan. Such a strategy requires building up domestic capacity to monitor, assess, and if required adapt, scientific and technological developments, both at universities and research institutes and in the business sector. These capabilities are critical for enabling these actors to absorb knowledge and apply the most advanced technologies. Such capacity, in turn, requires high levels of competence, which is most likely to be gained by conducting original research and participating in international scientific and technological endeavours.

In summary, innovation can make at least three key contributions to the future of Kazakhstan:

1. It can help Kazakhstan to adopt advanced technologies by building the required absorptive capacity. It also helps to find solutions to specific local problems.
2. It facilitates structural transformation and reallocation, in particular in making manufacturing and high value-added services more competitive in international markets.
3. Innovation is important in reaching non-economic development goals like reducing pollution, providing high-quality healthcare and fighting poverty.

In meeting these challenges, Kazakhstan has a number of advantages, but also faces obstacles. A major comparative advantage is its vast mineral wealth. Industries exploiting this wealth can both exert demand and provide financing for innovation. The geographical position of Kazakhstan is also an important potential advantage, especially if the country succeeds in exploiting the opportunities arising from being located on one

of the potentially great trade routes of the 21st century by improving its infrastructure and facilitating international trade in all possible ways. Stable macroeconomic conditions and strategic planning have resulted in better framework conditions for innovation; cutting red tape, supporting the development of the ICT infrastructure and providing public funding for innovative ideas are all very important in this regard.

Resource abundance, at the same time, also presents a challenge for diversifying the economy. The development of human capital is also a key issue, as relatively low skills of the workforce often hold back firms from implementing more advanced technologies. Similarly, there is a need to help the financial sector to become more effective in intermediation and providing capital for small young firms in order to enable them to experiment effectively with new ideas, methods of production and business organisation.

Synthesis

The main achievements and remaining challenges related to economic performance and framework conditions for innovation are presented in the Table 2.4.

Table 2.4. **Achievements and challenges related to economic performance and framework conditions for innovation in Kazakhstan**

Achievements and progress	Remaining challenges
Macroeconomic performance	
• Strong GDP growth (since the 2000s until the recent slowdown), briefly interrupted by the global financial crisis • High productivity growth until recently, about twice as fast as the average of countries with similar levels of initial productivity • Slight increase of the competitiveness of manufacturing relative to the extractive sectors recently	• Labour productivity level remains low, resulting in low GDP per capita in international comparison • Multifactor productivity growth decreased during 2008 and 2009 and has remained low since 2010, suggesting a fall in the rate of technological upgrading • Small employment share of knowledge-intensive services, such as ICT; finance and insurance; and professional, scientific and technical services • Largest recipient of FDI in Central Asia • Low diversification of FDI inflows in terms of originating countries and target industries
Framework conditions	
• ICT infrastructure of Kazakhstan has improved rapidly in the recent years • Very significant progress in terms of reducing administrative burdens • Relatively light process dealing with the state bureaucracy, for instance to open a business • Well-functioning labour market	• Limited entrepreneurship • Low efficiency of product and service markets, limited competition in some key markets • Perceived corruption is still relatively high • Corporate lending has been especially weak in recent years • Development of human capital to implement more advanced technologies

Notes

1. It should be noted, however, that this correlation is far from perfect. Some countries spectacularly failed to catch up, while others did so at a far slower pace as predicted by the simple catch-up hypothesis. "Absorptive capacities" or broader "social capabilities" were invoked to account for theses variations in performance.
2. The negative relationship between the level of development and inter-sectoral productivity differences is shown by Figure 2.2 in McMillan and Rodrik (2011).
3. This number is similar to what is estimated for comparable countries, for example Brazil, Colombia, Thailand or Turkey (McMillan and Rodrik, 2011). Such reallocation would increase aggregate productivity in more developed countries (e.g. Hong Kong, China and Korea) less and much more (above 100%) in China, India or Indonesia.
4. The recent literature about the relationship between competition, innovation and growth is surveyed by Aghion, Akcigit and Howitt (2013).
5. It should be noted, however, that there are considerable problems related to the measurement of the number and activity of SMEs in emerging economies. About half of small firms were inactive (OECD, 2016a). Hübner (2000) provides an example when during a mandatory data collection exercise for Almaty-based SMEs only 18% of SMEs reported any activity and 22% did not complete the exercise at all.
6. Note that the definition of small and medium-sized enterprises in Kazakhstan relies exclusively on the number of employees; revenue does not play a role in defining firm size categories.
7. Austria, Belgium, Denmark, Finland, France, Germany, Norway, Sweden and the United Kingdom.
8. In fact, these numbers are not comparable because since 2014 Kazakhstan's definition of an SME relies only on the number of employees. In 2013 the definition also used revenue criteria, and in that year the SME share of employees working in SMEs was only 21% while the GDP share was 6.5%, making the difference between Kazakhstan and OECD countries even larger.
9. In the comparison group, firms employing 46% of employees produce 41% of GDP on average.

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Chapter 3

Innovation performance in Kazakhstan

This chapter examines the innovation capabilities and performance of the business and public research sectors in Kazakhstan. It begins with a review of the significant increase in research and development (R&D) efforts, as evidenced by the increase in science, technology and innovation expenditures and personnel, which still remain insufficient and uneven. It then examines the mixed results of these efforts in terms of scientific publications and patents.

This chapter analyses Kazakhstan's research and innovation inputs and performance outputs as a backdrop to the assessment of the public research, business innovation and public governance systems that will be developed in the rest of this review.

The chapter shows that, following the degradation of the research and higher education performance after independence, at the beginning of the 2000s the government of Kazakhstan started to gradually increase the national research and development (R&D) effort and initiated major legal reforms, strategies and programmes affecting scientific and technological activities. These initiatives have resulted in improvements in the delivery of research activities. However, as yet, these positive developments have mainly concerned science outputs, and have not yet been turned into innovation and economic value. The performance of the research and innovation system in terms of commercialisation of research results has remained weak and been concentrated in a few public institutions. Moreover, results are confined mostly to a few public research organisations. Companies have not yet taken a leading role in this regard.

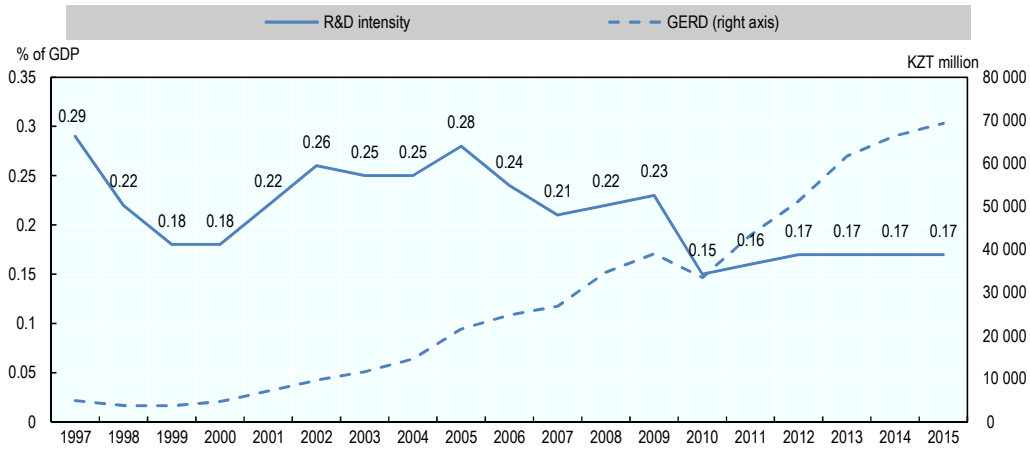
Innovation inputs

A major and widely used input indicator for a country's ability to mobilise resources for R&D and to some extent innovation at national level is gross expenditure for R&D (GERD). This capacity differs markedly across countries not only in terms of the level of effort, but also with regards to its allocation and balance between the funding and performance of the different types of R&D performing sectors, and the type of activities from fundamental research to, for instance, prototyping and demonstration. A number of indicators shed light upon the current trends in Kazakhstan and its position relative to OECD and selected benchmark countries.

R&D expenditure

R&D expenditure grew from about KZT 11 billion in 2003 to KZT 69.3 billion in 2015 (Figure 3.1). This rise of investment in R&D has, however, not translated into a concomitant increase in R&D intensity (the ratio of GERD to gross domestic product [GDP]) as the country experienced rapid economic growth during the same period. Against this background, the R&D intensity decreased from a peak of 0.28% in 2005, and has stagnated with some fluctuations between 0.15% to 0.17% since 2010.

Figure 3.1. **R&D intensity and gross expenditure for R&D in Kazakhstan**

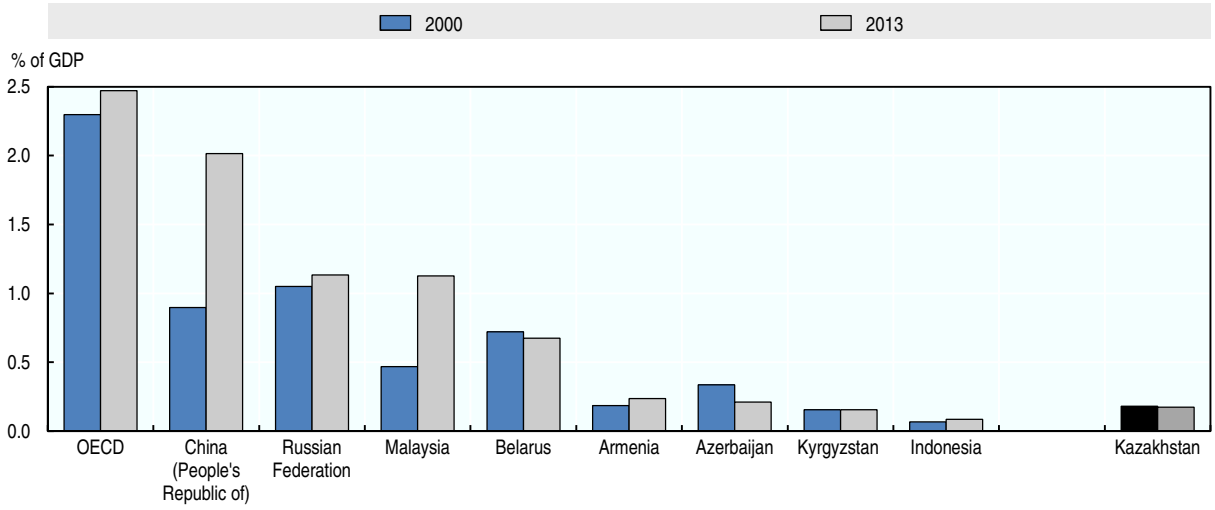


Note: GERD: gross expenditure for R&D.

Sources: UNESCO (2016), *UIS.Stat* (database), http://data.uis.unesco.org; World Bank (2016a), *World Development Indicators* (database), http://data.worldbank.org/indicator/SP.POP.SCIE.RD.P6?view=chart; Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz (accessed 14 October 2016).

According to the Global Innovation Index 2016, Kazakhstan occupies 92nd place (out of 128) in terms of R&D intensity (Cornell University, INSEAD and WIPO, 2016). Despite strong efforts, Kazakhstan does not distinguish itself from other Central Asian countries which also suffer from low investment in R&D. All countries in the region are in the 0.12-0.17% bracket, except Uzbekistan, which experienced a steep increase of its R&D intensity, reaching 0.41% in 2013.[1]

Figure 3.2. **Research and development expenditure: International comparison**



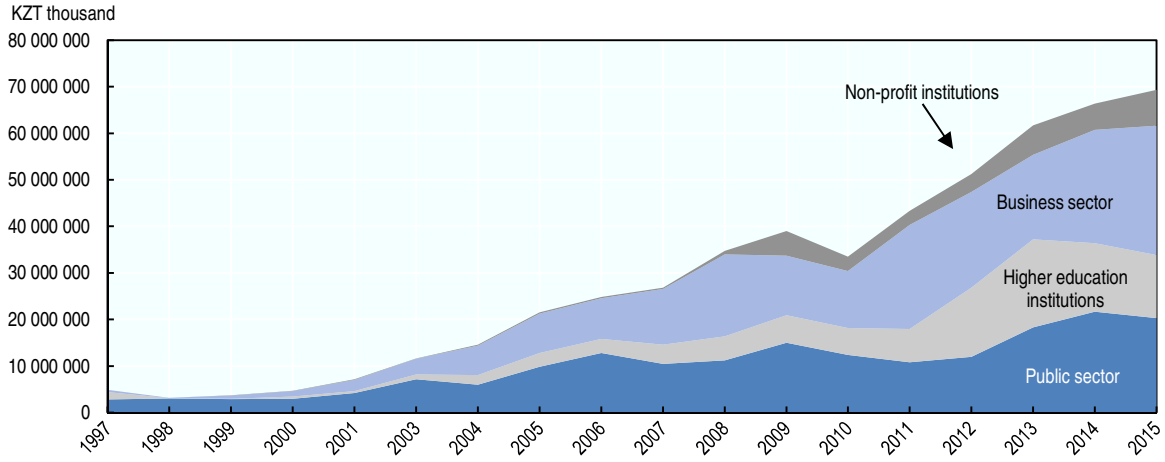
Note: Some 2013 data were missing and replaced by 2012 for OECD, Kyrgyzstan and Malaysia.

Source: World Bank (2016a), *World Development Indicators* (database), http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

Accordingly, Kazakhstan's GERD is far below the OECD average of 2.5% (2013) and most benchmark countries such as the People's Republic of China (hereafter "China"), the Russian Federation, Malaysia or Belarus (Figure 3.2). As will be discussed in Chapter 5, it also does not reach the targets set repeatedly in various government strategies and programmes (2% in 2020). According to World Bank data, Kazakhstan substantially lags behind other countries when R&D expenditure per head is considered. In 2013, GERD per capita (in PPP terms) amounted to USD 35 in Kazakhstan, well below the USD 174 per capita invested in the Russian Federation (World Bank, 2016a) and the USD 895 per capita average investment in OECD countries (OECD, 2016b).

Differences in volumes and shares of the particular types of R&D institutions in the execution of domestic R&D efforts indicate different profiles of national innovation systems. In Kazakhstan, all R&D performing sectors have steadily increased the volume of their R&D activities since 2000. This trend has resumed at an accelerated pace as from around 2010, once the first shock of the global financial crisis was absorbed and major reforms of the innovation system were initiated. The latest data available (for 2014 and 2015), reinforced by anecdotal evidence regarding 2016, suggest that this increase of resources invested in R&D has paused due to a less favourable global macroeconomic environment and, more recently, strains on public finances related to the drop in commodity prices.

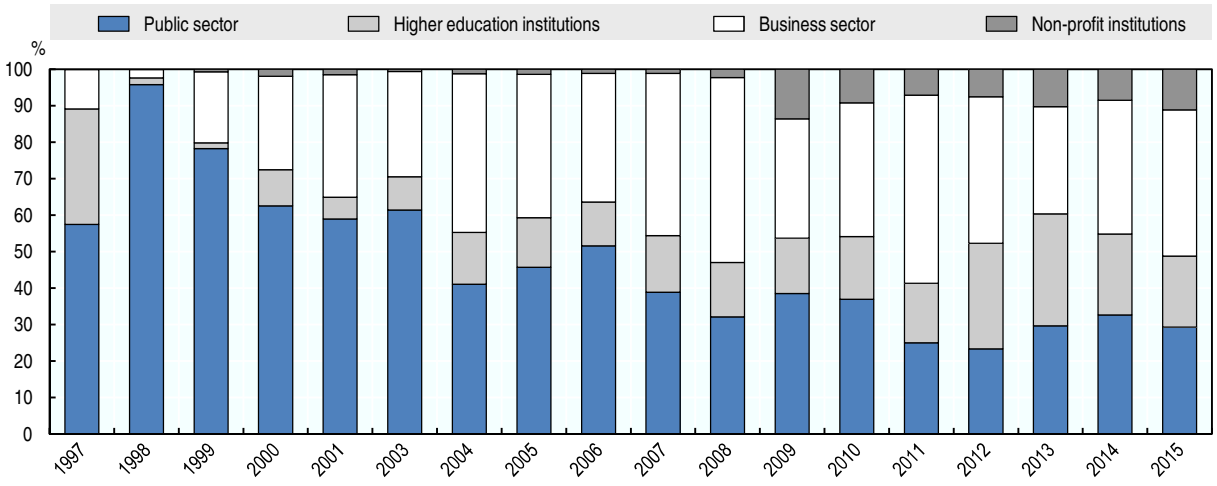
Figure 3.3. **Gross expenditure for R&D by performing sector in Kazakhstan**



Source: UNESCO (2016), *UIS.Stat* (database), http://data.uis.unesco.org/.

Although the respective weights of performing sectors fluctuated significantly over the period, some general trends can be identified for the last 15 years or so: higher education institutions (HEIs) have become relatively more prominent as R&D performing organisations, in line with international developments. This trend was mirrored by the development of the public research institutes (PRIs) which had emerged from the Soviet times as the only organisations performing research. The share of the business sector has remained rather stable in recent years, with a peak at 52% in 2011. The business sector performed about 40% of R&D in 2015, while HEIs and PRIs performed 19% and 29%, respectively, of the GERD (Figure 3.4).

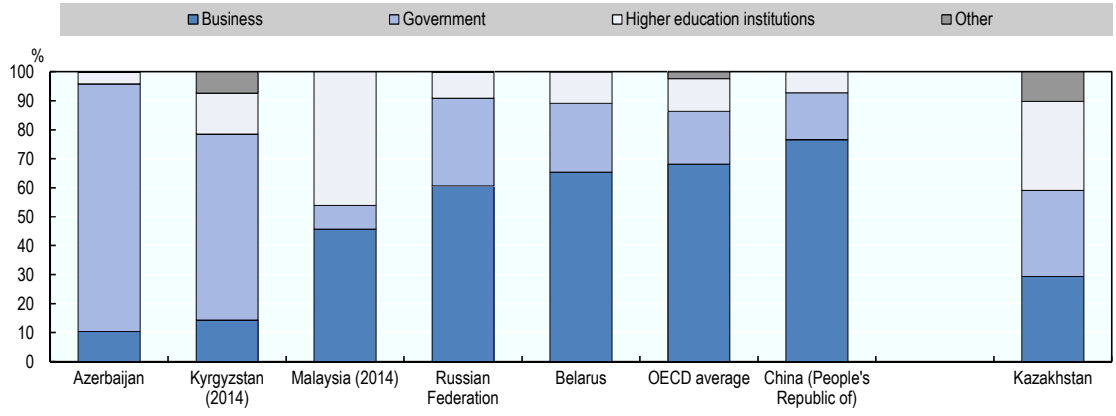
Figure 3.4. **Share of gross expenditure for R&D by performing sector in Kazakhstan**



Sources: UNESCO (2016), *UIS.Stat* (database), http://data.uis.unesco.org; Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz (accessed 14 October 2016).

At about 30%, the role of the business sector is low by international standards, especially compared to the OECD average of 68%. Kazakhstan also substantially lags behind countries like China and Malaysia in terms of business engagement in R&D. However, it is much higher than most of the post-Soviet Union countries in the sample. Business R&D and innovation activities are analysed in more detail in the Chapter 4.

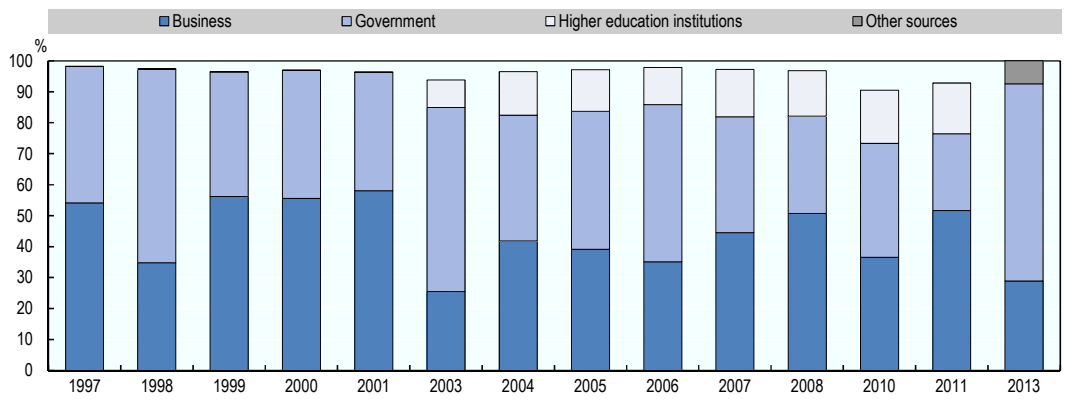
Figure 3.5. **Gross expenditure for R&D by performing sector in a sample of countries, 2013**



Sources: UNESCO (2016), *UIS.Stat* (database), http://data.uis.unesco.org; OECD (2016a), "Main science and technology indicators", *OECD Science, Technology and R&D Statistics* (database), http://dx.doi.org/10.1787/data-00182-en for the OECD average.

The source of funds is characterised by a high degree of volatility in the composition of R&D funding. The business sector funds about 50% of the total GERD, whereas PRIs and HEIs contributed respectively 25% and 16% in 2011, the last year with a complete set of data. The truncated data available for 2013 show a strong increase of the R&D expenditures funded by government (64%) and a decrease of the funds originating from the business sector (29%). Although the volatility of the data series does not allow robust international comparisons on the basis of any given year, the share of R&D financed by business firms in Kazakhstan (below 40% on average) appears in any case below the OECD average (about 60%), but above what it was in 2013 in Azerbaijan or the Russian Federation (both at around 30%).

Figure 3.6. **Gross expenditure for R&D by source of funds in Kazakhstan**



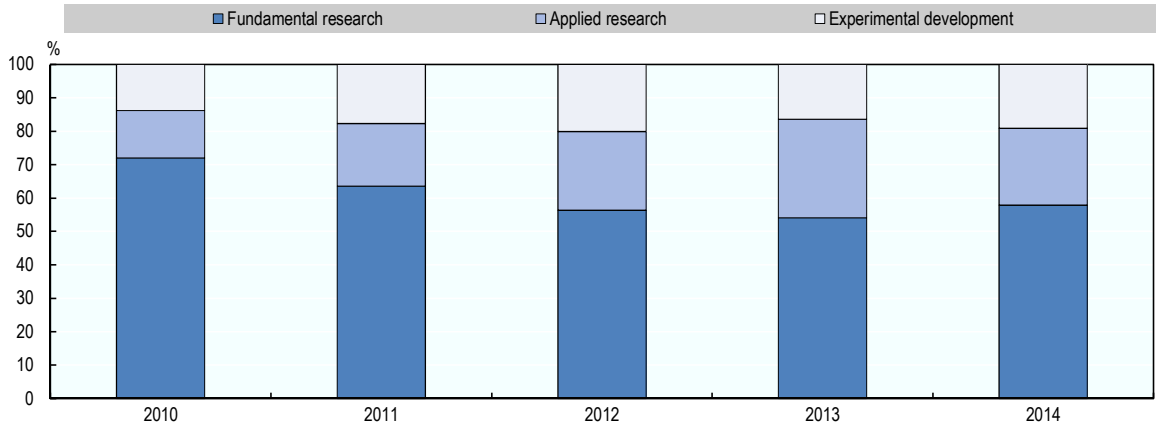
Note: No data available for 2012. Data for HEIs and other sources not available for 2013.

Sources: UNESCO (2016), *UIS.Stat* (database), http://data.uis.unesco.org; OECD (2016a), "Main science and technology indicators", *OECD Science, Technology and R&D Statistics* (database), http://dx.doi.org/10.1787/data-00182-en.

Although its share has decreased in recent years, more than half of R&D expenditures are still dedicated to fundamental research. More downstream research, i.e. applied research and experimental development, have increased their relative importance, which could be perceived as a positive signal of a shift towards market-oriented research and

innovation. Nevertheless, the share of experimental development is still far below the level of advanced countries (62% in Japan and 35% in France in 2013). More precise data from the Committee on Statistics for the year 2014 show that PRIs are mainly involved in applied research (65% of their research performed), while HEIs have a more balanced portfolio of activities between fundamental research (41%) and applied research (53%). Not surprisingly, business companies focus on applied research (47%) and development (42%). They execute 81% of development activities (whereas PRIs and HEIs account for about 6% each).

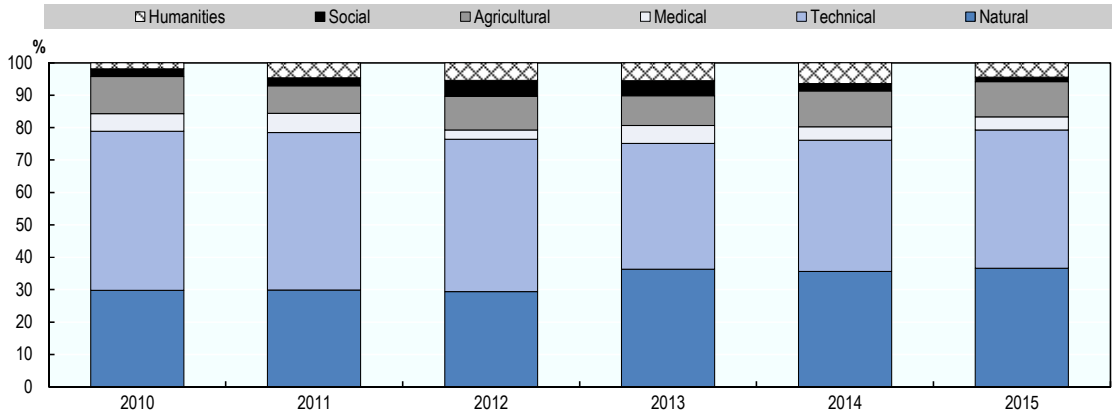
Figure 3.7. **Gross expenditure for R&D by type of activity in Kazakhstan**



Source: IAC (2015), "Country background report, OECD Innovation Policy Review of Kazakhstan" based on data provided by the National Centre for Scientific and Technical Information.

The biggest share of R&D funds is invested in natural (37%) and technical sciences (43%), as it is the case in other Central Asian economies. This is comparable with many OECD countries (i.e. in Chile it is 30% and 33% and in Hungary 25% and 53%, respectively. In accordance with the importance of this sector in the economy of Kazakhstan, agricultural research is the third largest field of science (11%). Research in social sciences is very limited, as is medical research.

Figure 3.8. **Gross expenditure for R&D by field of science in Kazakhstan**



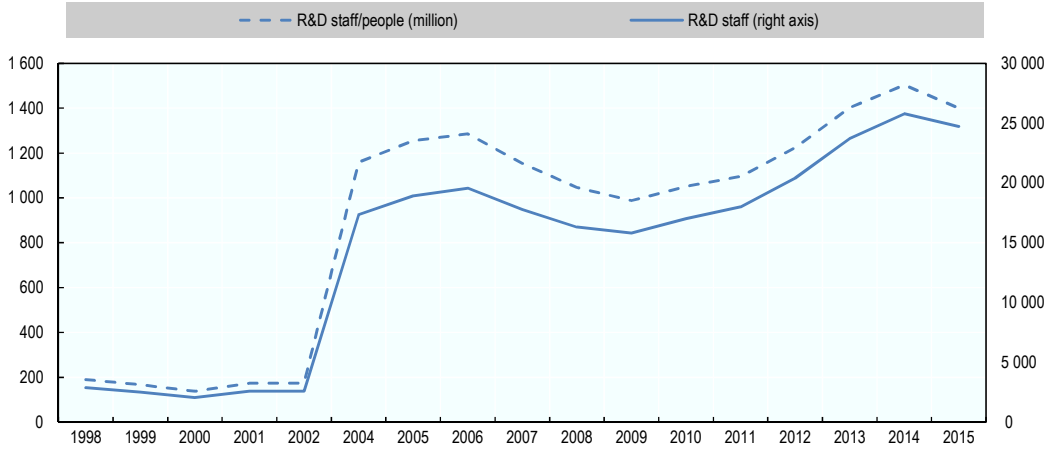
Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz (accessed 14 October 2016).

R&D personnel

The number of staff occupied in R&D in the public sector or in business enterprises, if suitably qualified, is an indicator of that part of a country's labour force which is able to perform research and innovation activities, and its ability to absorb, develop and diffuse economically useful knowledge.

In Kazakhstan, the relative size of the population employed in R&D increased dramatically in 2002-04, then again in 2012 after five years of steady decrease (Figure 3.9). The total number of staff (full-time equivalent) employed in R&D per million inhabitants in Kazakhstan reached 1 503 in 2014, which is significantly less than in countries such as Finland (9 513), Sweden (8 602), Japan (7 061), France (6 588) or the United Kingdom (6 030).

Figure 3.9. **Number of staff occupied in R&D and share of R&D staff in the population**

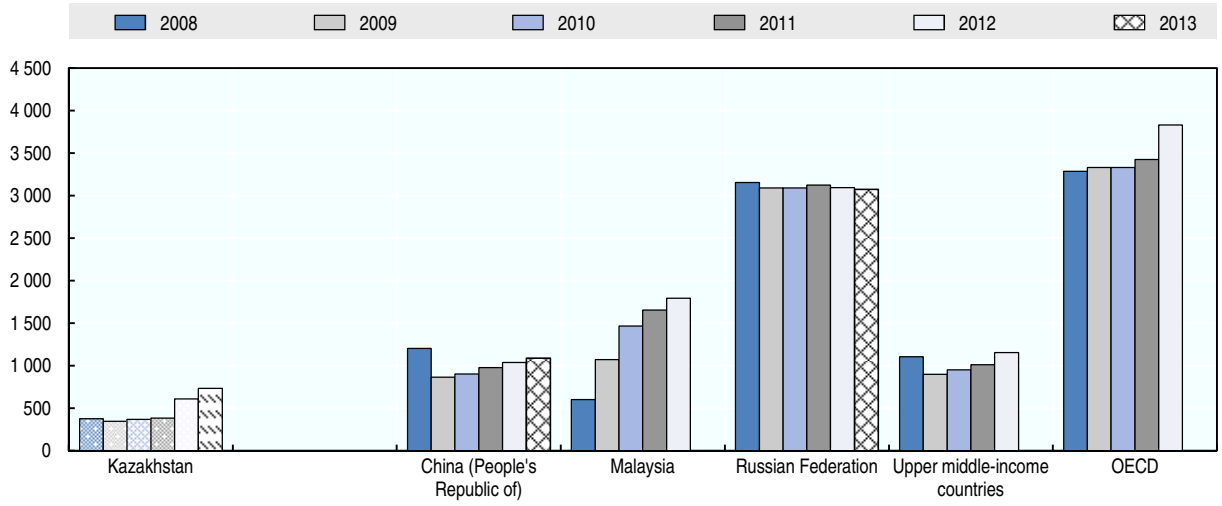


Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz (accessed 14 October 2016).

As expected, Kazakhstan lags behind the OECD average, the Russian Federation, Malaysia and China with regards to the relative size of its research community (Figure 3.10). More strikingly, it is also about half the average size of countries with a similar level of development (upper middle-income countries according to the World Bank country typology).[2] Even in countries such as Egypt, Pakistan and Turkey, the relative number of researchers is several times higher than that in Kazakhstan (NAS, 2016).

More than 70% of personnel employed in R&D in 2014 were researchers and specialists, whereas technical staff represented only 15%. In line with the comparatively low share of the "development" component of R&D, this proportion appears rather high in international standards, above the Russian Federation and not far from the level observed for Malaysia (Table 3.1). Almaty remains the main scientific centre of Kazakhstan, where more than 40% of all R&D personnel of Kazakhstan are located (NAS, 2016).

Figure 3.10. **Researchers in R&D (per million people)**



Source: World Bank (2016a), *World Development Indicators* (database), http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

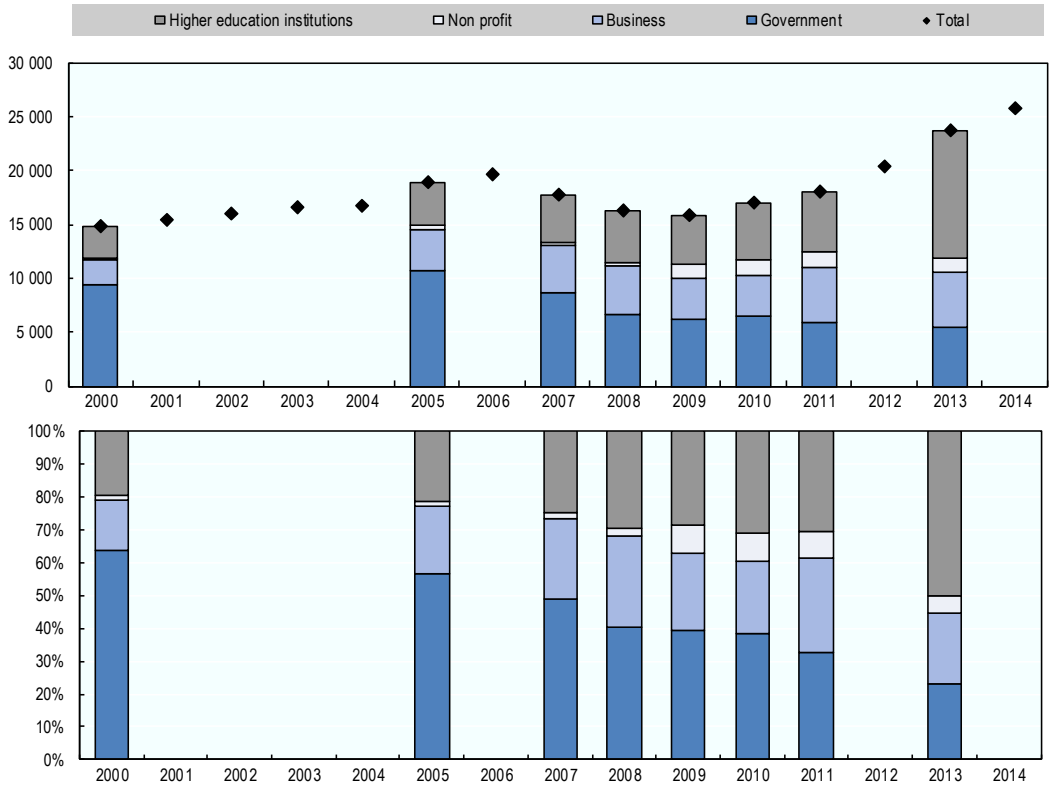
Table 3.1. **Persons employed in R&D by staff categories, 2014**

	Kazakhstan		Russian Federation		Malaysia	
Type of personnel	Number	%	Number	%	Number	%
R&D researchers, specialists	18 930	73.4%	444 865	53.7%	61 351	81.7%
Technical staff	3 882	15.1%	71 843	8.7%	6 336.6	8.4%
Other workers	2 981	11.5%	31 2481	37.7%	7 374.4	9.8%
Total	25 793	100%	829 189	100%	75 062	100%

Sources: NAS (2016), "National report on science 2015" – for Kazakhstan; UNESCO (2016), *UIS.Stat* (database), http://data.uis.unesco.org – for Malaysia and the Russian Federation.

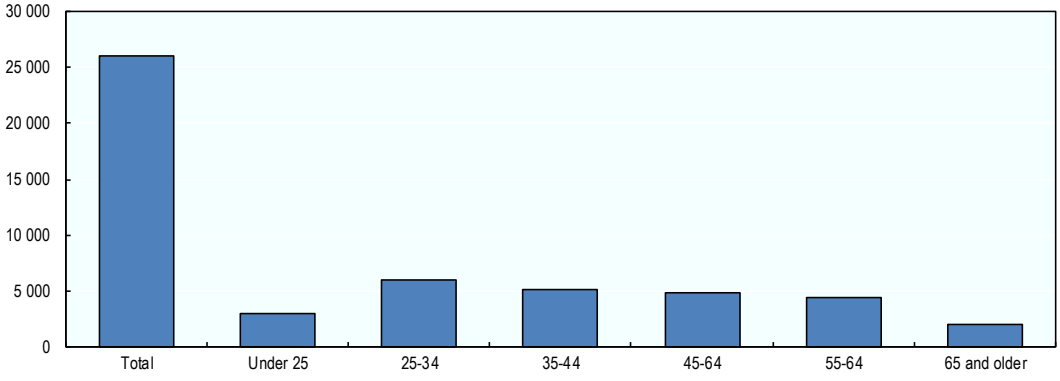
The distribution of R&D-related staff according to the type of R&D organisation (Figure 3.11) provides clear evidence of the ongoing changes in the R&D system of Kazakhstan in the last 15 years, i.e. the increasing number and share of R&D personnel in universities and the inverse trend in government research institutes. It should be noted that while the latter trend started at least in the early 2000s, the increase in human resources for research at universities has only accelerated since 2011 and the Law "on Science". While the number of R&D personnel in business companies doubled between 2000 and 2013, the increase has been much more gradual, accelerating from 2010 up to the latest data available in 2013. The increase of the share of business companies is far less impressive, starting from 15% in 2000 up to only 21% in 2013. In 2013, business companies employed 27% of R&D personnel in Romania and 56% in the Russian Federation. Among OECD countries, it was, for instance, 15% in Lithuania, 38% in the United Kingdom, 44% in Hungary, 59% in France and 70% in the Netherlands.

Figure 3.11. **Number and share of R&D personnel by type of R&D organisation**



Source: UNESCO (2016), *UIS.Stat* (database), http://data.uis.unesco.org/.

Figure 3.12. **Age distribution of R&D employees**



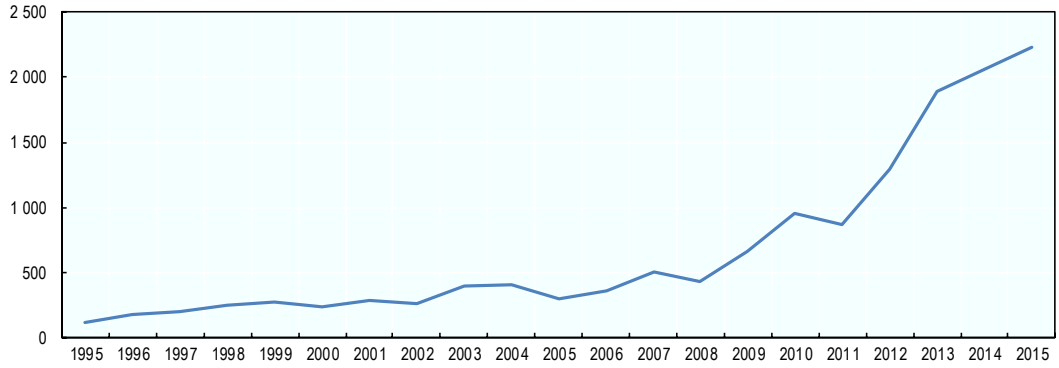
Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz (accessed 14 October 2016).

According to an analysis of recruitment over the last ten years, the age distribution of R&D personnel in Kazakhstan shows that a large number of R&D employees are less than 35 years old (Figure 3.12). This wave of new recruitments has started to significantly change the overall age structure of personnel which previously, further to the slowdown in hiring in the 1990s, counted a majority of personnel 45 years old and more.

Kazakhstan joined the European Bologna process in 2011 and substituted the two-level Soviet system (Candidate and Doctor of Science) by the PhD degree, which somewhat simplified the correspondence to international classification. The number of PhDs has risen steadily since the 1990s, and especially since around 2008. It multiplied fivefold between

2010 and 2015 (Figure 3.13). It should be also highlighted that Kazakhstan is the only Central Asian country where gender parity is achieved (UNESCO, 2015). However, the number of PhD students, and even more, of graduations in Kazakhstan, is still very low by international standards. The number of finished and defended theses remains very small relative to the number of entrants about three or four years before. In 2012, 565 students started a doctorate. In 2015, only 175 students defended their thesis. Although increasing (the number of PhD theses was about 100 in 2012 and 2013, and reached 125 in 2014), the resulting number of doctorates remains below what is required to feed the necessary increase of researchers in both the public and private sectors (OECD, 2016c).

Figure 3.13. **Number of PhD students in Kazakhstan**



Note: Before 2010 Candidate and Doctor of Sciences classification was used instead of PhD.

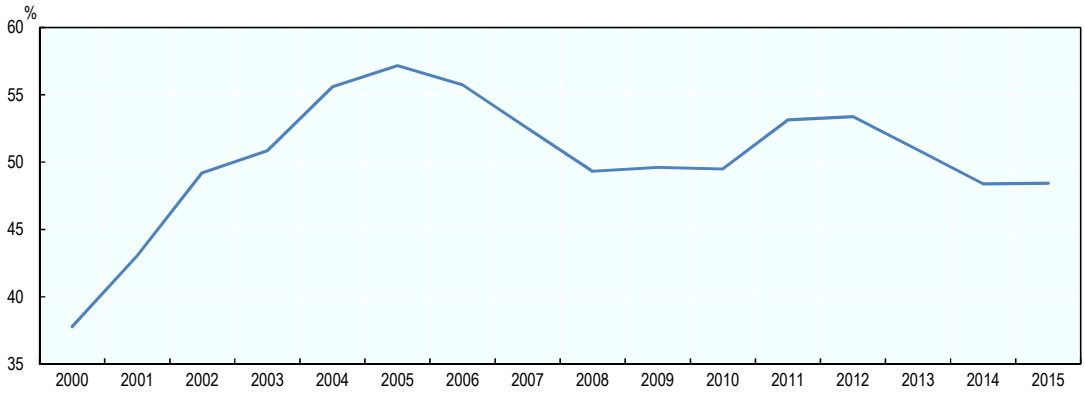
Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz (accessed 14 October 2016).

Education

The number of students enrolled in higher education decreased substantially from 2006 to 2016, which is an issue of concern for the country. With the exception of Astana, all regions show substantial decline in student numbers. One of the reasons generally put forward in official publications to explain this trend is the decline in the birth rate in Kazakhstan in the 1990s. According to demographic forecasts, the decline of the numbers of young people entering higher education will continue until 2020 (Bologna Process, 2015).

Figure 3.14. **Gross enrolment in higher education**

Ratio of the total number of students

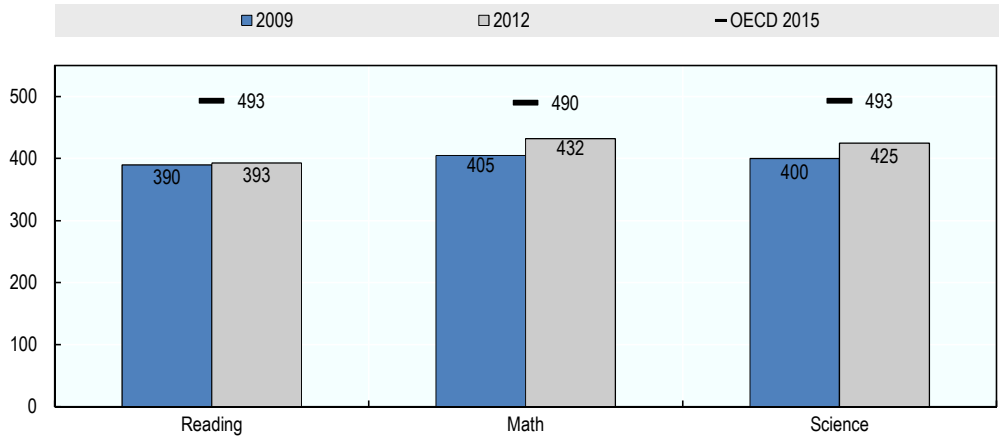


Note: The gross enrolment rate in higher education is defined as the ratio of the number of students, regardless of age.

Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz (accessed 14 October 2016).

Kazakhstan actively participates in the OECD Programme for International Student Assessment (PISA). The country's performance substantially improved between 2009 and 2012 (Keiko and Gortazar, 2014). Mathematics and science performance improvements equivalent to more than half a year of schooling were achieved. According to the OECD, 40 points in PISA is equivalent to what students learn in one year of schooling. These improvements reduced the gap with other countries in Europe and Central Asia by almost half. However, performance on reading improved only marginally and overall reading achievement remained low, with some groups of students actually performing worse in 2012. Almost six out of every ten students lack basic reading skills. Most importantly, Kazakh reading scores still lag about one year of schooling behind the average for Europe and Central Asia and almost two years of schooling behind the OECD average. PISA results also show that the type of learning is too academic, enabling students to apply what they have learned only imperfectly in a real-life situation. The higher education review team came to the similar conclusion that, both at the higher education level and in the years that lead up to entry to that level, the development of broad cognitive skills is less of a focus than the memorisation of facts (OECD, 2016c).

Figure 3.15. **Average mean scores in reading, mathematics and science in Kazakhstan and OECD**



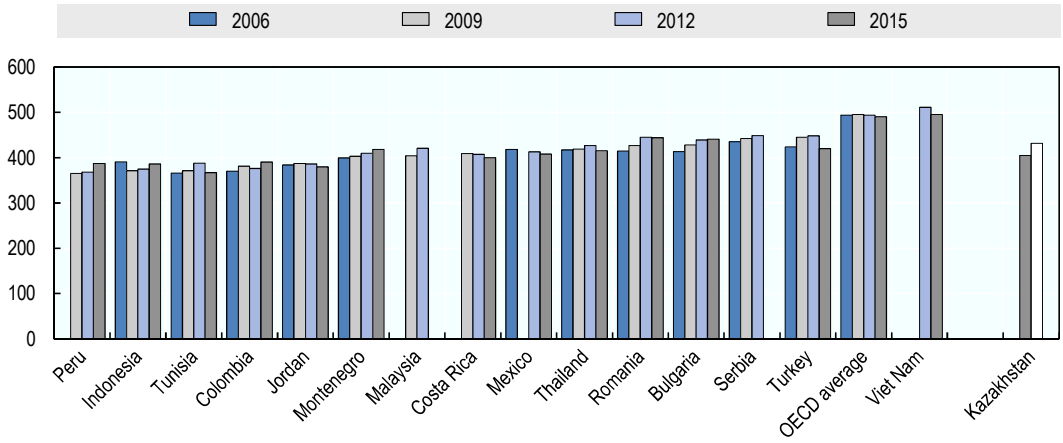
Note: 2015 data for Kazakhstan is not included, because the coverage is too small to ensure comparability.

Sources: OECD (2014), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, http://dx.doi.org/10.1787/9789264208780-en; OECD (2016c), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, http://dx.doi.org/10.1787/9789264266490-en.

Fifteen-year-old students in all surveyed middle-income countries with the exception of Viet Nam achieved lower performance than students in OECD countries (Lockheed, Prokic-Bruer and Shadrova, 2015). However, among these countries, Kazakhstan compares favourably, as shown by the comparison of results in mathematics. With Albania and Malaysia, it is among the countries with the largest average annual improvement, at more than 5 points per year.

It should be noted that among the countries that participated in the PISA in 2012, public expenditure on education was the lowest in Kazakhstan, which likely hampers the country's ability to ensure effective learning for all (Keiko and Gortazar, 2014).

Figure 3.16. **Average scores in mathematics in a selection of middle-income countries, PISA**



Note: 2015 data for Kazakhstan and Malaysia is not included, because the coverage is too small to ensure comparability.

Sources: OECD (2014), *PISA 2012 Results: What Students Know and Can Do (Volume I, Revised edition, February 2014): Student Performance in Mathematics, Reading and Science*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264208780-en; OECD (2016c), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264266490-en.

Synthesis

The main achievements and remaining challenges related to research and innovation inputs are presented in Table 3.2.

Table 3.2. **Achievements and challenges related to research and innovation inputs**

Achievements and progress	Remaining challenges
• Significant increase in the volume of R&D investment • More prominent research activities of higher education institutions (increase of expenditures and R&D staff) • Dramatic increase of the number of PhD students • Good performance in mathematics in international comparison	• R&D intensity stable at a low level (0.17% of GDP) in recent years, below the level achieved by most comparable countries • Stable share of business sector research expenditures in recent years (at around 40% of gross expenditure on R&D in 2015); low by international comparison • Role of business sector weaker than in most other comparable countries as a source of funds for research and employer of R&D staff • Low relative size of the population employed in R&D by international comparison, despite an increase • Substantial decrease of student enrolment in higher education • High rate of drop outs in doctoral studies • Reading performance in PISA assessments still lagging behind Europe and Central Asia average in spite of significant improvements

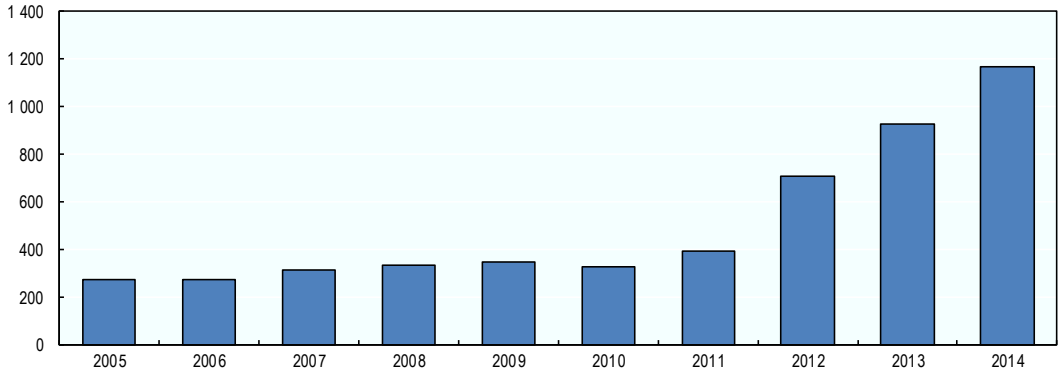
Innovation outputs

Scientific publications

In the last few years, the number of Kazakhstani scientific publications has substantially increased (Figure 3.17). Since 2010, it has increased threefold according to the Web of Science and has doubled according to Scopus. While on an upward trajectory, the number is low (1 168 publications in 2014) by the standards of developed countries.[3] Kazakhstan's scientific performance also appears very low when the number is normalised by the number of population: it was 198 publications per million inhabitants

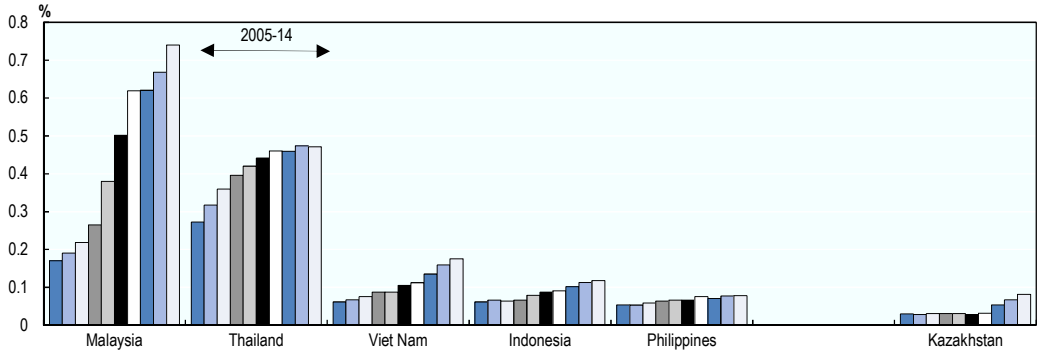
over the period 2011-14, compared with 6 707 in Germany, 11 833 in Australia (OECD, 2016c) and 3 126 in Malaysia (OECD, 2016d). Kazakhstan occupies 85th position among 239 countries in terms of number of publications. About 95% of all Kazakhstani articles have been published in English and only 4.7% in Russian (NAS, 2015).

Figure 3.17. **Total number of Kazakhstani publications in the Web of Science**



Source: OECD (2017), *Higher Education in Kazakhstan 2017*, www.oecd.org/publications/higher-education-in-kazakhstan-2017-9789264268531-en.htm.

Figure 3.18. **World share of publications in the Web of Science international citation database, Kazakhstan and select Southeast Asian countries**



Source: Thomson Reuters Web of Science, updated and based on calculations made for IVA (2013), *Sweden's Global Connectivity in Research: An Analysis of International Co-authorship*, www.iva.se/globalassets/rapporter/agenda-for-forskning/agenda-for-forskning-swedens-global-connectivity-in-research.pdf.

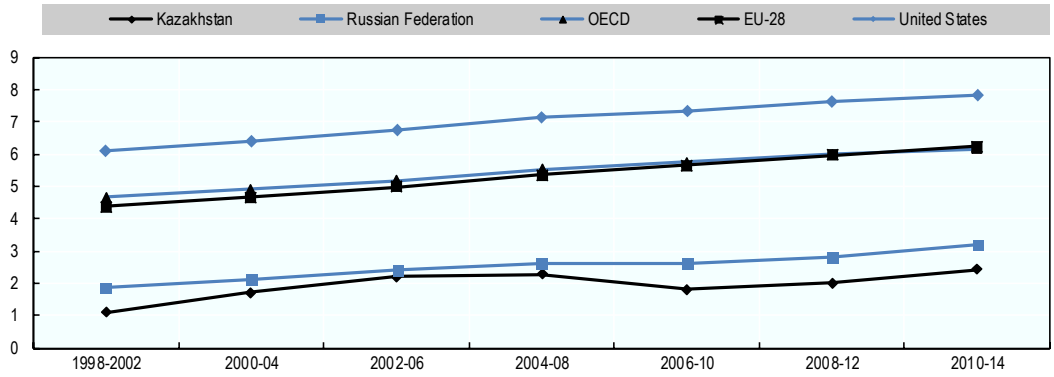
The share of Kazakhstani publications in the world increased from 0.017% in 2005 to 0.08% in 2014 in the Web of Science database (Figure 3.18). Similar results are obtained from the Scopus database. This share is below the publication performance of emerging countries such as Malaysia and Thailand, as well as of Indonesia and Viet Nam. The increase since 2010 has allowed Kazakhstan to catch up with countries such as the Philippines. It is also important to note that these countries are lagging far behind more advanced countries. The Russian Federation, for instance, not shown in Figure 3.18 for the sake of clarity, accounted for 1.75% of world publications in 2014 and 2.05 in 2015.

In the Web of Science Core Collection, publications from Kazakhstan are distributed across fields of science as follows: 35% physics, 25% life sciences and biomedicine, 21% technical and applied sciences, 18% social sciences and 1% arts and others (NAS, 2015). Kazakhstan's research organisations have performed well in terms of number of

publications at international level in fields such as mathematics, plasma physics and high-energy physics, biotechnology, geology, metallurgy, and chemical engineering (NAS, 2015).

Figure 3.19 shows the citation impact for Kazakhstan in comparison with the Russian Federation, the European Union average, the OECD average and the United States.[4] While Kazakhstan is almost at a par with the Russian Federation, its impact per paper is about 40% that of the OECD or EU28 countries' averages.

Figure 3.19. **Citation impact of publications by country/region in Web of Science journals by five-year period**



Source: OECD (2017), *Higher Education in Kazakhstan 2017*, http://dx.doi.org/10.1787/9789264268531-en, based on InCites Global Comparisons: Compare Countries/Territories 5 Year Trends, Thomson Reuters.

Table 3.3 reflects the InCites information about the citation level in the world. Kazakhstan has strongly improved its results since 2011, outdriving all Eurasia Economic Community (EAEC) countries except Armenia and has almost reached the world average level (normalised to 1).

Table 3.3. **Citation of publications in Kazakhstan and other EAEC countries**

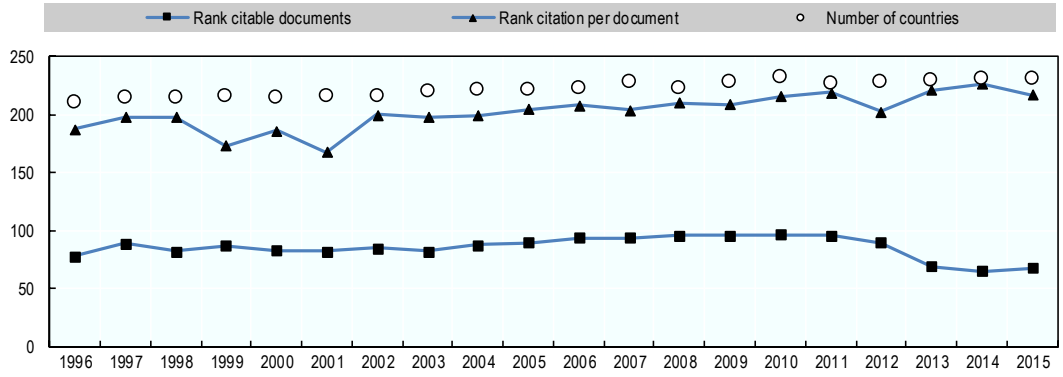
Comparison to the world average (=1)

	2011	2012	2013	2014	2015
Armenia	0.95	1.64	1.47	1.12	1.12
Belarus	0.71	1.12	0.93	0.88	0.87
Kazakhstan	0.49	0.68	0.52	0.59	0.95
Kyrgyzstan	0.46	0.63	0.78	0.65	0.93
Russian Federation	0.61	0.75	0.75	0.82	0.76

Source: NAS (2016), "National report on science 2015" based on InCites (Thomson Reuters).

A comprehensive comparison on a global scale can be made using the Scimago database. Figure 3.20 shows the rank of Kazakhstan based on its number of citable documents and number of citations per document, relative to the total number of countries included in the global ranking. This analysis clearly shows that Kazakhstan has slightly increased its international position in terms of number of documents produced, but its position worsens when considering its citation impact. Even more, Kazakhstan seems to be very close to the bottom of the ranking in the last five years.

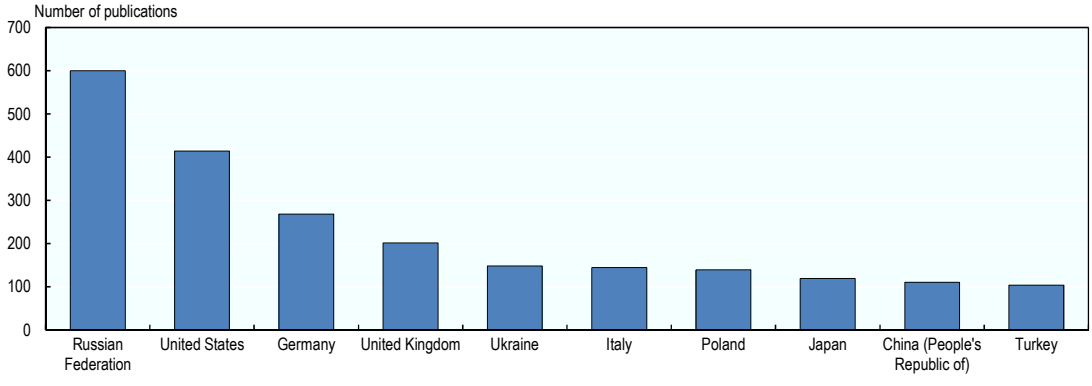
Figure 3.20. **Kazakhstan's rank in terms of number of citable documents and number of citations per document**



Source: SCImago (2016), *Country Rankings* (database), www.scimagojr.com/countryrank.php.

About 42.4% of articles were co-published with international partners. Kazakhstan's main co-publication partners according to Thomson Reuters (Figure 3.21) were from the Russian Federation (32.9% of international co-publications), the United States (22.3%) and Germany (14.3%). Moreover, there is also a significant strengthening of scientific ties between Kazakhstan and Asian countries (NAS, 2015).

Figure 3.21. **Kazakhstan's top 10 co-publication partners, 2011-15**



Source: NAS (2016), "National report on science 2015" based on InCites (Thomson Reuters).

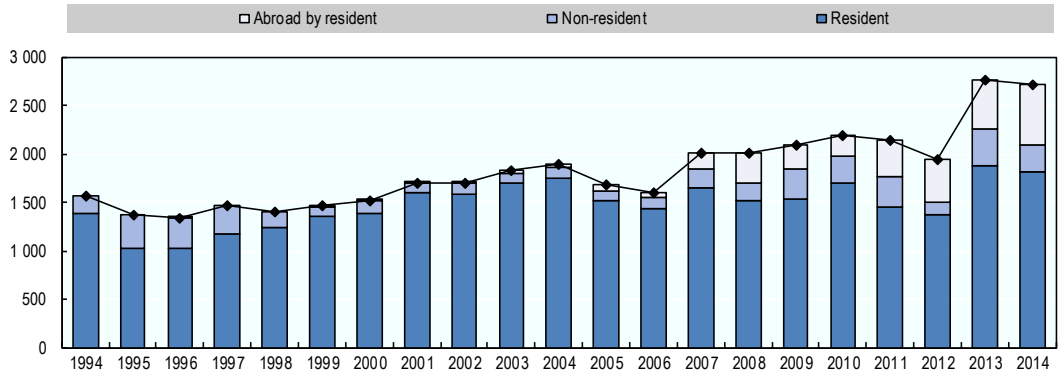
Patents

The number of patent applications in Kazakhstan has varied between 1 500 and 2 000 during most of the last two decades, with a peak at 2 764 in 2013. The bulk of applicants are residents (68% of applications in 2013). However, the World Intellectual Property Organization (WIPO) data clearly show an increase of patents applied for by non-residents, which is a sign of the internationalisation of the innovation system in Kazakhstan beyond the mere acquisition of foreign technologies by Kazakhstan. Another encouraging signal is the near tripling since 2010 of the number of patents applied for abroad by residents (Figure 3.22).

Kazakhstan occupied 26th position in the WIPO global ranking in terms of number of resident patent applications in 2013 (WIPO, 2015a) compared to 25th position in 2004. The total number of resident applicants for patents in Kazakhstan in 2014 was 1 820,

which represents about 67% of all patent applications made during the year. More and more residents apply for patents abroad, i.e. there was only 1 application in 2002 whereas in 2014 there were 633. Non-residents represent about 10% of all applications (271 in 2014).

Figure 3.22. **Patent applications in Kazakhstan by type of applicants**

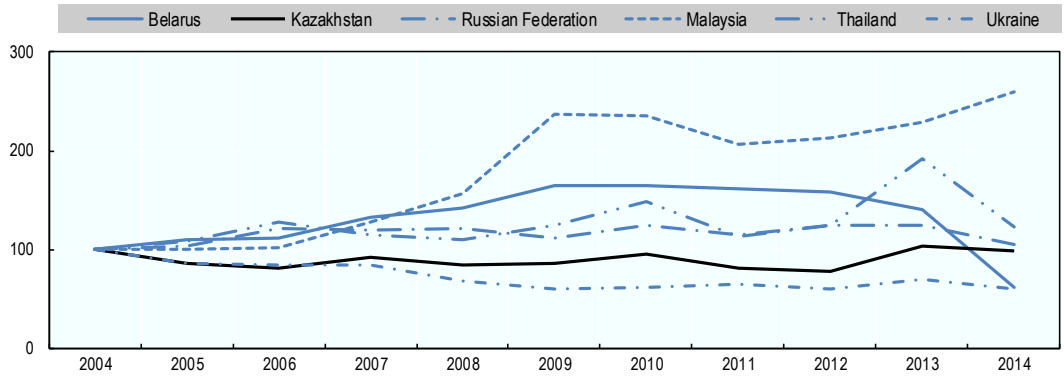


Notes: A resident application is one filed with an intellectual property office by an applicant residing in the country in which that office has jurisdiction. A non-resident application is one filed with a patent office of a given country/jurisdiction by an applicant residing in another country. An application abroad is filed by a resident of a given country/jurisdiction with a patent office of another country/jurisdiction.

Source: OECD (2016b), *Boosting Kazakhstan's National Intellectual Property System for Innovation*, http://dx.doi.org/10.1787/9789264260955-en based on WIPO (2015b), "Intellectual property statistics", *WIPO Statistics Database*, www.wipo.int/ipstats/en#data. Data on resident and non-resident patents for 2012 were gathered from the NIIP, as they were unavailable from WIPO.

Figure 3.23. **Patent applications by residents in Kazakhstan and selected countries**

2004 = 100



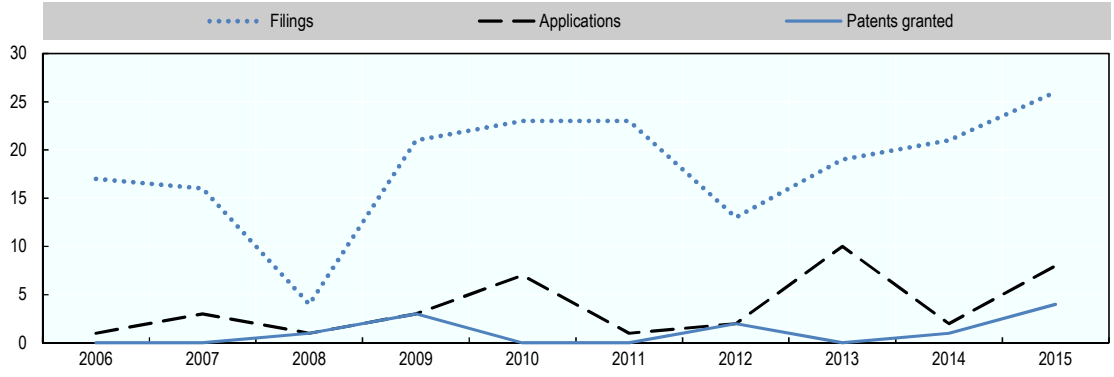
Source: OECD (2016b), *Boosting Kazakhstan's National Intellectual Property System for Innovation*, http://dx.doi.org/10.1787/9789264260955-en based on WIPO (2015b), "Intellectual property statistics", *WIPO Statistics Database*, www.wipo.int/ipstats/en#data.

Patent applications in Kazakhstan by residents per million population numbered 101 in 2014, which is much lower than in the majority of OECD countries. It is, however, comparable with other EAEU countries (40 in Armenia, 69 in Belarus, 23 in Kyrgyzstan and 167 in the Russian Federation). The annual number of patent applications by residents in Kazakhstan was relatively stable from 2004 to 2014. However, the gap with some European and Southeast Asian countries is still quite important (Figure 3.23).

The total number of patents granted in Kazakhstan to Kazakhstani residents in 2014 according to WIPO statistics was 1 313, whereas the number of patents to non-residents and abroad was 210 and 173 accordingly. Between 2007 and 2014, the average number of patents granted to residents was about 961; however, the annual data are non-uniform, i.e. 15 patents in 2012 and 1 657 in 2010. The internationalisation trend is also visible in the number of patents granted abroad (with an increase from 1 in 2001 to 173 in 2014).

The number of PCT patents or patents applied for in a foreign patent office is a good indicator of the degree of internationalisation of the commercialisation of Kazakhstani research. The highest number of patents applied for by Kazakhstan residents in foreign patent offices during the period 2007-14 were filed at the Eurasian Patent Organization. During that same period, on average there were only six annual filings to the United States Patent and Trademark Office (USPTO) (OECD, 2016b). The number of patents applied for at the European Patent Office (EPO) has been very volatile, but grew somewhat between 2006 and 2015, although it remains at very low level (Figure 3.24). It is also much lower than patent filings and, to a lesser extent, applied for, which might indicate difficulties in bringing the process to completion. With regards to PCT patents, Kazakhstan applied for 19 patents in 2014 (18 in 2013), at par with countries such as Indonesia, Serbia or Sri Lanka. For comparison, in 2014, Malaysia applied for 314 PCT patents, the Russian Federation 890, Uzbekistan 6 and Kyrgyzstan 1 (WIPO, 2016).

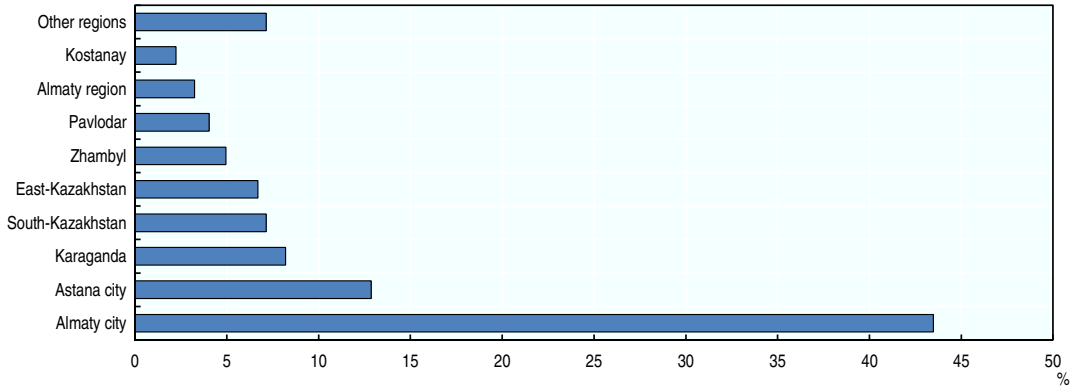
Figure 3.24. **European patents filed, applied for and granted by residents in Kazakhstan at the European Patent Office (EPO)**



Source: EPO (2016), *European Patent Office Patent Database*, https://www.epo.org/about-us/annual-reports-statistics/statistics.html#national (accessed 31 October 2016).

In terms of regional distribution, almost 44% of patents from 2007 to 2014 were applied for by residents of Almaty, which with Astana (12.9%) represented more than half of all applications. The shares of the industrial regions Karaganda and East-Kazakhstan, as well as agricultural region of South-Kazakhstan, were also relatively high (Figure 3.25).

Figure 3.25. **Distribution of patent applications in Kazakhstan by region, 2007-14**



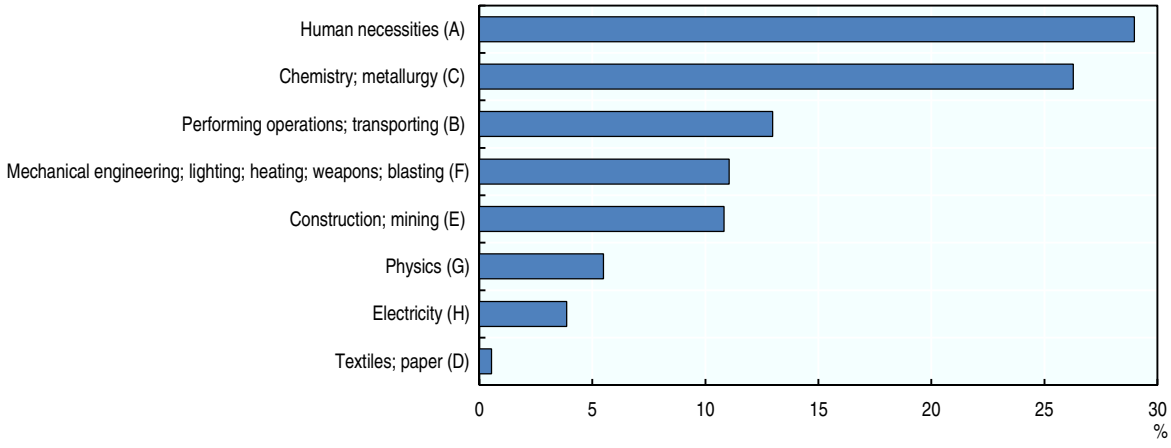
Note: Almaty region and Almaty city are separate administrative entities.

Source: NIIP (2015), *Annual Report 2014*, http://kazpatent.kz/images/files/rus/123.pdf.

The highest share of patents was granted in the "human necessities" area (agriculture and food products and health items), followed by chemistry and metallurgy, which is coherent with the historically strong sectors in Kazakhstan (Figure 3.26).

Figure 3.26. **Patents granted to residents in Kazakhstan by technology field, 2014**

As a percentage of total patents



Notes: Based on a total of 1 294 patents granted to residents in Kazakhstan in 2014. Class letters in parentheses correspond to the International Patent Classification (IPC) system under the Strasbourg Agreement. Full details of this system can be accessed at: www.wipo.int/classifications/ipc/en. Class A includes agriculture; foodstuffs and tobacco; personal or domestic articles; health, lifesaving, amusement. Class B includes separating and mixing; shaping; printing; transporting; micro-structural technology and nanotechnology. Class C includes chemistry; metallurgy; combinatorial technology. Class D includes textiles or flexible materials not otherwise provided for; paper. Class E includes building; earth or rock drilling; mining. Class F includes engines or pumps; engineering in general; lighting; heating; weapons; blasting. Class G includes instruments; nucleonics. Class H includes electricity.

Source: OECD (2016b), *Boosting Kazakhstan's National Intellectual Property System for Innovation*, http://dx.doi.org/10.1787/9789264260955-en based on NIIP (2015), *Annual Report 2014*, http://kazpatent.kz/images/files/rus/123.pdf.

Commercialisation

Data on research commercialisation are scarce and piecemeal. It is only possible to infer from anecdotal evidences and scattered information. Universities, including Nazarbayev University at this stage, have shown little success of research

commercialisation (some licenses of intellectual property) and valorisation (a few start-ups created).

According to data reported by the National Institute of Intellectual Property of Kazakhstan, the total number of resident patent licensing agreements in Kazakhstan has been steadily increasing but remains low. It grew from 2 agreements in 2012 to 14 in 2013 and 17 in 2014 (NIIP, 2015). In recent years, roughly around 50 technology-based spin-offs have been established annually (OECD, 2016b).

Kazakhstan is a net importer of intellectual property rights, paying USD 1 774 000 in royalties and receiving USD 166 072 185 in return in 2014. The gap between payments and receipts has increased since 2003, revealing that Kazakhstan is even more dependent on foreign technologies, while its intellectual property (IP) licensing expands, but at a much slower pace. In absolute terms, the amounts involved are rather small: in 2014, receipts amounted to less than 1% in countries such as China, the Russian Federation and Singapore. As for the royalties, they were also rather small in comparison with the above-listed counties; however, they are almost at the same level as in Thailand and much higher than in Indonesia.

Figure 3.27. **Licensing fee receipts, Kazakhstan**

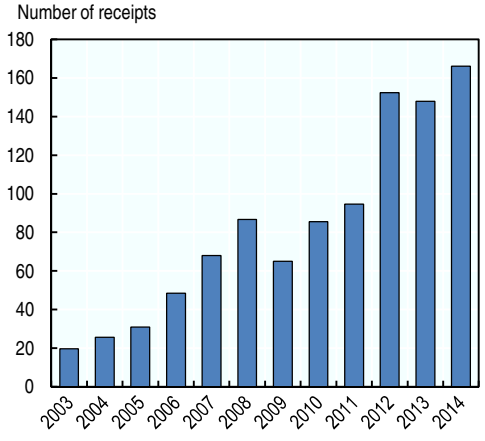
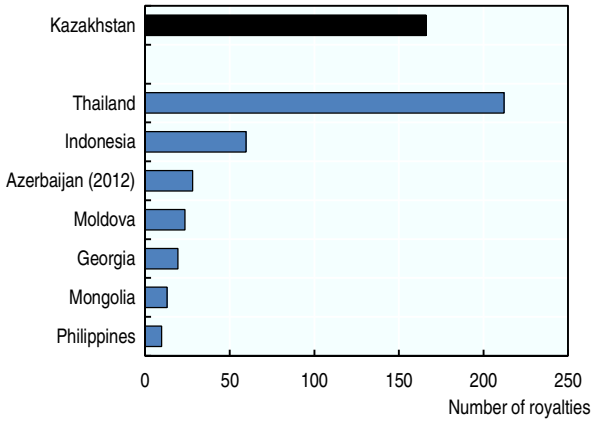


Figure 3.28. **Royalties, selected countries (2014)**



Source: World Bank (2016a), *World Development Indicators* (database), http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

The World Bank Technology Commercialization Project (2008-15), of an unprecedented scale in Kazakhstan, provides an interesting state of the art of research commercialisation in the country. Following a wide call for proposals, the Technology Commercialisation Centre received 785 recent applications, from which 33 projects were selected for funding. These projects, as well as other projects not originating from the call, resulted in the creation of 65 technology-based start-ups, 40 of which achieved commercial sales, for a total over KZT 900 million over the whole project duration. They also led to 5 Patent Cooperation Treaty (PCT) agreements in 2015 and 11 signed license agreements. According to the World Bank, these numbers, although low, are above the average country performance in the region: the number of patent applications in national sciences and engineering registered per 1 000 researchers at the Eurasian level is 11.2 while the 5 project patents provided a rate of 18.3; as for license agreements, there were only 4 nationwide in 2014 (World Bank, 2016b).

As will be argued in Chapter 4, the main problem lies as much in the still limited research capability in public and private organisations as in the lack of business awareness and interest in innovation. These structural weaknesses on both sides are strengthened by a mismatch by the limited offer of research results by research-performing organisations and business demands for new knowledge. The Science Fund carried out a survey of 1 627 projects funded by government grants and found only 3% of relevance to identified industry needs (OECD, 2016c).

According to the World Economic Forum's *Global Competitiveness Report*, innovation performance has significantly improved in Kazakhstan in the last five years, especially in terms of the R&D university-industry collaboration. This puts Kazakhstan in the leading position in the region (Table 3.4). Between 2010 and 2016, the country's global ranking on capacity for innovation also slightly improved, from 75th to 73th place. This progress seems modest in comparison with that of Tajikistan (from 88th position in 2010 to 66th in 2016).

Table 3.4. **Global Competitiveness Report – innovation pillar indexes, Kazakhstan**

	2010-11		2016-17	
	Kazakhstan's ranking			
	Global	Central Asia	Global	Central Asia
Capacity for innovation	75	1	73	2
University-industry collaboration in R&D	111	2	66	2

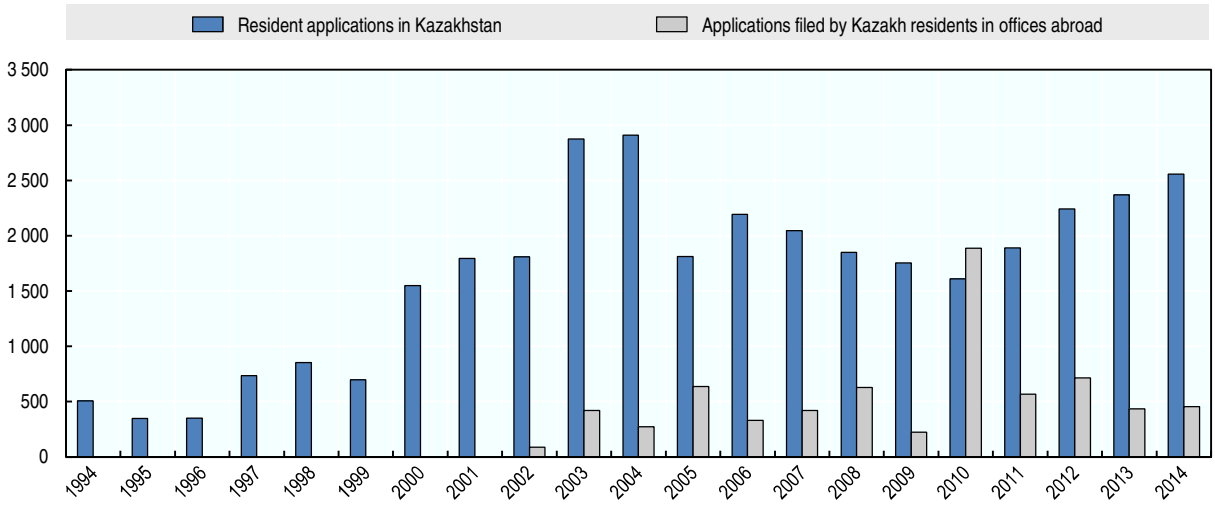
Sources: World Economic Forum (2016), *Global Competitiveness Report 2016-2017*, https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1; World Economic Forum (2011), *Global Competitiveness Report 2011-2012*, www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2010-11.pdf.

Trademarks

The evolution of trademark applications over the last two decades shares some features with patents:

- Despite fluctuations, the number of residents' applications increased significantly between 2008 and 2014 as Kazakhstan moved from 66th to 55th position according to WIPO.
- The number of applications abroad by residents has also risen, which might indicate more ambitious strategies to conquer international markets.
- In comparison with the other four EAEU countries (OECD, 2016b), the number of trademark applications in Kazakhstan and their distribution by residence of the applicant are close to those of Belarus and Armenia, whereas in the Russian Federation resident filings are more numerous than non-resident ones.

Figure 3.29. **Trademark applications in Kazakhstan**



Notes: Data correspond to total trademark applications, direct and via the Madrid system. Data on resident applications for 2005-07 were gathered from the NIIP, since they were unavailable from WIPO.

Source: OECD (2016b), *Boosting Kazakhstan's National Intellectual Property System for Innovation*, http://dx.doi.org/10.1787/9789264260955-en.

Most trademarks registered in Kazakhstan were in the pharmaceuticals, business services, machinery and foodstuff sectors (OECD, 2016b). The share of registered trademarks held by locals is relatively high in business services and food products, while non-residents registered a particularly high share of trademarks related to chemicals (including pharmaceuticals), machinery and clothing. In all top ten trademark classes, however, non-residents account for the lion's share of total registrations.

Copyrights

According to the OECD *Review of the National Intellectual Property System*, taking into consideration the fact that there is no need to register the copyrights in an IP office, there are no available data on the volume or evolution of this process. In 2002, WIPO started conducting research on copyright-based industries. On average, these industries contributed 5.18% to GDP and 5.32% to total employment in the 42 countries covered so far by WIPO studies (OECD, 2016b). Kazakhstan has not yet taken part in such research, and statistics on the copyright industries appear to be unavailable for Kazakhstan.

Synthesis

The main achievements and remaining challenges related to research and innovation outputs are presented in Table 3.5.

Table 3.5. **Achievements and challenges related to research and innovation outputs**

Achievements and progress	Remaining challenges
Scientific publications and patents	
• Substantial increase of the number of scientific publications • Dramatic increase of the number of articles written in English • Increase of patent applications, including by non-residents in Kazakhstan • Strong increase of patents applied for by Kazakhstani residents in foreign patent offices; however, from very low levels, and mainly at the Eurasian Patent Organization • Patent applications by residents per million population comparable with or above other Eurasian Economic Union (EAEU) countries	• Low scientific production relative to the size of the population • Share of Kazakhstan's publications in the world below that of emerging countries, despite an increase • Citation impact for Kazakhstan very low in international comparison • Low number of patents applied for and, even more, granted at the European Patent Office (EPO) and United States Patent and Trademark Office (USPTO)
Commercialisation, trademarks, copyrights	
• Encouraging results of the World Bank Technology Commercialization Project (PCT patents, licenses, start-ups) – above the average performance in the country • Significant improvement of "capacity for innovation" and "university-industry collaboration in R&D" in the last five years according to the World Economic Forum's Global Competitiveness ranking	• Scarce and piecemeal information available on commercialisation performance • Steady increase of resident patent licensing agreements in Kazakhstan, but still at a low level • Rise of the number of trademark applications, but remains at a low level, close to those of Belarus and Armenia • Undeveloped system of copyright in Kazakhstan; no meaningful statistics

Notes

1. Kyrgyzstan was 0.16% and Tajikistan is 0.12% in 2013 (UNESCO, 2015).
2. For the 2017 fiscal year, upper-middle-income countries are defined as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of more than USD 4 036 but less than USD 12 475 (high-income economies threshold [World Bank, 2016c]).
3. It should be noted that Kazakhstan's scientists published a total of 4 687 works in 1 755 journals during the period 2011-15. Only 1 215 of these journals were indexed in the Web of Science Core Collection. However, it is very likely that these non-indexed journals are in Russian language and have a very low impact (NAS, 2016). The data might change as the Russian Science Citation Index, including more than 600 Russian scientific journals, will be added to the Web of Science by 2016 (http://thomsonreuters.ru/2015/12/thomson-reuters-and-elibrary-included-rsci-database-in-web-of-science/).
4. The citation impact is the total number of citations in any five-year period per paper published up to that period.

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Chapter 4

Innovation actors in Kazakhstan

This chapter examines successively the role and performance of the main public and private research and innovation actors in the development of the Kazakhstani innovation system in recent years: business enterprises, higher education institutions (HEIs) and public research institutes (PRIs), highlighting their respective roles in the development of the innovation system. It reviews scientific, technological and related functions carried out by the main actors within the system and their contributions to 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 recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the 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 Union
The Republic of Cyprus is recognised 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.

Business sector

The economy of Kazakhstan is strongly concentrated around primary products, especially oil, gas, minerals and agricultural products, with manufacturing and services, in particular the high added-value segments, remaining very limited. Labour productivity is relatively high in mining and oil and gas and very low in agriculture with manufacturing in between, which creates opportunities to increase aggregate productivity through a reallocation of production factors from agriculture to other sectors. However, a major almost untapped potential lies in the increase of productivity within the manufacturing and service sectors through innovation and technological upgrading. Another rationale for innovation and diversification is the vulnerability of the Kazakh economy to external market conditions due to its dependence on extractive industries and a few key international trade partners, as recently evidenced by the severe consequences of the financial and economic crisis and the subsequent drop in oil prices. Despite significant efforts and some progress, diversification is still a major challenge for Kazakhstan.

This section will discuss the extent to which the Kazakhstani economy can succeed its diversification process through an upgrade of business firms' innovation capabilities, thus allowing an improvement of the competitiveness and development of existing sectors and the creation of new industries.

Overall industry landscape

Profile of business companies

Small companies account for the bulk of firms established in Kazakhstan, but most of these have only a few employees and their productivity is very low. Medium and large firms, much less numerous, contributed 84% to gross domestic product (GDP) in 2014. More than 90% of small and medium-sized enterprises (SMEs) are privately owned, while about half of medium-sized and large firms are state-owned (Table 4.1). State-owned enterprises play a key role in the economy in Kazakhstan – contributing 30-40% to GDP (OECD, 2016a).

Table 4.1. **Number and share of firms (only legal persons) by size and ownership, 2015**

	Total	State	Private	Foreign
Small	336 422	5.45%	89.28%	5.27%
Medium	14 936	55.84%	40.77%	3.39%
Large	2 475	40.48%	53.25%	6.26%
Total	353 833	7.82%	86.98%	5.19%

Source: Authors' calculations, based on data from the Committee of Statistics of Kazakhstan.

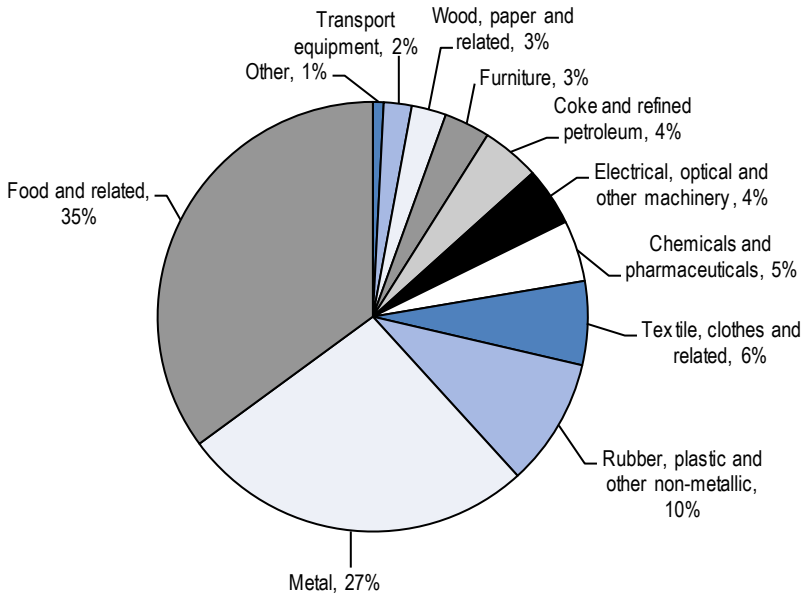
Recently, several waves of market-based reforms aimed at reducing the role of government ownership in the economy. At the end of 2014, a comprehensive privatisation plan was announced, which indicated 782 state assets to be transferred to the private sector, including 106 firms owned by the sovereign wealth fund Samruk-Kazyna. In addition, in April 2015, the competition law was amended to prohibit the establishment of SMEs by legal entities with more than 50% government participation (OECD, 2016a).

Industry structure and technological level

As mentioned in Chapter 2, despite notable growth at the beginning of the 2010s, manufacturing still represents a relatively small share in the Kazakhstani economy. It employed a mere 5% of all workers and produced only 11% of GDP in 2014. The distribution of employees across broad industries within manufacturing (Figure 4.1) shows the strong reliance of Kazakhstani manufacturing on the main primary resources of the country. More than 40% of manufacturing is directly related to mineral resources (27% in metal and 10% in rubber, plastic and other non-metallic with another 4% in coke and refined petroleum). Thirty-five per cent of manufacturing workers are employed by the food industry.

However, the employment share of manufacturing and some knowledge-intensive services has grown in recent years, notably in the transport equipment industry (a 15% increase of 2010 and 2013) and in the financial and insurance industries (a 10% increase). Significantly, the increase in productivity between 2010 and 2013 was also the highest in the fastest-growing sectors, including transport equipment, chemicals and pharmaceuticals, rubber, coke and refined petroleum (OECD, 2016a).

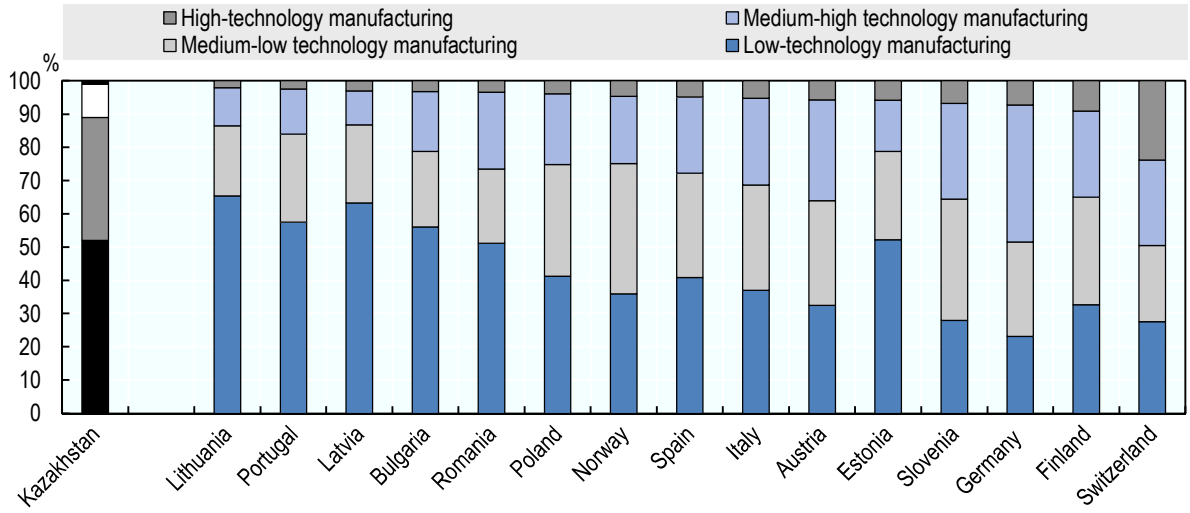
Figure 4.1. **Share of employment of manufacturing industries, 2014**



Source: Authors' calculations based on data from the Committee of Statistics of Kazakhstan.

The technological intensity of the manufacturing industries[1] is low, even by international standards (Figure 4.2). About 52% of Kazakhstani firms operate in low-tech industries, 37% in low-medium tech (where the bulk of engineering companies in extractive industries lie), 10% in high-medium tech and only 1% in high-tech industries. Moreover, although the data for earlier years are scarce, those that are available suggest that only limited technological upgrading took place between 2010 and 2014.

Figure 4.2. **Manufacturing employment by level of technological intensity of the industry, 2013-14**



Note: 2014 for Kazakhstan, 2013 for European countries.

Source: Authors' calculations based on data from the Committee of Statistics of Kazakhstan and Eurostat (2016b), *Short-term Business Statistics* (database), http://ec.europa.eu/eurostat/web/short-term-business-statistics/data/database.

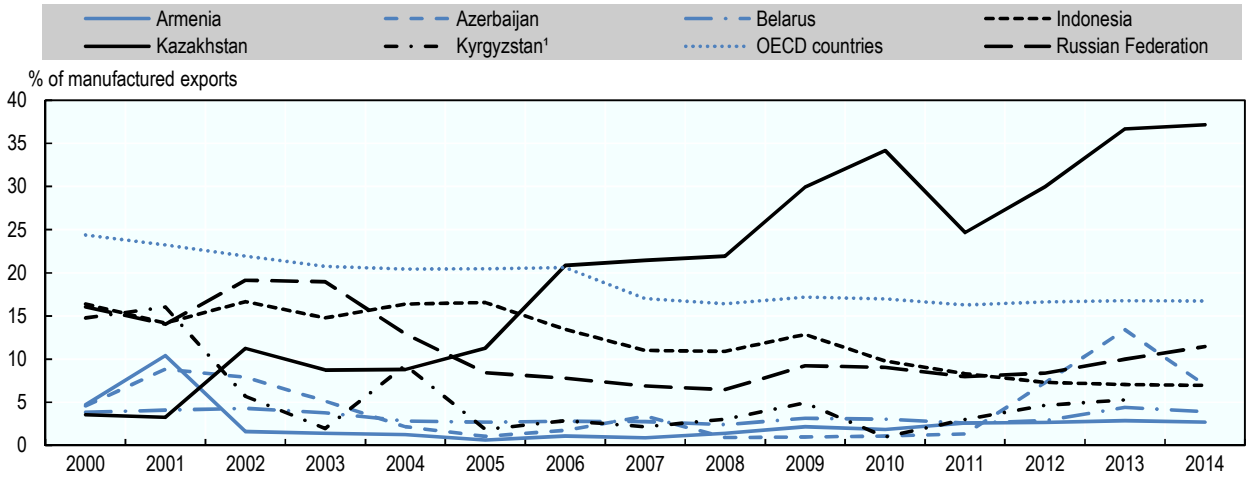
Integration in global value chains

In line with the structure of the industry, the overwhelming majority of Kazakhstan's exports consist of primary products, while manufacturing exports are small. In 2013, according to the World Bank Enterprise Survey, only 2.4% of firms exported directly. This proportion is very small, even by Eastern European and Central Asian countries' standards, where the share of directly exporting firms was 5.6% in the same year. The main market of most Kazakhstani firms is domestic: more than 98% of the surveyed firms' turnover came from the domestic market in 2013.

Although limited, a closer look at the manufacturing sector reveals that the composition of exported products has significantly changed over the last 15 years, in favour of higher added-value products. This evolution contrasts with that of most of its traditional benchmark countries such as the Russian Federation and Central Asian countries (Figure 4.3). However, this positive trend should be nuanced in the light of the share of manufacturing exports in total exports. As explained in Chapter 2, primary and resource-based products accounted for more than 90% of Kazakhstan's exports in 2014. What is more, manufacturing exports have declined rapidly in the last decade.

Global value chains (GVCs) and multinational buyers within such value chains can be very important sources of knowledge (Amador and di Mauro, 2015; OECD, 2013a; OECD, WTO and World Bank, 2014). At the level of the whole economy, very few Kazakhstani firms are integrated into GVCs, therefore missing out on the opportunity to learn from such buyers. The fact that most Kazakhstani businesses produce mainly for the domestic market also implies that they are unlikely to face sophisticated demand or strong competition and, therefore, have fewer incentives to innovate. In recent years, however, a few positive developments have taken place in this respect. An important example is the joint venture of Toyota and Saryaka AvtoProm announced in 2014.[2]

Figure 4.3. **High-technology exports**



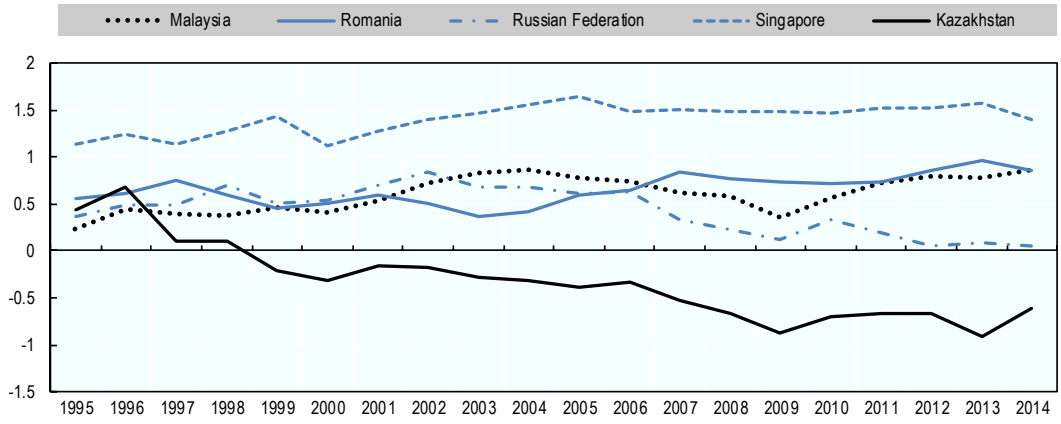
1. Latest available data are for 2013.

Source: World Bank (2016), *World Development Indicators* (database), http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

In contrast, more than 63% of Kazakhstani firms rely on imported inputs which constitute 35% of their total input use. These shares are similar to the average of Eastern European and Central Asian countries. Even at the macro level, the import of capital goods was very high in international comparison, amounting to around 10% of GDP at the beginning of the 2000s and 6% of GDP in the second half of the 2000s (OECD, 2016a). Imported inputs, and especially imported machinery suppliers, can also be important sources of knowledge, in particular about up-to-date production processes (Amiti and Konings, 2007; Kugler and Verhoogen, 2009; Halpern, Koren and Szeidl, 2015). The large import of capital goods has been used strategically, for instance by the People's Republic of China (hereafter "China") for technology upgrading (OECD, 2016a).

An analysis of the complexity of the productive structures of a country provides complementary evidence of the country's development path, the assumption being that more advanced countries produce a more diversified portfolio of more complex products (Hidalgo and Hausmann, 2009). The Economic Complexity Index (ECI) measures this trend using trade data to quantify a country's capacity to diversify its productive structures through technology upgrading. The ECI has declined steadily and significantly in Kazakhstan since the 1990s, while that of comparable countries has remained rather stable, or only slightly decreased as in the case of the Russian Federation (Figure 4.4). Authors have argued that that the measures of complexity are correlated with a country's level of income and that its evolution is predictive of future growth. According to this approach, it appears that the conditions that would allow complexity to emerge and generate sustained growth through diversification and innovation are deteriorating in Kazakhstan.

Figure 4.4. **Economic Complexity Index, Kazakhstan and selected countries**



Source: OEC (2014), *Economic Complexity Rankings*, http://atlas.media.mit.edu/en/rankings/country/2014.

Synthesis

The main achievements and remaining challenges related to the overall industry structure and how conducive it is to innovation activities are presented in Table 4.2.

Table 4.2. **Achievements and challenges related to the overall industry structure**

Achievements and progress	Remaining challenges
• Rise of employment share of manufacturing and some knowledge-intensive services in recent years (transport equipment industry, financial and insurance industries) • – Increasing share of high-tech exports in manufacturing (but the share of manufacturing in total exports remains minimal)	• Large number of very small firms, with low productivity • Divide between small private businesses and large state-owned enterprises – low share of medium-sized enterprises • Small size of manufacturing, composed of relatively low-tech processing of food and minerals • Low technological intensity of manufacturing industries by international standards – little progress in recent years • Few export-oriented firms; majority of exports of primary products, limited manufacturing exports • Low level and dynamic of the E, reflecting the intense export specialisation in primary products and the declining capacity to diversify the national productive structures through innovation

How innovative are Kazakhstani firms?

How much do Kazakhstani firms invest in innovation?

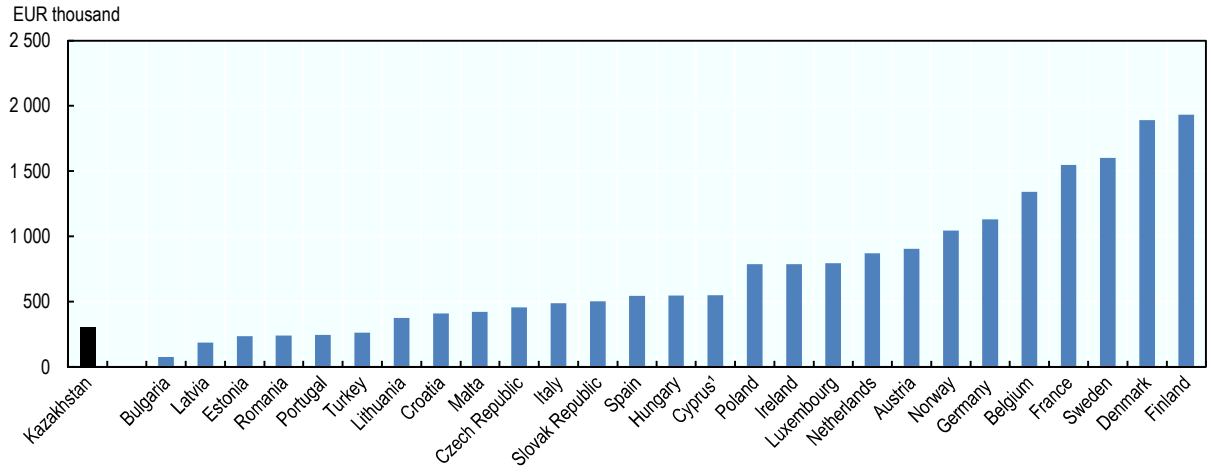
The size of business innovative expenditures

The share of the business sector in the national innovation effort of a country helps in understanding the role of this sector in the national innovation system.[3] In international comparison, the business sector plays a small role in performing research and development (R&D) in Kazakhstan. In terms of the number of researchers, the share of the business sector fluctuated around 20% between 2005 and 2013, while it was around

50% in OECD countries; this share is only smaller in the Slovak Republic and Greece in the comparator group. A somewhat larger share of R&D spending (20-50%) was performed by the business sector (see Chapter 3), below the OECD average of 68% and all other countries in the sample. Such a low share of business in R&D shows the limited ability of firms to shape research directions based on market needs and it may also weaken their ability to absorb knowledge from research.

Expenses on product and process innovations provide a proxy for the total innovative effort of businesses. This includes the purchase of improved capital goods, the implementation of new processes as well as training and investment into knowledge-based capital besides R&D. According to data from the Committee on Statistics, such efforts for product and process innovations amounted to about 1.15% of GDP in 2014. The average innovation expenditure per innovative firm was about EUR 300 000 per year (Figure 4.5). This order of magnitude is similar to European countries positioned at the lower end of the scale – Estonia, Romania or Portugal. However, the number of innovative firms is much higher in the comparator group, hence total business expenditures on innovation is also proportionately higher.

Figure 4.5. **Expenses for product and process innovation, Kazakhstan and European countries**



1. 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 recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the 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 Union

The Republic of Cyprus is recognised 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.

Notes: 2014 for Kazakhstan and 2010 for European countries. In Kazakhstan, firms report innovation expenditures for three years, so the reported number was divided by three. For EU countries, the total expenditure in "core innovation sectors" was divided by the number of product and/or process innovative enterprises, regardless of organisational or marketing innovation (including enterprises with abandoned/suspended or ongoing innovation activities) in the same sectors.

Source: Authors' calculation based on data from the Committee on Statistics of Kazakhstan, and Eurostat (2016c), *Science, Technology and Innovation Statistics* (database), http://ec.europa.eu/eurostat/web/science-technology-innovation/data/database.

The composition of innovation expenditures

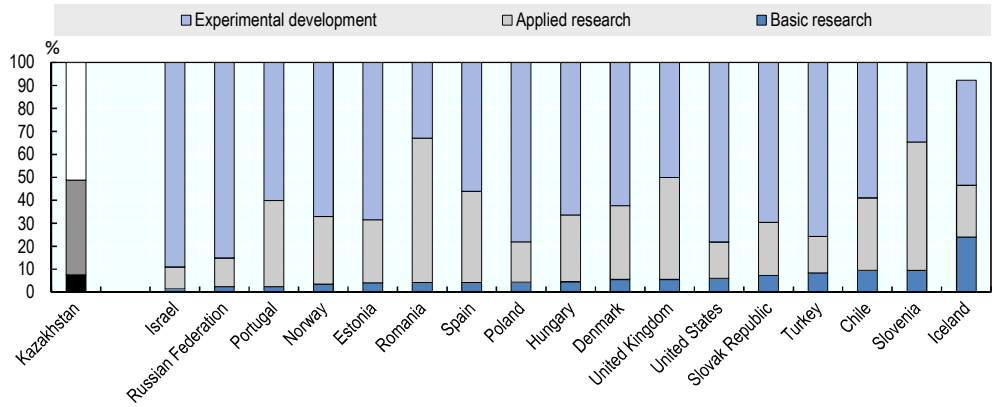
The composition of innovation expenditures reveals a lot about the type of efforts firms focus on and, in turn, helps in designing the most useful innovation policy tools. It provides information not only on the level of innovativeness of business firms, but also on the type of innovation activities they engage in, for instance whether it is externalised or conducted in-house, or the profile of R&D activities, from applied to experimental development.

Importantly, the bulk (63% in 2015) of innovative expenditures (as defined earlier) went to the purchase of advanced machinery, while only 8.4% (in 2015) was spent on R&D. Similar to other countries remote from the technological frontier, innovation primarily relies on knowledge embedded in advanced machinery while business R&D plays a limited role (Cengel, Alpay and Sultangazin, 2013).

This confirms that in many economies, especially in those farther from the technological frontier, many firms can effectively innovate without R&D. Four main mechanisms have been identified: 1) technology adoption; 2) minor modifications or incremental changes; 3) imitation, including reverse engineering; and 4) combining existing knowledge in new ways. While non-R&D innovation may be a useful strategy for catching up, it has its limits. Firms relying on non-R&D innovation, in general, have lower innovation capabilities than R&D performing firms, including a lower capacity to absorb new knowledge. As a result, fewer non-R&D innovators are capable of developing new products in-house and of upgrading innovation-related skills (Arundel, Bordoyand and Kanerva, 2007; OECD, 2011).

Although limited in Kazakhstan, R&D remains a key component of innovation spending. About 8% of Kazakhstani business R&D consists of basic research, 40% is applied research and a little more than half is spent on experimental development (Figure 4.6). While the share of basic research is similar to that of developed countries, experimental development activities are rather modest compared to similar countries – it is more than 75% of total R&D spending in countries like Poland and Turkey. The resulting high share of business sector-applied R&D tends to show that firms focus somewhat less on directly applying their knowledge to develop new products and processes than on acquiring less directly applicable knowledge.[4]

Figure 4.6. **Business R&D spending by type of R&D, Kazakhstan and selected countries**



Note: 2014 for Kazakhstan and 2013 for other countries.

Source: Authors' calculations based on data provided by the Committee on Statistics of Kazakhstan and OECD (2016b), "Main science and technology indicators", *OECD Science, Technology and R&D Statistics* (database), http://dx.doi.org/10.1787/data-00182-en.

The structure of Kazakhstani business R&D by field of science is quite similar to that of developed countries, with engineering being the dominant field (about 75%) followed by natural sciences (16%). The share of agriculture (7%) is larger than the OECD average (but lower, than, for example, in Chile), which reflects the large role of agriculture and the food industry in Kazakhstan. Spending on medical research (1% of business R&D) is quite low, however, showing the minor role of innovative medicine in the Kazakhstani industry.

Innovators' profile

The overwhelming majority (81% in 2014) of innovation expenditures was performed by private firms, with foreign firms responsible for 13% and state-owned enterprises for 6%. Similarly, the breakdown of gross expenditure on R&D (GERD) by type of ownership (Figure 4.7)[5] shows that fully state-owned entities (including universities, research institutes and fully state-owned enterprises) were responsible for 30% of GERD. Partly state-owned entities were responsible for 13% of GERD, while fully private entities contributed 53%. This confirms that, despite the importance of state ownership in terms of GDP, the bulk of innovation decisions and investments take place in private firms. This underlines the importance of an environment conducive to private innovation.

There is also a considerable amount of heterogeneity across industries, with electricity, transportation and manufacturing firms spending over KZT 400 million in three years and innovative service firms spending much less (Figure 4.8).

Although they are not as innovation-intensive in Kazakhstan as in many other countries, there are many examples that demonstrate that some state-owned enterprises can play an important role as innovators. This is the case, for instance, in China in the oil sector (Tonurist and Karo, 2016). In Kazakhstan, Samruk-Kazyna was instructed by the government to focus more on its core activities, i.e. developing industries with promising long-term prospects, including increasingly through research and innovation activities in a broad sense, which in 2014 accounted for nearly 5% of its revenues (Box 4.1).

Box 4.1. **Research and innovation activities in Samruk-Kazyna sovereign wealth fund**

The sovereign wealth fund Samruk-Kazyna (SK) manages the assets of the state in some of the largest state-owned firms, including for instance the national oil and gas company KazMunayGas (KMG) and the national mining company "Tau-Ken Samruk" JSC. SK also manages some of the banks nationalised during the crisis of 2008-09. In 2014, SK employed more than 320 000 people and its consolidated revenue was more than KZT 5 billion, or 13.3% of GDP. Most of these companies have been owned by the state since the Soviet era (OECD, 2016a: 143-144). In 2014, the firms managed by the sovereign fund spent KZT 240 billion (or nearly 5% of revenues) on the implementation of innovative projects and KZT 8.8 billion (or 0.17% of revenues) on R&D.

Box 4.1. **Research and innovation activities in Samruk-Kazyna sovereign wealth fund** (*cont.*)

SK manages state-owned companies not only for the sake of efficient and transparent financial management, but also with a view to improving their contribution to national goals, in particular the modernisation and diversification of the economy. As stated in its Industrial and Innovation Policy approved in December 2012, one way of achieving this is through the overall co-ordination of the innovation activities of companies in its portfolio, while their implementation remains under the responsibility of each company. The objective of the co-ordination at the level of the whole portfolio of state-owned companies is twofold: to prevent duplication of research and to enhance internal co-operation and sharing of technology among the firms it manages. SK requires all companies in its portfolio to develop five-year innovation strategies. By the end of 2014, 11 companies had developed such a strategy.

SK also monitors evaluation activities of its portfolio companies through the implementation of a dedicated system of key performance indicators. The individual "innovation ratings" integrate various activities, such as the creation of new products, processes and services and/or the improvement of existing ones, as well as the implementation of technology audits, the establishment of new research infrastructure, or the implementation of methods to stimulate the generation of ideas and proposals. Target "innovation rating" values have been defined for 2016. At the end of 2014, some companies were on track to meet their assigned targets, in particular Samruk-Energy JSC (91% of the target value), JSC NC Kazakhstan Temir Zholy (88.5%) and Kazakhtelecom JSC (75.4%). Other companies are lagging behind and will have to commit significant further effort to meet their objectives.

Internal surveys of the technological levels of SK portfolio companies have revealed to what extent they lag behind their global counterparts. SK intends to reduce this gap through international technology transfer, as well as by identifying and providing information on relevant technologies for potential adoption by companies in its portfolio. Technology transfer projects account for the bulk of innovative activities such as, for instance, the acquisition of energy storage technology from Primus Power (United States) in May 2015, followed a few months later by the announcement of a large – megawatt scale – demonstration project in Kazakhstan.

SK has also founded a research centre together with Nazarbayev University as part of the future Science Park "Astana Business Campus". According to the Memorandum of Understanding signed by the partners in September 2014, the new centre will provide a research capacity for companies without their own research departments, in particular in the area of green technologies, robotics and renewable energy. The centre will also implement educational programmes for the executives of affiliated companies, in co-operation with Nazarbayev University's Graduate School of Business.

As part of recent market-based reforms, many of the companies under SK have been or are scheduled to be privatised. In particular, a Comprehensive Privatization Plan is being implemented between 2014 and 2016. This plan envisages the privatisation of 106 SK companies, 37 of which were sold in 2014 and 2015. Between 2016 and 2020, another round of privatisation will be implemented based on the government decree "On some issues of privatization for 2016-2020".

Sources: OECD (2016a), *Multi-dimensional Review of Kazakhstan: Volume 1. Initial Assessment*, http://dx.doi.org/10.1787/9789264246768-en; Mukhtarov, D. (2014), "Kazakhstan approves list of companies of Samruk-Kazyna group going private", http://en.trend.az/casia/kazakhstan/2268335.html; SK (2016), Samruk-Kazyna website, www.sk.kz; SK (2015a), "'Samruk-Energy' JSC signed a number of agreements on development of innovative technologies in the framework of VIII AEF", http://sk.kz/news/view/4206/4?lang=en; SK (2015b), "Annual report 2014", https://sk.kz/page/download/8446?lang=en; SK (2014), "'Samruk-Kazyna' JSC and Nazarbayev University sign memorandum of cooperation", http://sk.kz/event/view/224?lang=en.

Figure 4.7. **Gross expenditure on R&D by type of ownership, 2014**

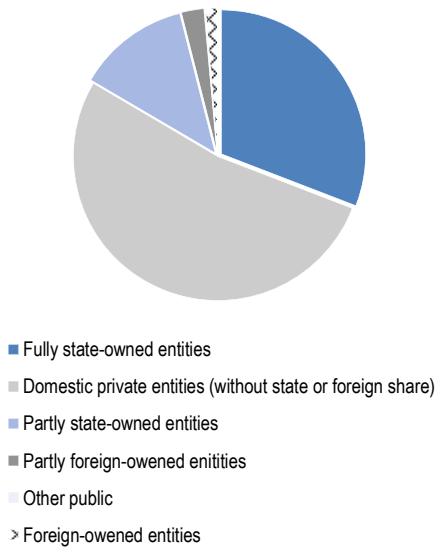
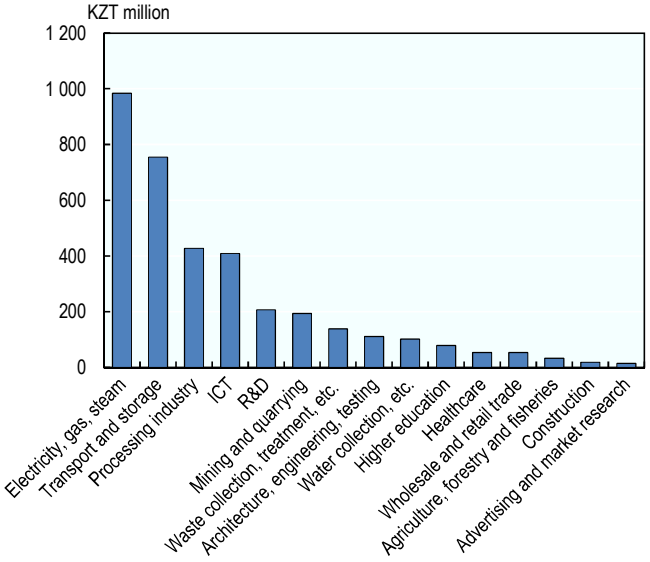


Figure 4.8. **Innovation expenditure per innovating company, 2012-14**



Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan.

Which firms introduce new processes or products?

According to the innovation survey of 2014, 8% of Kazakhstani firms reported some innovation activity (either product, process, organisational or marketing). The share of innovative firms was 13.3% in manufacturing industries compared to 7% in the service sector.[6]

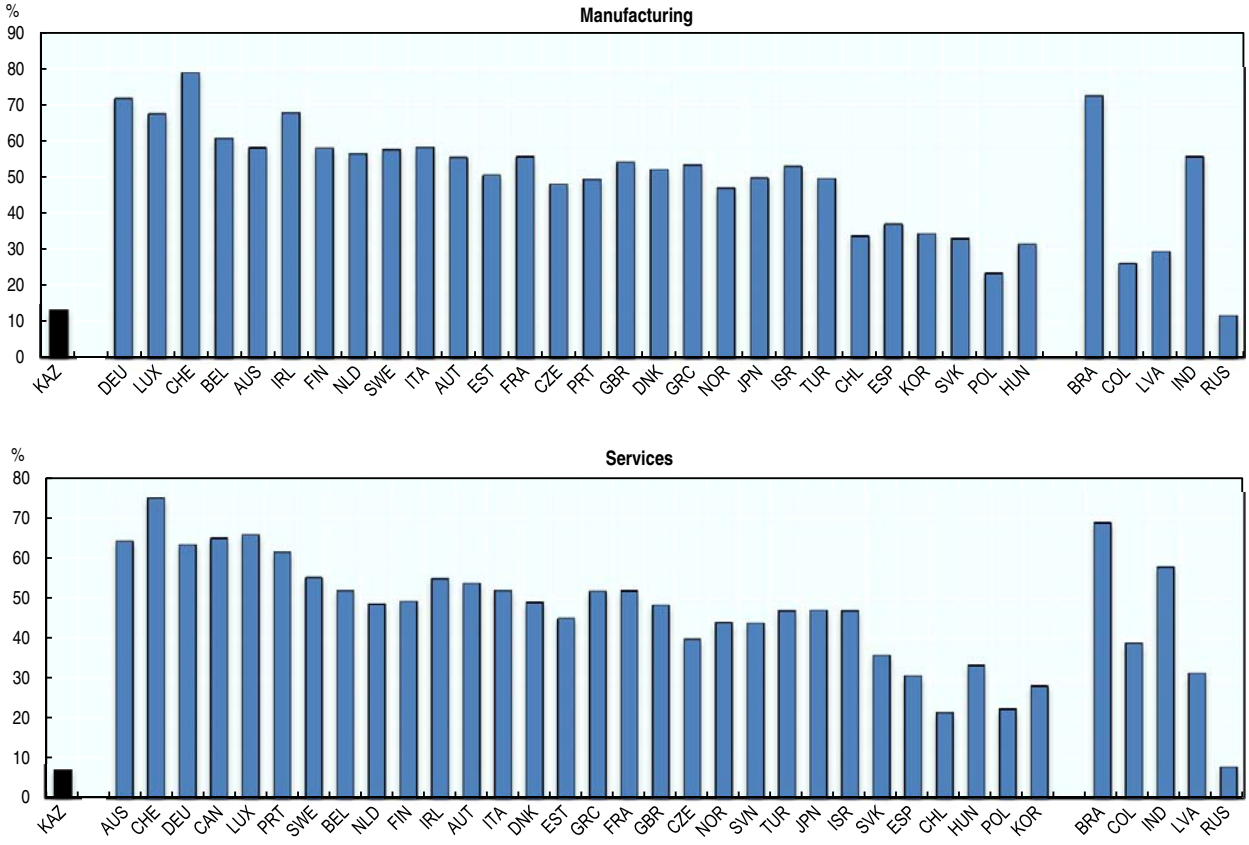
These numbers are very low in international comparison (Figure 4.9). Even in less developed OECD countries, the share of innovative firms is above 30% in manufacturing and above 20% in services, while in the most developed countries the share of innovative firms is above 60%. Similar patterns can be found in most countries outside the OECD for which data are available (Brazil, Colombia, India and Latvia). The only country in which the share of innovative firms is similar to that of Kazakhstan is the Russian Federation, where the share of innovative firms was 12% in manufacturing and 8% in services in 2010-12.

The most innovative industries in Kazakhstan are in healthcare (16.1%) and manufacturing (13.3%).[7] The share of innovative firms is somewhat lower in the primary sectors (around 8% in mining and agriculture), while it is very low in such services as wholesale, retail, construction and transportation. However, the share of innovative firms even in the most innovative industries is much lower than the average in OECD countries.

Statistics at the disaggregated level within manufacturing for 2010 reinforces the earlier conclusion that innovative activity is very low (Cengel, Alpay and Sultangazin, 2013). The share of innovative firms was highest (more than 20%) in some medium and high-tech industries: coke and oil refining, vehicles and trailers, metallurgy and electric equipment. The group of industries in the 10-20% range of innovative firms included notably computers, pharmaceuticals, machines and equipment. Firms in other industries, including the food industry – a priority sector under the State Programs for Accelerated

Industrial and Innovative Development (SPAIID) – were even less innovative (only 4.3% of firms introduced innovations in 2010).

Figure 4.9. **Share of innovative firms in the manufacturing and services sectors, Kazakhstan and other selected countries**

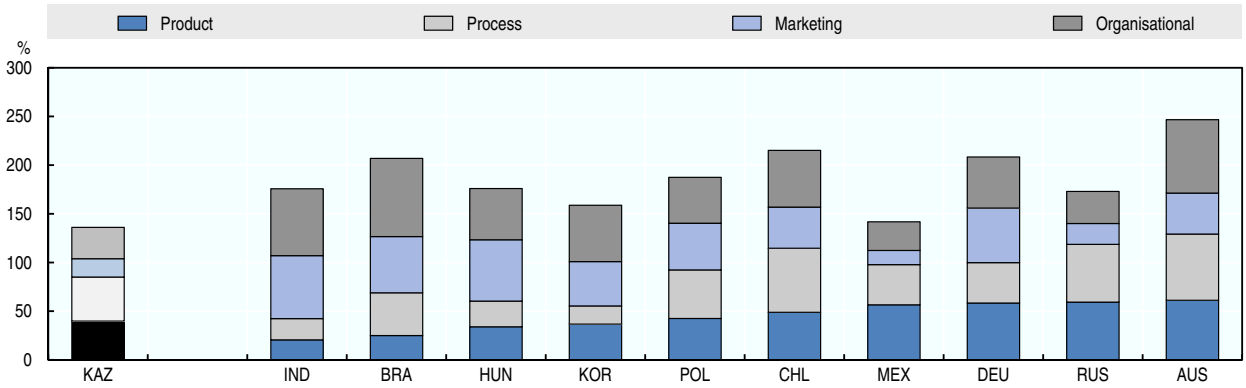


Note: 2012-14 for Kazakhstan and 2010-12 for other countries.

Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan and OECD (2015a), *OECD Science, Technology and Industry Scoreboard 2015: Innovation for Growth and Society*, http://dx.doi.org/10.1787/sti_scoreboard-2015-en.

Overall, in 2015, about 40% of innovative firms reported product innovation and 45% conducted process innovation. Marketing innovation was conducted by 20% of innovative firms while about a third of innovative firms undertook organisational innovation. In international comparison (Figure 4.10), the share of product and process innovations is similar to the average of the comparator group, but the share of marketing and organisational innovations is very low compared to developed countries; similarly low shares can only be found in Mexico and the Russian Federation. Kazakhstani firms tend to underinvest in non-technological innovation, with little effort to modify their processes and marketing strategy. This low prevalence of marketing and organisational innovation might find its roots in the Soviet heritage, characterised by sub-standard management knowledge or non-competitive markets. Regardless of the cause, the consequences of this gap might be significant as it translates into lack of management skills, which may hamper firms in actually reaching new markets with their products and services.

Figure 4.10. **Share of firms conducting different types of innovation (only innovative firms), Kazakhstan and other selected countries**



Notes: 2012-14 for Kazakhstan and 2010-12 for other countries. Data presented here show the share of firms reporting each kind of innovation from the firms which conduct at least one type of innovation, hence the percentages can be more than 100%.

Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan and OECD (2015b), *Innovation Statistics and Indicators: Innovation Indicators 2015* (database), www.oecd.org/sti/inno/Innovation%20Indicators%202015.xls.

Some evidence (Ballot et al., 2015) suggests that combining different types of innovation (product and process or product and organisational) increases firms' performance as they benefit from internal complementarities between corresponding activities (OECD, 2015a). In Kazakhstan, the prevalence of mixed modes of innovation is much smaller than in other countries. Survey data show that innovative Kazakhstani firms conduct 1.44 modes of innovations on average, much less than the average of 1.90 in the comparison group, with the most similar patterns in Korea, Mexico and the Russian Federation.

Figure 4.11. **Innovative expenditures per innovative firm, 2012-14**

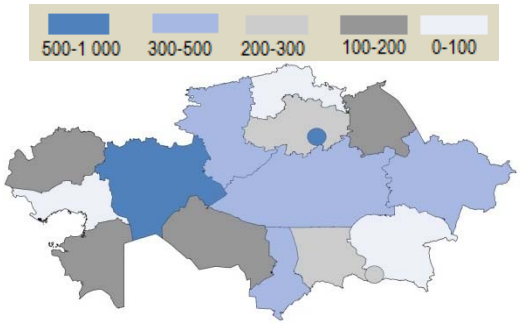
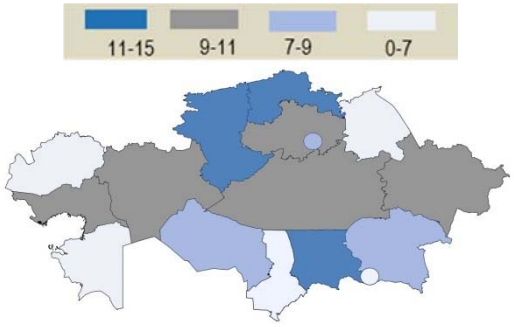


Figure 4.12. **Share of innovative firms, 2012-14**



Note: These numbers are separately reported for Astana (innovation expenditure KZT 13 436, share of innovative firms 10.7%) and Almaty (innovation expenditure KZT 5 626, share of innovative firms 5%), which are not shown on the map.

Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan.

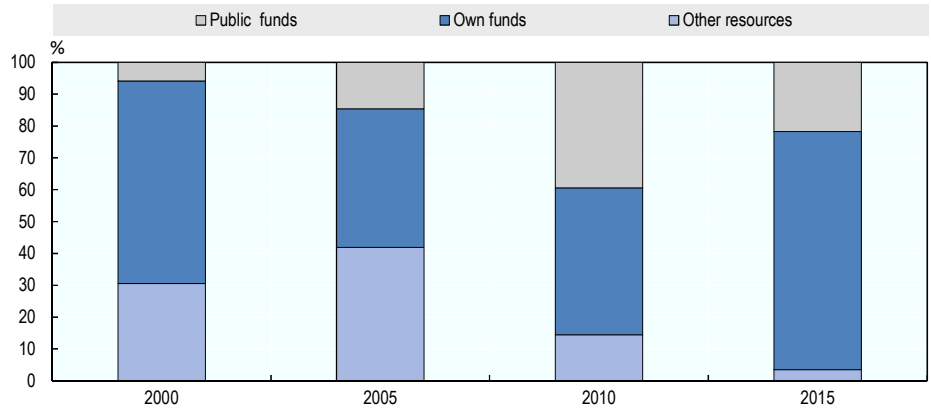
There are large differences both in terms of innovative inputs and outputs across regions (Figures 4.11 and 4.12). The spending on product and process innovation per capita ranges from KZT 772 in the Kyzylorda region to KZT 33 732 in the Atyrau region.

Even after "trimming" these outlier regions, there are about tenfold differences in innovative expenditures per capita. In general, average innovation expenditures are higher in the oil-extracting regions (Atyrau and Aktobe) and lower in the easternmost and southernmost regions of the country. This suggests that these differences are mainly driven by a few large firms. Smaller differences can be found in the share of innovative firms (about fourfold) and, interestingly, this share is not related to the sectoral composition of regions: indeed, the three regions with the highest share of innovative firms are all primary agrarian regions.

How do firms finance their innovation activities?

A relatively large part of both R&D and innovation (75% and 60%, respectively) is self-financed by firms. Although the central and local government plays an important role for R&D (21.5%), it only plays a limited one for innovation (9%). In other words, innovative firms have to finance about 90% of their innovation expenditures from either their own sources or from banks.

Figure 4.13. **Source of business R&D expenditures, Kazakhstan**



Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan.

Synthesis

The main achievements and remaining challenges related to the upgrade of the innovation capabilities of firms are presented in Table 4.3.

Table 4.3. **Achievements and challenges related to the innovativeness of Kazakhstani firms**

Achievements and progress	Remaining challenges
• Relatively large part of both R&D and innovation self-financed by firms	• Small R&D activity of business sector in international comparison (R&D expenditures, number of researchers) • Relatively low average product and process innovation expenditures per firm; importance of non-R&D innovative inputs in innovation expenditures (purchase of advanced machinery) • Very low share of innovative firms in international comparison (comparable to the Russian Federation) • Low prevalence of marketing and organisational innovation • Large differences both in terms of innovative inputs and outputs across regions

How do firms co-operate and learn?

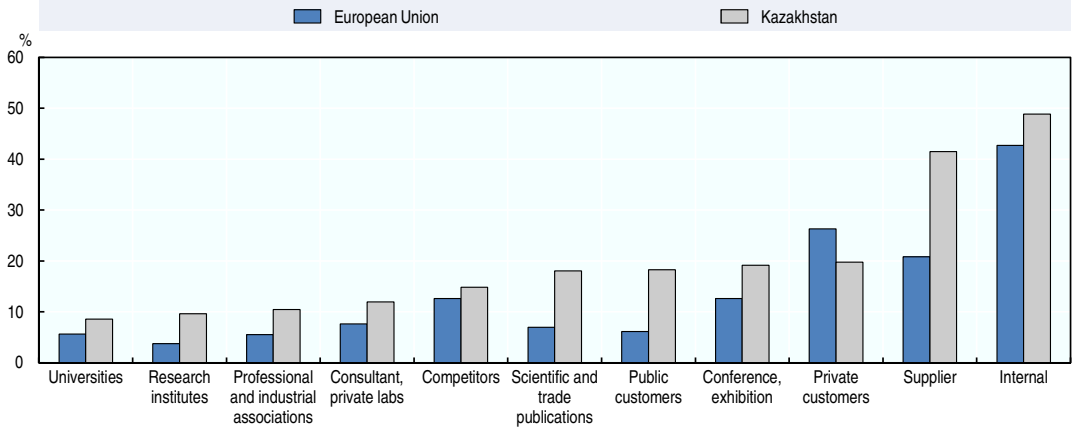
Who do firms learn from and co-operate with?

A key characteristic of an efficient national innovation system is the intensity and diversity of knowledge flows among its actors. Besides internal research and innovation activities, business firms increasingly rely on knowledge available from other actors in the innovation system, including other firms which can be competitors or suppliers, as well as academic partners.

Figure 4.14 shows the share of innovative firms rating different sources of knowledge as "highly important" both in Kazakhstan and EU countries.[8] In almost all countries, internal (within firm or group) sources are the most important, followed by market sources (especially buyers and suppliers), while institutional sources – including academic research – are, by and large, important for fewer firms. There are, however, significant differences between Kazakhstan and EU countries:

- First, while in the European Union about 20% of innovative firms considered suppliers as a highly important information source, about 40% of Kazakhstani firms did so. This could be connected to the relative importance of acquisition of international advanced machinery and other production equipment. Using these capital inputs often requires the adaptation of the production process to the domestic conditions, where the supplier can be of great help.
- Second, in the European, private customers are the most important information source while they are less important for Kazakhstani innovators. This significant difference provides additional evidence that few Kazakhstani firms sell their products to private buyers and that, when they do so, there is only limited interaction taking place before the final stages of the innovation process. This configuration can find its roots in both the supply and demand sides. Firms still rely on a linear model of innovation with limited feedback loops from clients. Also, the lack of sophisticated private buyers reduces the knowledge firms can source from clients.

Figure 4.14. **Share of innovative firms citing source as "highly important", Kazakhstan and the European Union**



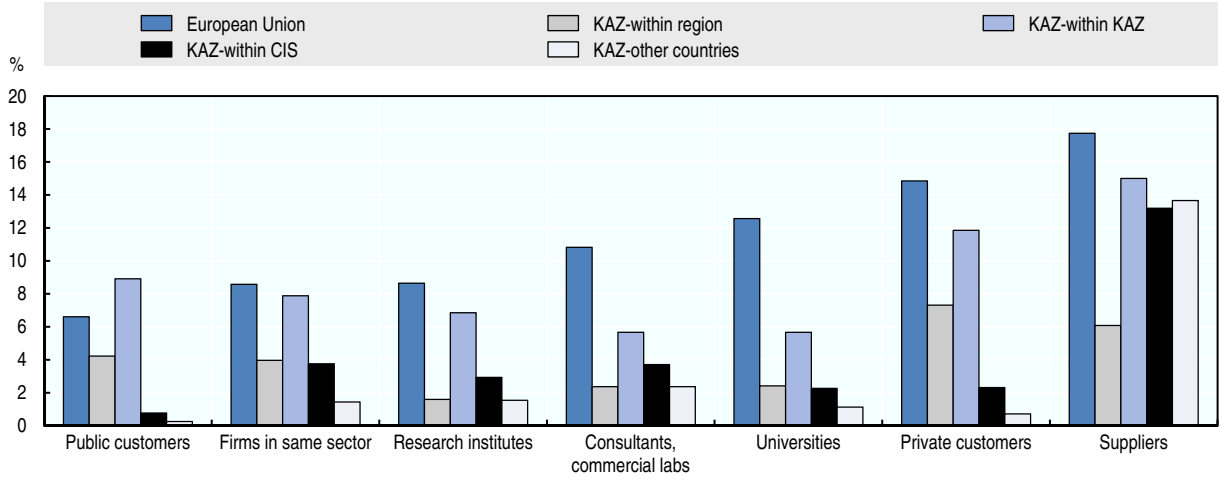
Notes: 2014 for Kazakhstan and 2012 for EU countries. The EU statistics include firms with product or process innovation while in Kazakhstan the ratio is calculated for all innovators.

Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan and Eurostat (2016c), *Science, Technology and Innovation Statistics* (database), http://ec.europa.eu/eurostat/web/science-technology-innovation/data/database.

The state, however, is a more important information source in Kazakhstan than in most European countries. Most noticeably, about four times more Kazakhstani firms mentioned public customers as an important information source than firms in the European Union. This may follow from the larger role and different composition of the public sector in Kazakhstan as compared to the European Union. As in most countries, universities are at the very low end of the spectrum of innovation partners. It is noticeable that Kazakhstani firms rely somewhat more on universities and research institutes when sourcing information for innovations than firms in the European Union. This contrasts quite strikingly with anecdotal evidence that suggest that research-industry relationships are very limited, mainly concentrated on a few companies.[9]

The type of co-operation partner is quite similar to that of information sources: similar to firms in the European Union, Kazakhstani firms most frequently co-operate with their suppliers and buyers in developing their innovations (Figure 4.15). Co-operation between firms and universities (and to a smaller extent between firms and research institutes) is less frequent in Kazakhstan than in Europe. In terms of geography, as expected, firms are much more likely to co-operate with domestic organisations than with foreign partners. This is especially the case for both private and public buyers, where co-operation with foreign buyers in implementing innovations is very small, which is in line with the small share of exports in manufacturing. The pattern is very different when it comes to suppliers: besides domestic suppliers, Kazakhstani firms often co-operate with suppliers from the Commonwealth of Independent States (CIS) and other countries. This, again, reflects the large role of advanced imported machinery in Kazakhstani business innovation.

Figure 4.15. **Co-operation in innovation, Kazakhstan and the European Union**



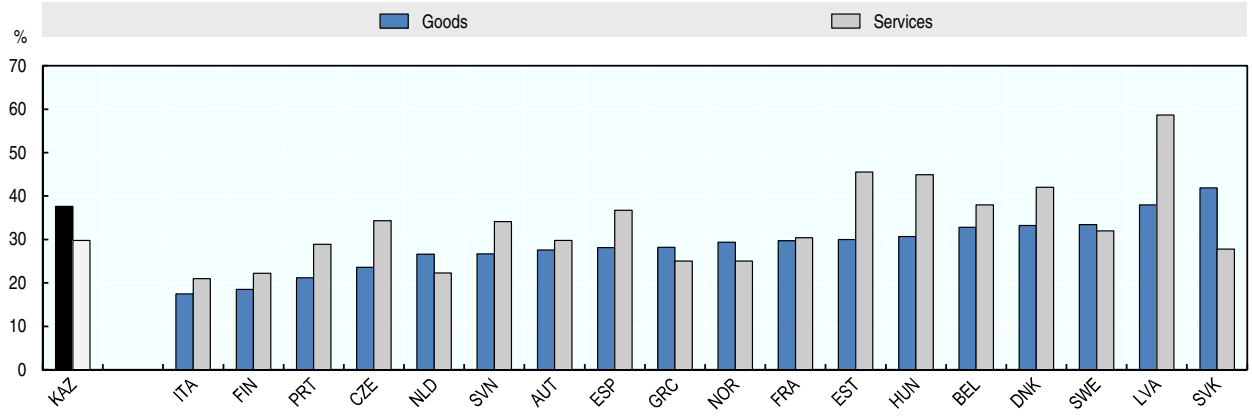
Notes: 2014 for Kazakhstan and 2010-12 for the European Union. The Committee of Statistics only reports co-operation broken down by geographic area.

Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan and Eurostat (2016c), *Science, Technology and Innovation Statistics* (database), http://ec.europa.eu/eurostat/web/science-technology-innovation/data/database.

Beside co-operation, Kazakhstani firms also frequently externalise the development of new products or services, certainly in relation to their lack of domestic innovation capabilities. In 2014, between 40% and 45% of innovations were developed by the firms themselves, namely, without partners, and about 20% in co-operation with other

organisations. The remaining 35-40% of innovations were externally developed, from which about 10% required significant further work by the firm itself. In international comparison (Figure 4.16), the share of externally developed innovations is high in Kazakhstan, especially for product innovation. It compares with the level achieved by small, very open economies in the European Union with a large multinational presence.

Figure 4.16. **Share of firms introducing externally developed goods and services from product innovating firms, Kazakhstan and European countries**



Note: 2014 for Kazakhstan and 2010-12 for European countries.

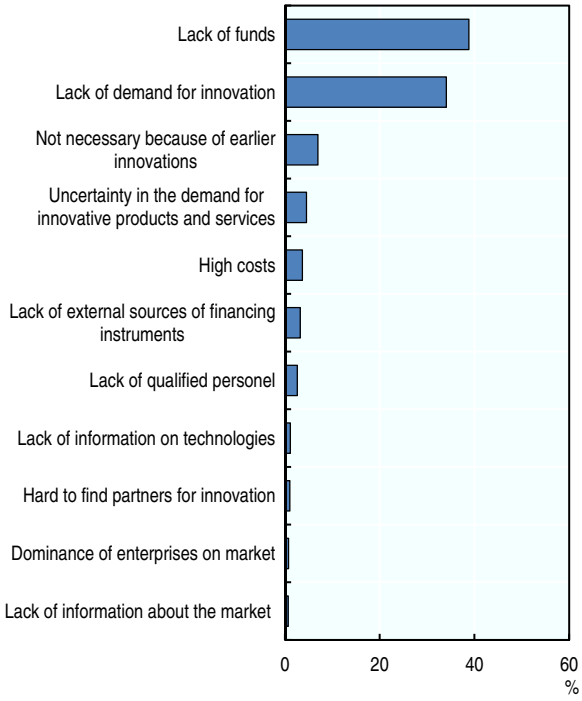
Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan and OECD (2015b), *Innovation Statistics and Indicators: Innovation Indicators 2015* (database), www.oecd.org/sti/inno/Innovation%20Indicators%202015.xls.

What are the main perceived barriers for innovation?

The lack of funds and the lack of demand for innovation are the two most important barriers to innovation as perceived by Kazakhstani firms (respectively 38% and 34% of firms citing these obstacles as "highly important"). Although important, these two factors do not play such an outstanding role as they do in most other countries (Figures 4.17 and 4.18). This is consistent with recent research on this issue, which states that such differences are related to the technological level achieved by countries. The lack of funds and demand are perceived to be more important in economies farther away from the technological frontier, while other constraints become increasingly prominent in countries conducting cutting-edge research and innovation activities (Hölzl and Janger, 2014).

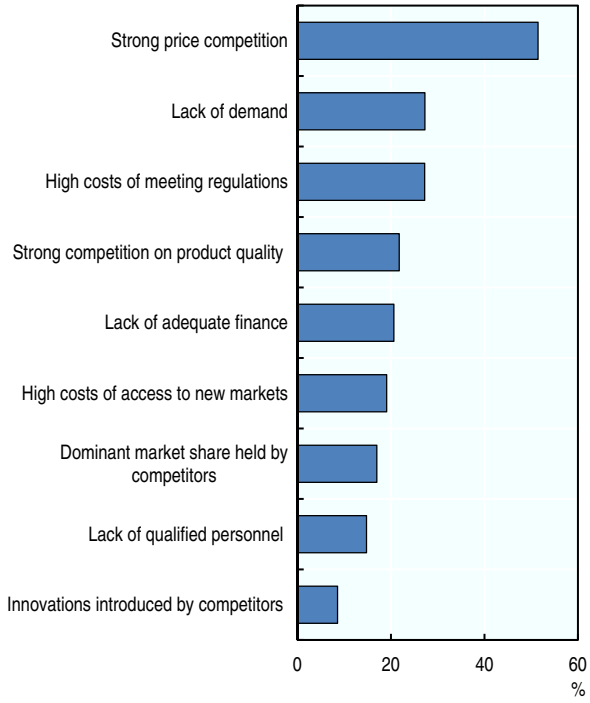
It should be noted that the lack of external financing instruments is not indicated as a major problem, which might suggest that firms still do not consider innovation as an investment, but mainly as an activity to be performed using their own funds, if and when available. This is consistent with the data on the sources of financing for innovation, which show that the share of auto-financing of business R&D is very high – 75% in 2015 – but may also reflect to some extent the low demand for and supply of innovation.

Figure 4.17. **Share of Kazakhstani firms indicating innovation obstacles as "highly important" by type of obstacle, 2014**



Source: Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan.

Figure 4.18. **Obstacles to innovation in the European Union, 2010-12 (share of firms answering "highly important" for each question)**



Source: OECD (2015b), *Innovation Statistics and Indicators: Innovation Indicators 2015* (database), www.oecd.org/sti/inno/Innovation%20Indicators%202015.xls.

Synthesis

The main observations with regards to firms' co-operation in research and innovation are presented in Table 4.4.

Table 4.4. **Main observations with regards to firms' co-operation in research and innovation**

Observations
• Important role of suppliers in the innovation process, both as information sources and co-operation partners, in relation to the large role of imported machinery in business innovation
• Private customers less important and public customers more important for innovators in Kazakhstan than in EU countries as a source of information
• Co-operation between firms and universities (and to a lesser extent between firms and research institutes) is less frequent in Kazakhstan than in Europe
• Significantly larger share of externally developed product innovations in international co-operation, reflecting the possibility of adapting foreign solutions and the limited capabilities of Kazakhstani firms to develop new products
• Lack of demand and funds perceived as the two most important obstacles of innovation

Innovation in selected key sectors

While the level of innovation-based diversification appears relatively limited overall, a closer look reveals some promising initiatives and pioneering experiments at sectoral or organisational level. As in many resource-rich countries, the extractive industries are a

major source of lock-in, attracting demand for production factors and policy makers' attention at the detriment of other "lagging" sectors. At the same time, with careful management of revenues stemming from these activities and relevant policies, these industries, such as the oil and gas industry in Kazakhstan, can provide unique opportunities. The Kazakhstan Oil and Gas R&D and Technology Roadmap, which involved the upstream oil and gas industry actors along with the government, is an example of a proactive initiative that can support a co-operative and forward-looking approach that is often lacking in Kazakhstan. Related to oil and gas, the machinery and equipment sector has also demonstrated both its capacity to change through technology upgrading and adoption of international standards on the one hand, and the resilience of the "old model", characterised by limited strategic focus and the omnipresence of the state and captive markets. In the still underperforming food industry, the success of a domestically leading company such as RG Brands shows the latent opportunities, should Kazakhstan address some framework condition issues that hinder innovation. Finally, in the knowledge-intensive – IT-based in most instances – services, specific firms have demonstrated their innovation capacity, while still relying upon public authorities and/or government-linked companies as main or "pioneer" buyers.

Oil and gas

Given its weight in the national economy, the oil and gas sector is the natural starting point for any diversification strategy in Kazakhstan. This industry may create linkages for local R&D and engineering actors or order machinery, equipment or other inputs from local manufacturers. Strong local content requirements put pressure on multinational enterprises to form such linkages with local firms. Such links can be vital sources of knowledge for the local industry and the high quality requirements of global firms can also provide incentives for domestic firms for technology and quality upgrading.

These policies are complemented in the field of R&D with a requirement to spend at least 1% of subsoil revenues on R&D. As Chapter 5 shows, this policy is not effective yet because of the lack of detailed regulation, but it may turn out to be an important policy in the future.

Box 4.2 describes the Kazakhstan Oil and Gas R&D and Technology Roadmap prepared through the co-operation of upstream oil and gas industry actors with a strong endorsement by the government. The exercise analysed the specific technological challenges and relevant opportunities for the domestic oil and gas industry. According to this analysis, the best opportunities lie, for instance, in the area of steel and concrete structural design and fabrication, the provision of upstream chemicals and well sand-screen manufacturing. However, several of the potential solutions identified were considered as quite unrealistic due to problems affecting the domestic industry, including insufficient capabilities, immature technology and inefficient regulations, as well as some non-existing markets (for instance, in sulphur). The Roadmap Project concluded that there is a place for well-targeted strategies in narrowly defined activities whose implementation would require a longer term upgrading of capabilities and institutions.

Box 4.2. **Kazakhstan Oil and Gas R&D and Technology Roadmap**

The Kazakhstan Oil and Gas R&D and Technology Roadmap project has been a key effort aimed at understanding the R&D and technological challenges in Kazakhstan and devising relevant options to address them. The final aims of this exercise were to provide guidance for the government and local actors, to improve co-ordination and generate linkages between key actors. It was initiated by Shell, in co-operation with other firms in the industry and, finally, endorsed by the government in 2013.

This project involved the detailed analysis of challenges, the identification of possible technological solutions, and the assessment of the capabilities of the domestic oil and gas industry and research infrastructure to implement these solutions.

The project identified five types of key challenges in Kazakhstan which necessitate specific technological solutions. These are: 1) the complex geologic structure of reservoirs; 2) high temperature and pressure; 3) high H_2S content; 4) transportation issues; and 5) extreme climate and shallow water reservoirs. Several groups of technological solutions were identified for each challenge. The first group of solutions is related to mapping and interpreting reservoirs. Because of the complex nature of these reservoirs, this requires specific training, skills and experience in this kind of field. The second group of technological solutions involves developing and supplying robust field equipment that operates well under the extreme temperature/pressure and high H_2S content. The next three groups help in assuring fluid flow, efficient field management, and safe and sustainable operations.

Using standard industry cost-benefit analysis methods, the different options explored to implement these solutions were: 1) technology transfer; 2) adaptation of existing technology; and 3) search for new solutions.

Source: Shell (2013), *Kazakhstan Oil and Gas R&D and Technology Roadmap*, www.ifm.eng.cam.ac.uk/uploads/Roadmapping/Kaz_RM_book_English.pdf.

Beside the numerous multinational companies present in the upstream oil and gas sector, the national oil and gas company KazMunayGas (KMG) owned by Samruk-Kazyna plays a key role in this sector. Box 4.3 describes the research infrastructure of this firm. Importantly, partly because of the privatisation strategy and partly because of the detailed regulations of R&D policies, the engineering part of its strong engineering and R&D subsidiary was privatised while the R&D part, employing 600 people, remained under KMG ownership.

Box 4.3. **Research infrastructure in KazMunayGas (KMG)**

KMG is a key oil and gas producer owned by Samruk-Kazyna, with 40 000 employees. KMG is itself a holding with many subsidiaries in all fields of oil and gas exploration, production and transportation. Since the Soviet times, KMG has operated its own university, vocational schools and research institutes. Since its foundation in 2002, it has also been the owner of the largest research and engineering company in Kazakhstan, the Kazakh Institute of Oil and Gas (KING), employing around 1 600 people in 2014. One of its subsidiaries – JSC NIPI "Caspimunaigas" in Atyrau – is one of the oldest design and engineering institutes in Kazakhstan. This company celebrated its 75th anniversary in 2015 and has contributed to almost every large oil and gas project in the country. About 80% of KING's budget comes from engineering while the remaining 20% is the result of R&D services.

Box 4.3. **Research infrastructure in KazMunayGas (KMG)** (*cont.*)

KING was included in the list of the companies to be privatised as part of the comprehensive privatisation plan conducted between 2014 and 2016. The engineering capacities were sold in 2015 for KZT 7.5 billion while part of the R&D capacities of KING was meant to be used for setting up a new FMG research institute, the Research and Development Institute of Production and Drilling Technology, in 2014.

In addition to generally applicable arguments in favour of privatisation, a specific motivation for selling the engineering part and constituting a new entity dedicated to research might have been to be eligible for certain R&D policy instruments, including funds stemming from the 1% subsoil user requirements and the 150% tax deduction (see Chapter 5). The Research and Development Institute of Production and Drilling Technology employs 600 people at its two branches in Atyrau and Aktau. Its annual revenue is above KZT 4-5 billion per year and it is 100% financed by KMG.

Sources: Zhabayev, A. (2014), "General Director of KING: Race for efficiency has started", http://astanatimes.com/2015/09/general-director-of-king-race-for-efficiency-has-started; SK (2015c), "Kazakh Institute of oil and gas sold for 7,5 bln tenge", http://sk.kz/news/view/4268?lang=en; Zhumzhumina, A. (2014), "Kazakhstan to establish Drilling and Production Research Institute", https://en.tengrinews.kz/science/Kazakhstan-to-establish-Drilling-and-Production-Research-26316; KMG (2016), "Innovation and technology", webpage, www.kmg.kz/en/manufacturing/innovation_and_technology.

Machinery manufacturing for upstream oil and gas

The manufacturing of machinery for the upstream oil and gas industry is considered a priority sector in the government programme "SPAIID", and is based on the advantage of the familiarity with the specific problems of extraction and the experience gained while working in Kazakhstan. However, as shown by the results of the Kazakhstan Oil and Gas R&D and Technology Roadmap Project, in the short run only a few narrowly defined activities seem to be competitive: steel and concrete structural design and fabrication, the provision of upstream chemicals and well sand-screen manufacturing.

Machinery manufacturing plays a relatively minor role in the Kazakh economy. Total machinery production was KZT 80 billion (approximately USD 300 million) in 2014. This should be compared with nearly USD 7 billion worth of industrial machinery import in the same year (UN Comtrade, 2015). The lack of sectoral competitiveness is also reflected in the relatively slow growth of the industry: between 2010 and 2014 its nominal growth rate was only 21%, compared to 60% for manufacturing as a whole.

As exemplified by the case of one of the leading oil and gas equipment producers, PZTM (Box 4.4), these firms were forced to change radically after 1990, basically from fully state-dependent military equipment producers to market-oriented civilian machinery producers. This dramatic transformation involved significant technology upgrading, co-operation with foreign partners and adopting international standards. However, these firms are still owned by the state and are, to a great extent, dependent on captive markets. As opposed to the recommendations of the Roadmap Project (Shell, 2013), these firms tend to have an overly broad product portfolio instead of focusing on a few key products and developing a specific competitive advantage. Furthermore, capabilities are frequently not up to date, which does not make them attractive suppliers for the key actors in the upstream oil and gas sector.

The machinery manufacturing industry illustrates concretely the dilemmas of an industrial policy promoting diversification. As discussed in Chapter 2, Kazakhstan's export and production structure is concentrated in primary products, while the set of high

value-added exported products is small and has declined in the past. In such a situation, a possible diversification strategy in the short and medium term is to identify products which are on the "margin" of becoming competitive, and promote their competitiveness (World Bank, 2013). The machinery equipment industry for oil extraction is a natural candidate for this given the possibility of supplying world-class oil producers in the country. The history of PZTM reflects the working of such a strategy (Box 4.4). The production of such machinery – and other types of machinery with supposed competitive advantage, including for railways machinery – were encouraged and incentivised by the state. Restructuring its product portfolio, modernisation and management innovation have helped PZTM to operate successfully, but its success in international markets is still limited.

Box 4.4. **Petropavlovsk Heavy Engineering Plant (PZTM)**

One of the largest firms in the oil and gas machinery industry – as well as in the whole of the Kazakhstani industrial sector – is the Petropavlovsk Heavy Engineering Plant (PZTM). PZTM was founded in 1948 with the aim of producing military equipment. It is owned by Samruk-Kazyna through its holding "Kazakhstan Innovation". Since 1990 it has changed its product mix to focus more on industrial machinery production. The company currently supplies equipment for field development, drilling and maintenance of oil and gas wells to leading Kazakhstani and foreign companies.

The firm has gone through a number of important steps of technological upgrading, which has allowed it to meet several ISO standards since 2003. It actively co-operates with partners from France, Japan and Great Britain. Its technology centre employs 90 experts for design and technical projects. They have developed and put into production a number of projects in the upstream oil, oil refining and railway industries.

The state has supported the technology upgrading of PZTM. In 2009, the company's machinery producing equipment was modernised for KZT 634 million. In 2014, a new production line was built for the production of energy boiler equipment with the explicit aim of import substitution in the energy industry.

The company offers a striking example of successful transformation from a Soviet military equipment firm to a successfully operating civilian machinery manufacturer meeting international standards. However, this significant market is still dominated by foreign firms, and the company is still state-owned and part of a group with a military focus ("Kazakhstan Engineering"). This ownership structure may not be the most conducive to innovation-based strategies. Moreover, it has diversified its production activities into energy and railways, based on government priorities instead of deepening its competitive advantage on its core market.

Sources: PZTM (2016), JSC "Petropavlovsk Plant of Heavy Machine Building" website, www.pztm.kz/eng/index.php; Kazakhstan Export (2012a), "Machinery", webpage, http://export.gov.kz/en/page-418-machinery.

The main challenge for such an industrial policy is that it should make firms more competitive and not simply shield them from competition. Products, or even firms, which do not become competitive in the medium and long run should not be defended from international competition indefinitely. Such long-term competitiveness and market success depends on broader framework conditions, such as the upgrading of physical, human and institutional capital of the country. Upgrading physical capital involves modernising the country's infrastructure. Human capital development means teaching transferable and flexible skills which do not become obsolete even in a quickly changing

environment. Such skills naturally include language, financial and management skills, including innovation management skills. Upgrading of institutions includes reforms to fight corruption and create a level and stable playing field through transparent and predictable regulations which guarantee market incentives and discipline in the long run (World Bank, 2013).

Food industry

The combination of large agricultural areas, low population density and traditions in agriculture can provide favourable conditions for developing a competitive food industry sector in Kazakhstan. Both agriculture and the food industry already play a quantitatively important role in the Kazakh economy. However, the agricultural sector has undergone a difficult transition and still faces many challenges, including water availability, extreme climate, dominance of subsistence-oriented producers in key product sectors, weak integration of domestic food chains, difficult access to external markets, lack of qualified labour and narrow commercial credit markets (OECD, 2013b).

Natural abundance is indeed not sufficient for competing effectively in processed food markets. The export structure of the country (see Chapter 2) reflects the fact that, in contrast to unprocessed agricultural products, Kazakhstan has little revealed comparative advantage in processed foods.

New products and varieties, secure and innovative packaging, and efficient use of intellectual property (IP) are necessary for international competitiveness. The company RG Brands provides an example of a firm that could become a powerful domestic producer and retailer by building on a strategy which emphasises continuous innovation; combines product, process, marketing and organisational changes; and co-operates both with firms in the same industry and equipment manufacturers (Box 4.5). The relatively low productivity and revealed comparative advantage of the Kazakhstani food industry, however, suggests that many firms may lack the capabilities and resources to follow such a strategy.

Box 4.5. **RG Brands: Innovation in the food industry**

RG Brands is one of the leading food and beverage producers in Kazakhstan. RG Brands was formed in 1994 as a distributor of imported food and beverage products. The firm has grown into one of the largest companies in Kazakhstan and is the owner of some of the best-known local brands through constant innovation and partnerships with many foreign firms. Nowadays, it exports to all countries across Central Asia and manufactures its own brands at four plants.

In the first four years after its foundation the company remained an importer of overseas products and focused on developing its various distribution channels. The firm started its R&D activities in order to understand how to produce its own brands and compete successfully with imported products. Based on this research, the firm identified locally made fruit juices with seasonal variety as a potential market to enter. Consequently, in 1999 it introduced 12 varieties of natural fruit juices under the brand Da-Da. The company has been developing new products (including iced teas and chips) and varieties ever since. Product innovation is always complemented with innovative packaging.

Box 4.5. **RG Brands: Innovation in the food industry** (*cont.*)

Co-operation with local and international firms has also been important in the success of the company. Besides co-operation with international food and beverage producers, relationships with equipment manufacturers also proved to be key. One of the first such relationships started in 1999 with Tetra Pak, a multinational packaging company. Under this agreement, Tetra Pak provided the necessary equipment and training abroad in order to enable the secure and durable packaging of natural juice products. The fact that this packaging allows the juices to last up to one year without refrigeration provided an important competitive advantage in the Central Asian market. The co-operation with Sidel, which supplied large bottling production lines, was equally important.

The initial financing of RG Brands came from its owner (REMI), but it was listed on the Kazakhstani Stock Exchange as early as 1999. It has also issued bonds on the market. Of great importance were two loans from the European Bank for Reconstruction and Development (EBRD), which helped the firm to expand to export markets, integrate backwards and make its production process more sustainable.

The success of RG Brands shows the opportunities in the Kazakhstani food industry. It underlines the importance of continuous innovation in which product, process and marketing innovation complement each other. The co-operation with equipment suppliers yielded an important competitive advantage for the firm on its markets. Finally, funding proved to be available, but partly because of the already profitable importing operations of the firm. Moreover, it was very efficiently leveraged into R&D, innovation and higher value added domestic production.

Sources: WIPO (2015), "Shifting from brand importer to brand innovator", webpage, www.wipo.int/ipadvantage/en/details.jsp?id=3686; RG (2016), RG Brands website, www.brands.kz/en; EBRD (2015), "RG Brands loan facility", www.ebrd.com/work-with-us/projects/psd/rg-brands-loan-facility.html.

Organic production, as part of the green economy initiative, has been set recently as a government priority. The rationale for this is the abundance of prime agricultural land and the resulting low level of chemical use in the agricultural sector. The lack of a proper legal framework for defining organic production has been a key constraint for the growth of this sector. Although the law signed in November 2015 defining organic products was an important development, the regulatory framework is still underdeveloped. There is a need for detailed regulations, a certification system as well as a national authority for the co-ordination of this system. There is strong co-operation between the government of Kazakhstan and the Food and Agriculture Organization in developing such a framework. (FAO, 2015; Kazakhstan Export, 2012b; Witte, 2015).

IT-based services

Although IT-based services account for only a small share of the Kazakhstani economy and the number of innovative start-ups in Kazakhstan is modest, this sector provides some examples of innovative and creative business models (Box 4.6). Despite the wide diversity of cases, available examples of Kazakhstani IT start-ups allow us to identify some common features.[10] First, many of them have benefited significantly from both financial and non-financial assistance from Kazakhstani and/or international donors. Second, their strategy often relies to a certain extent on the state (public authorities and/or government-linked companies) as a main or "pioneer" buyer. Some other innovative ideas rely on good ICT infrastructure and actions against problems which are typical in most emerging countries, including corruption or counterfeit goods.

Box 4.6. **Innovative IT-based start-ups in Kazakhstan**

Wipon

Wipon, which currently employs six people, provides a smartphone application to identify counterfeit cigarettes, drugs and alcohol by checking the barcode on the package. The application can also send information directly to the Tax Office, including the location of the counterfeit goods. By December 2015 it has already been downloaded 400 000 times. The application can be downloaded for free and the firm receives payments from the Ministry of Health.

Wipon acts upon the pervasive problem of counterfeiting in Kazakhstan. Although a business model of charging the consumers may never be sustainable, in this case it provides large public benefits, both in terms of health and tax revenues, hence justifying the state subsidies.

APARU

APARU addresses the problem of the lack of reliable, independent information on prices and timetables of competing inter-city bus companies. The company claims that ticket vendors at large terminals are not impartial and are more likely to sell tickets of carriers which supply them with kickbacks. As a result, consumers may buy more expensive tickets or travel at suboptimal times. APARU installs ticket machines at these terminals, which provide accurate and impartial information.

APARU's business model alleviates a problem generated by corruption. In this case, private agents may be willing to pay for the service. This service can also yield large benefits for the society at large by making competition between bus service companies more efficient and transparent.

Source: Based on the interviews made by the author in Kazakhstan (December 2015).

Public research institutions

In the past, universities in Kazakhstan were fully dedicated to higher education and focused almost exclusively on teaching. Research was performed mainly in institutes of the Academy of Sciences and in other non-university research institutes oriented towards specific industrial sectors and connected to different sectoral ministries. In the period following independence, the Academy of Sciences was reorganised and the institutes became independent organisations, most of them with the status of joint stock companies (JSCs) under the organisational frame of the Ministry of Education and Science, Ministry of Investment and Development, Ministry of Health, Ministry of Agriculture and others.

More recently, following international experience, several reforms have been initiated to replace the former model relying on the divide between research and teaching. The higher education institutions (HEIs) are currently in a transitional period facing the challenges of integrating education, research and innovation into their strategies, structures and activities, in co-operation with enterprises and other societal actors. Some of the universities were also merged with research institutes and various partnerships have been engaged between these two types of institutions. As a result, the science, research and technology development system in Kazakhstan has changed substantially and universities are playing an increasingly important role in research and also in commercialisation of research results and innovation. However, these changes are quite recent and the system is still at an early stage, not yet reflected in the scientific and

knowledge transfer performances of public research organisations despite progress in recent years.

This section reviews the recent structural changes and scientific, higher education and knowledge transfer performances of public research organisations. It focuses on HEIs due to the lack of available information on the activities of public research institutes (PRIs).

Overall public research landscape

Institutional status of HEIs

In the academic year 1990/91, when Kazakhstan became independent, there were 55 higher education institutions (HEIs) in Kazakhstan, which increased to 185 in 2001/02, mainly through the establishment of private institutions. Since then, the number of HEIs has decreased continuously, from 176 in 2006/07 to 126 in 2014/15 (Committee on Statistics, 2016). This development is driven by the increasing importance of accreditation, quality assurance and national rankings of HEIs. The continuous decrease in the number of HEIs over the last ten years and the stabilisation of their number is the result of withdrawing the licences from low-quality private institutions (OECD, 2014).

According to publicly available information about HEIs, the 126 HEIs (IAQQ, 2016) operating in Kazakhstan in 2014/15 belong to the following categories (IAC, 2015b).

- 9 national universities
- 1 autonomous educational organisation
- 1 international university
- 38 state HEIs
- 13 non-civil HEIs
- 64 private higher education institutions.

Table 4.5. **Location and identity of national universities in Kazakhstan**

Institution	Location
Eurasian National University, L.N. Gumilyev	Astana
Kazakh National University of Arts	Astana
Kazakh National University, Al-Farabi	Almaty
Kazakh National Research Technical University, K.I. Satpayev	Almaty
Kazakh National Pedagogical University, Abaya	Almaty
Kazakh National Conservatory Kurmangazy	Almaty
The Kazakh National Academy of Arts, T. Zhurgenov	Almaty
Kazakh National Agrarian University	Almaty
Kazakh National Medical University. S. Asfendiyarov	Almaty

Source: IAQQ (2016), "List of universities of the Republic of Kazakhstan with numeration", http://nkaoko.kz/en/component/k2/item/7759-home.

The status of national university is granted to universities on the basis of their performance in education, research and innovation in co-operation with industry and other societal actors.[11] They receive higher funding compared to institutions in the other categories. In addition to other research Techniogroups and laboratories, some of them also host national labs and/or national laboratories of engineering profile (OECD, 2014).

The status of autonomous educational organisation was created specifically for the Nazarbayev University. This university was founded in 2010 in order to serve President Nursultan Nazarbayev's strategy of joining the world's 50 most competitive countries (Box 4.7). With the establishment of a prestigious international university in the capital, the objective was to provide Kazakhstan the engineering and scientific personnel and future leaders needed to take on Kazakhstan's industrial and innovative challenges.

International university is another special status granted to the Kazakh-British Technical University to acknowledge its binational character.

A national research university label is granted to HEIs with significant research capacity. Once their development programme for five years is approved by the government, national universities can independently develop educational programmes of graduate and postgraduate education, conduct fundamental and applied research, and use or transfer the results obtained. So far, only Nazarbayev University and the Kazakh National Research Technical University K.I. Satbayev have been granted the status of a research university in 2015.

Box 4.7. **Nazarbayev University's higher education and research activities**

Nazarbayev University was established in 2010 following on the initiative of President Nazarbayev as a flagship project with the aim to become the first world-class research university in Kazakhstan setting "a national standard of higher education for the rest of the country" and taking a central role in the modernisation process of Kazakhstan's higher education system.

The university's strategy and activities are closely related to and oriented towards the priorities of the country that are defined in the national strategies "Kazakhstan 2030" and "Kazakhstan 2050". The university is intended to make important contributions towards developing the national innovation system and the knowledge society in Kazakhstan, offering advanced programmes for carefully selected students, developing excellent research and promoting innovation together with business. Although it is clear given the level of investment it requires that it could not be reproduced, the university is a pioneering example and is meant to serve as a role model for the country's higher education system.

Precisely, Nazarbayev University's institutional goals are to take the lead in the educational reform of the country; promote academic and research excellence; become a model for healthcare services; stimulate innovation; translate research into production. In order to be in the best position to meet these ambitious goals, the university was granted a specific autonomous status by the Law of the Republic of Kazakhstan of 19 January 2011 "on the Status of 'Nazarbayev University', 'Nazarbayev intellectual schools' and 'Nazarbayev Fund'".

Higher education activities

In 2016, there are 700 students in the Foundation Programme with 84 faculty, 2 000 students in the undergraduate programmes and 800 in graduate programmes with 35 faculty. The first student cohort graduated in June 2015. Academic programmes are developed together with leading international academic institutions and according to international standards. Nazarbayev University does not host branch campuses of partner universities but various academic partners provide advice regarding curriculum development and back offices.

Box 4.7. **Nazarbayev University's higher education and research activities** (*cont.*)

For instance, the Center for Preparatory Study has a partnership with a variety of institutions, including the University College London and the University of Warwick, the School of Engineering with the University College London, and the School of Humanities and Social Sciences works with the University Wisconsin-Madison. In 2011, the National Medical Holding and its hospital system was assigned to the university as an important step in the creation of an integrated academic healthcare system, together with the Center for Life Sciences and the School of Medicine.

Research activities

Fundamental research is performed by faculty in Nazarbayev University schools and applied research by research centres' staff. Most research entities are gathered under the Nazarbayev University Research and Innovation System (NURIS), in close contact with educational programmes in different fields of science and biomedicine. The strategic planning and management of research conducted in Nazarbayev University schools and research centres is under the responsibility of the NU Research Council that meets every three weeks. As for education, Nazarbayev University engages in multiple research partnership agreements. Dedicated research centres co-operate with international partners. For instance, the Center for Energy Research, as part of the new "National Laboratory Astana" that gathers several research structures, has over 20 international academic partners from 9 different countries. Co-operation is also ongoing with two US Department of Energy national laboratories (the Lawrence Berkeley National Laboratory and Argonne National Laboratory).

Nazarbayev University research centres are funded via competitive grant schemes and targeted programmes of the Ministry of Education and Science. First results are already available regarding funding from other sources, such as Horizon 2020, the EU Framework Programme for Research and Innovation. Nazarbayev University also provides some seed grants (up to USD 20 000) on its own resources to finance early stage research implemented by its faculty.

Source: NU (2016), Nazarbayev University website, http://nu.edu.kz.

Restructuring of the research and higher education system

Reforms of the research system

Several structural reforms have been initiated recently to strengthen the national research base and improve the quality of its delivery. In 2004, the Academy of Sciences was transformed into a non-governmental organisation. According to its new mandate, the academy is assigned a broad range of supportive tasks, from participation in the definition of the national science priorities; provision of scientific expertise on fundamental and applied research; monitoring of science, technology and innovation activities through the annual National Report on Science; promotion of science achievements in academic scientific journals and other publications; as well as a variety of awareness-raising activities. Departments of the academy were connected to leading universities or research organisations in 2004.[12]

Institutes of the academy were organised in different forms, including JSCs under the Ministry of Education and Science and also in other ministries such as Health, Energy and Defence. Some of the institutes have been clustered in the National Scientific and Technological Holding "Parasat" since 2008. In September 2015, the Kazakh National Research Technical University named after Satpayev was merged with research institutes

of the Parasat Holding. On that occasion, the university was converted into the Satpayev Kazakh National Research University (KazNRTU) as the first research technical university in Kazakhstan. Due to the merger, the university intends to intensify its work in four sectors: metallurgy, oil and gas, electrical, and mechanical engineering. At the beginning of 2016, KazNRTU was combined with the Kazakh-British Technical University, thus creating the largest research and technology centre in Kazakhstan. The rationales for these restructuring measures were the identified needs for highly qualified personnel, especially with engineering and technical profiles. In connection with these changes, the stimulation of human resource development and research was supported in 2015 by the provision of 350 new places for master students and 100 additional places for doctoral candidates for KazNRTU (IAC, 2015c).

In 2014, the government initiated the restructuring and transformation of four leading universities (IAC, 2015c). Kazakh Agricultural University was merged with JSC "KazAgroInnovation" and the Kazakh Agricultural Technical University Seifullin with the "National Center for Biotechnology" [13] and KazNU Al-Farabi started conducting joint PhD programs with SRI "Gylym Ordasy.

Reforms of the higher education system

Reforms also aimed to improve the quality of the educational programmes delivered by HEIs. During the transition period following independence, a large number of new HEIs were established following private initiatives and investments into a new field of economic activity and possible profits. As a consequence of the lack of regulations and quality standards of the system, the Law "on Education" passed in 2007 introduced the request for accreditation as an element of the reorganisation and future development of the whole higher education system in accordance with the need for improving and safeguarding the quality of higher education (Bishimbayev and Nurasheva, 2012). Accreditation is voluntary but is seen as strategic by HEIs. The introduction of an accreditation system also aimed to allow:

- the mutual recognition of diplomas with international partner institutions
- the protection of the rights for education abroad, as well as access to the international labour market for Kazakh citizens
- the integration of the Kazakh higher and postgraduate system in the Bologna process
- the improvement of education quality in co-operation with dedicated international organisations.

Self-assessment is an important element of the accreditation process that can be carried out by national and international accreditation authorities. Since May 2012, the Ministry of Education and Science keeps a registry of accreditation agencies that are recognised in Kazakhstan. As of 2016, there are six recognised accreditation agencies, two from Kazakhstan (IAAR, IKQAAE), two from Germany (ASIIN, ACQUIN), one from Austria (AQA) and one from the United States (ABET). After the launch of this activity, some experts saw room for improvement towards compliance between reported qualitative information and reality, especially because of the weight of the self-assessment in the process (Bishimbayev and Nurasheva, 2012). As of 2016, 61 accredited HEIs are listed on the website of the Independent Kazakh Agency for Quality Assurance in Education.

Kazakhstan officially joined the Bologna Declaration in 2010 and became the 47th member of the European Higher Education Area and the first Central Asian state, which was recognised as a full member of the European Higher Education Area (EHEA). The Great Charter was signed by more than 60 Kazakhstani universities and the three-tier system of education – bachelor-master-PhD – was adopted. As the main objective of the Bologna Process, the EHEA was meant to ensure more comparable, compatible and coherent systems of higher education in Europe as a basis for enhanced student mobility in Europe.

Another important impact of the Bologna process in Kazakhstan is the change in the management of universities that are gradually granted more autonomy in terms of academic orientations, management and financing (OECD, 2014). At major public universities such as ENU L.N. Gumilev, the Kazakh National University or Al-Farabi Kazakh National Pedagogical University Abaya, to name only a few, boards of trustees have been established as a move towards transparency and accountability (IAC, 2015c). These boards gather representatives from the private sector, the university, business associations and trade unions. They are in charge of strategic planning, appointments, control of financial resources, development of corporate identity, and management of conflicts within the institution (OECD, 2014).

Enhanced autonomy for universities and the integration of stakeholders in their governance structure also allow them to develop closer linkages and interaction between them and with society. International experience shows that this is an essential component of HEIs' strategies to better contribute to the development of the national innovation system. In particular, universities try to strengthen the practical relevance of their programmes by working together with companies by signing contracts, agreements, memorandums and involving practitioners in teaching (IAC, 2015c).

Regional distribution of HEIs

The highest density of HEIs is in Almaty with 40 institutions in 2014/15. Almaty is followed by Astana (14 institutions), South-Kazakhstan (11), Karaganda region (9) and East-Kazakhstan (7).

The notable decrease of the number of HEIs since 2006 is particularly pronounced in regions with a large population, such as South-Kazakhstan or Almaty. This trend is most likely due to the low-quality private institutions established in higher numbers where the prospects for profits from dense human resource markets and demand for higher education were higher.

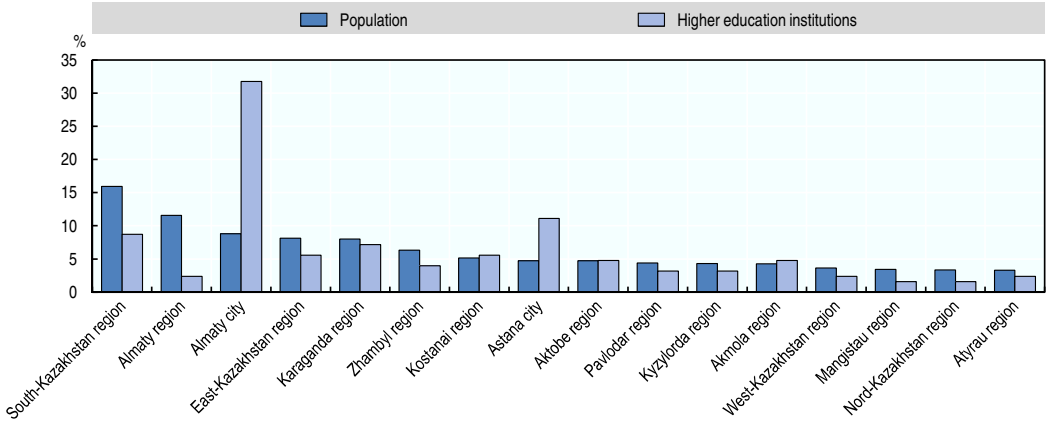
When factoring in the regional distribution of the population, Almaty and, to a lesser extent, Astana, are clearly overrepresented in the higher education system relative to their population size. Considering the increasing importance of HEIs as potential drivers and hubs in regional innovation ecosystems, this imbalance could have a significant effect on the country's regional development. However, the mere existence of HEIs as such is no guarantee for an impact on innovation in a region. Specific well-conceived strategies and structures as well as adequate human resources and professional services are needed to fulfil such roles at regional level and beyond.

Table 4.6. **Regional distribution of higher education institutions in Kazakhstan, 2006/07-2014/15**

	2006/07	2008/09	2010/11	2011/12	2012/13	2013/14	2014/15
Republic of Kazakhstan	**176**	**143**	**149**	**146**	**139**	**128**	**126**
Akmola region	7	6	6	6	6	6	6
Aktobe region	7	6	8	8	7	6	6
Almaty region	4	2	2	2	3	3	3
Atyrau region	3	3	3	3	3	3	3
West-Kazakhstan region	7	4	4	4	4	3	3
Zhambyl region	5	5	5	5	5	5	5
Karaganda region	15	14	13	13	10	10	9
Kostanai region	8	7	7	7	7	7	7
Kyzylorda region	6	5	5	4	4	4	4
Mangistau region	4	3	3	3	3	2	2
South-Kazakhstan region	17	12	12	14	12	11	11
Pavlodar region	4	4	4	4	4	4	4
Nord-Kazakhstan region	4	3	2	2	2	2	2
East-Kazakhstan region	10	9	10	10	10	7	7
Astana city	13	12	13	14	14	14	14
Almaty city	62	48	52	47	45	41	40

Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz.

Figure 4.19. **Regional shares of population and higher education institutions, 2014**



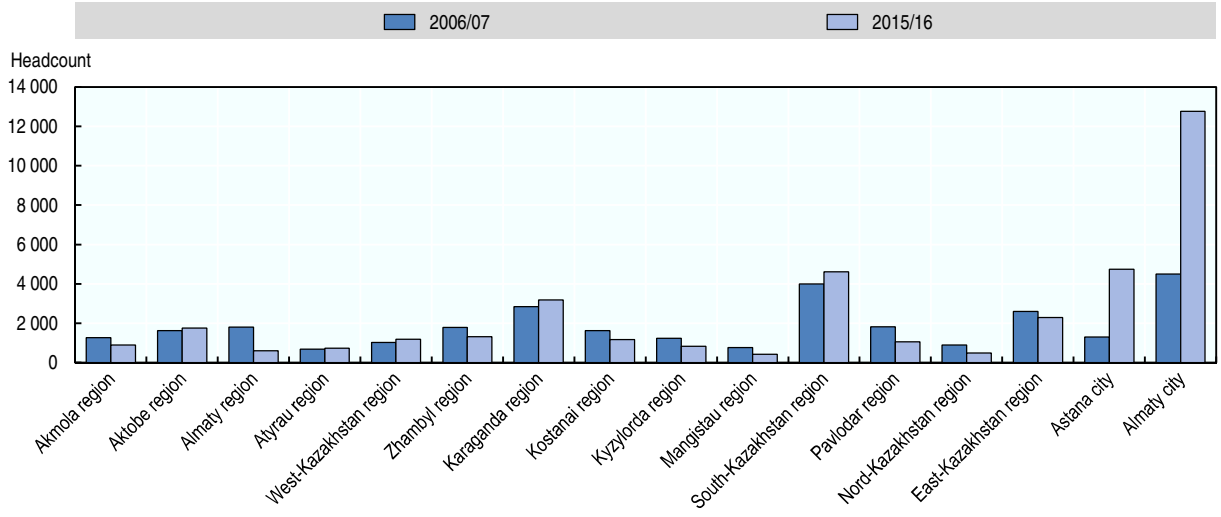
Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz.

Human resources of HEIs and PRIs

The quality of the higher education system depends on the quantity and quality of the human resources. In 2014, 25 793 persons were employed in R&D in Kazakhstani HEIs and PRIs (Committee on Statistics, 2016), which represents 1 503 people employed in R&D per million inhabitants. This is significantly less than in most comparable countries (see Chapter 3). Most of the people employed in R&D in 2014 were R&D researchers and specialists (NAS, 2015). Overall, from 2006 to 2015, the number of staff in HEIs increased by some 28% in Kazakhstan.

The analysis of the regional distribution across Kazakhstan's regions shows the high concentration of human resources for higher education and research in Almaty (Figure 4.20). In some regions like in Astana or Almaty, human resources in higher education have multiplied. In five regions staff numbers in 2015/2016 are between 107% and 116% that of 2006/07. In nine regions, the number of staff has decreased and is between 88% and 34% of the situation in 2006/07. These developments indicate the dynamic development of the higher education system in Kazakhstan as a whole and, on the other hand, may also be the sign of a certain consolidation in some regions.

Figure 4.20. **Regional distribution of higher education institutions' staff**

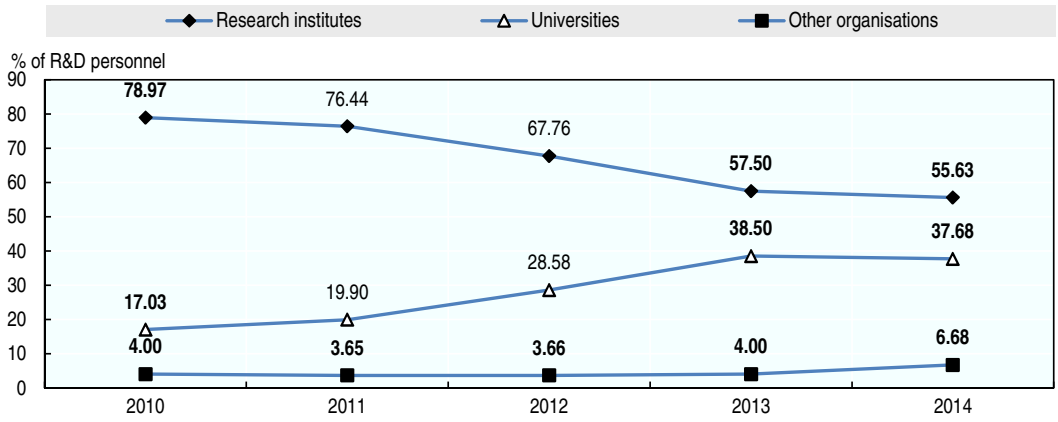


Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz.

The distribution of employees according to the type of R&D organisation shows that 9 720 persons were working in the area of R&D in universities in 2014, up from 2 899 in 2010 (IAC, 2015a). This substantial increase contrasts with the very decrease of R&D personnel in the research institutes. However, the latter still account for the largest share of R&D human resources.[14]

The distribution of R&D-related staff according to the type of R&D organisation (Figure 4.21) provides clear evidence of the ongoing changes in the R&D system of Kazakhstan and the increasing role of universities in R&D. Although the main increase in human resources for research has taken place in universities, the overall staff in universities, including teaching and research staff, remained almost constant between 2010 and 2014. Hence, the increase in the number of R&D-related university staff is probably due to a re-categorisation of university staff from teaching to R&D due to the growth of their research activities. The analysis of the age distribution of R&D personnel in Kazakhstan shows that a number of recruitments have been made in the last ten years or so, compensated by retirements (see Chapter 3).

Figure 4.21. **Distribution of R&D personnel by type of organisation**



Source: IAC (2015a), "Country background report: OECD Innovation Policy Review of Kazakhstan" and author's calculations.

Synthesis

The main achievements and remaining challenges related to the overall public research system are presented in Table 4.7.

Table 4.7. **Achievements and challenges related to the overall public research system**

Achievements and progress	Remaining challenges
• Transition of universities from education institutions to research and education institutions now well-engaged and still ongoing • Restructuration of the research institute sector (closure of some institutions, change of legal status, clustering and mergers) • Merger of several universities to achieve critical mass in research and higher education • Increasing focus on the quality of HEIs' research and education activities (accreditation and quality assurance mechanisms, domestic and international university rankings) – adoption of the Bologna Declaration • Structuring and institutional differentiation of universities (national universities, research universities, etc.) • Nazarbayev University created with ambitious goals and unprecedented resources, not only to become a world-class research and education institution, but also to serve as a role model for the entire public research system • Enhanced autonomy for universities • Greater integration of stakeholders in universities' governance structure	• Number of persons employed in R&D in higher education intuitions and PRIs significantly less than in most comparable countries in absolute and relative terms • Substantial decrease of the number of students since the mid-2000s, at least partly related to demographic reasons

What are the activities and performance of HEIs?

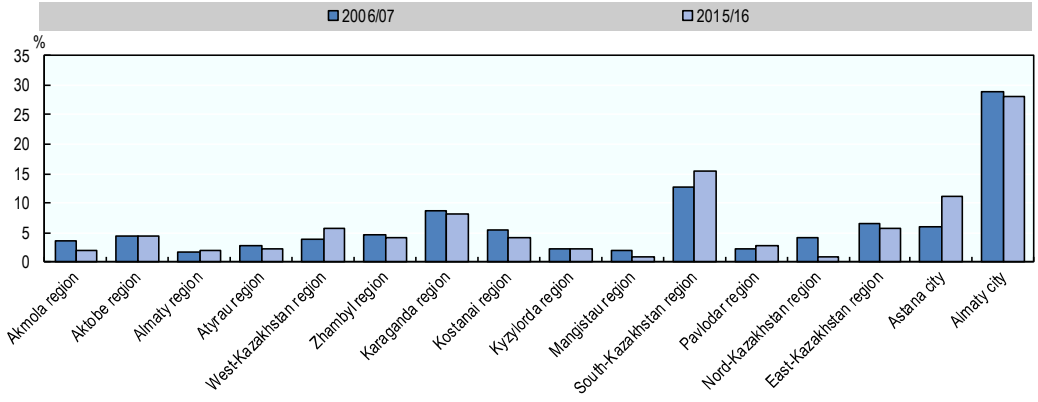
Higher education activities

Higher education enrolment

In 2015/16, 459 369 students were enrolled in HEIs in Kazakhstan, the largest student population being in Almaty. The South-Kazakhstan region, the region with the largest number of inhabitants in Kazakhstan, has the second largest student population. As mentioned earlier (see Chapter 3), the number of students has decreased substantially since the mid-2000s: gross enrolment in higher education decreased by some 7% between 2006 and 2014.[15]

With the exception of Astana, all regions show a substantial decline in the number of students. One reason provided to explain this trend is the decline in the birth rate in Kazakhstan in the 1990s (IAC, 2015c). The number of births was 407 000 in 1988 and only 222 000 in 1998. In 2015, the number of births was 399 000. According to demographic forecasts, the decline of the numbers of young people entering higher education will continue until 2020 (Bologna Process, 2015).

Figure 4.22. **Regional distribution of students in the academic years 2006/07 and 2015/16**



Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz.

Doctoral training

The training of doctoral researchers is essential for nurturing new research capacity in universities. Sixteen Kazakhstani universities offer PhD training in partnership with leading foreign universities, for a total number of 2 063 doctoral candidates in 2014, up from 412 in 2004. However, considering the large number of universities, the overall number of doctoral researchers in Kazakhstan is still very low by international standards. Moreover, comparing the total number of students with the number of doctoral students shows that only a very small fraction of students go for a doctoral degree, which poses a problem to the future development of Kazakhstan's science and innovation system.

Table 4.8. **Number of doctoral candidates in Kazakhstan**

2004	2006	2007	2008	2009	2010	2011	2012	2013	2014
412	366	508	439	666	960	868	1 296	1 892	2 063

Source: Committee on Statistics (2016), *The Official Statistical Information* (database), www.stat.gov.kz.

Again, the number of doctoral candidates shows the dominance of Almaty, with 59%, and of Astana (19%), followed far behind by the Karaganda region (6%), the South-Kazakhstan region (5%) and the East-Kazakhstan region (5%).

Almost all doctoral students are trained in universities. In the course of the mergers of research institutes with universities, the institutes are expected to also become involved in teaching at master level as well as in doctoral training, e.g. "Gylym Ordasy" received in the frame of the merger with Al-Farabi National University the order to train 50 PhDs.

The Kazakh National University Al-Farabi trains the largest number of doctoral students (35.4%). Among other HEIs preparing significant numbers of highly qualified personnel are KazNTU Satpayev, the Kazakh Economic University Ryshukulov, the Kazakh National Agricultural University as well as the Semey State Medical University (NAS, 2016).

The largest numbers of doctoral students are in engineering, followed by social sciences, economic and business; natural sciences; and medicine (Table 4.9). The number of doctoral students has increased since 2010 in agriculture, veterinary science, medicine and engineering and decreased in social sciences and services.

Table 4.9. **Distribution of doctoral students by field of study**

	Number of doctoral students in the current year					
Field	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Education	49	66	116	138	193	214
Humanities	65	116	126	174	193	226
Law	94	104	118	114	129	96
Arts	22	20	20	20	29	33
Social sciences, economics and business	333	356	310	376	270	346
Natural sciences	128	188	264	223	227	221
Engineering	145	297	438	564	583	603
Agriculture	7	49	73	103	142	147
Services	15	19	14	10	11	28
Medicine and social guarantees	33	51	-	125	201	264
Veterinary sciences	4	21	30	33	35	37
Other	65	50	79	12	50	73
Total (number)	960	1 337	1 588	1 892	2 063	2 288
Total in % of 2010	100%	139.27%	165.42%	197.08%	214.90%	238.33%

Sources: Committee on Statistics (2014), *Statistical Yearbook 2014 "Kazakhstan in 2014"*; Committee on Statistics (2015), *Statistical Yearbook 2015 "Kazakhstan in 2015"*.

In addition to the relatively low number of doctoral students, anecdotal evidence suggests that doctoral candidates can only dedicate about one-third of their time to their research work. The rest of their time is spent on other tasks at the university, including performing administrative tasks. Finally, two-thirds of doctoral graduates do not stay in R&D but work in another field after graduation (IAC, 2015a).

Research activities and publication performance

Since 2011, Kazakhstan's scientists have received access to electronic services for scientific and technical information such as Springer Link (Springer), Web of Science (Thomson Reuter), Scopus and Science Direct (both Elsevier) in order to provide them with the possibility of keeping abreast of scientific activities in their fields and monitor their publication performance in their scientific community. Providers conducted numerous training seminars on the use of the information resources at different places in Kazakhstan (IAC, 2015a). The most active users in Kazakhstan are KazNU Al-Farabi, Nazarbayev University, the Eurasian National University Gumilev, the Institute of Experimental Biology FM Muhamedgalieva, and the Institute for Mathematics and Mathematical Modeling.

As previously discussed (see Chapter 3), the number of scientific publications by Kazakhstani authors has increased substantially since 2011. However, this scientific production is low by international standards, especially when normalised by the size of the population. Although its share of publications in the world has also increased during the period, the level remains below the publication performance of other emerging countries, not to mention that of advanced ones. Finally, in spite of the increased scientific production, the quality of publications remains low compared to other countries. The average citation impact of these publications is at par with or slightly above the Russian Federation, Kyrgyzstan and Belarus depending on sources, but far below the average OECD performance. In terms of co-publication, the main partners are scientific partners from Germany, the Russian Federation, the United Kingdom and the United States.

Table 4.10. **Top 10 Kazakh institutions by number of patents granted by the national patent office**

Rank	Name of institution	Number of patents	
		2014	2015
1	Satpayev Kazakh National Research Technical University	69	57
2	Al-Farabi Kazakh National University	33	23
3	Gumilyov Eurasian National University	31	21
4	Bekturov Institute for Chemical Sciences	31	20
5	Asfendiyarov Kazakh National Medical University	13	12
6	Almaty Institute of Power Engineering and Telecommunications	12	27
7	Semey State Medical University	10	4
8	Sokolsky Institute of Organic Catalysis and Electrochemistry	8	11
9	Kazakh-British Technical University	5	16
10	National Nuclear Center of Kazakhstan	4	14

Source: OECD (2016c), *Boosting Kazakhstan's National Intellectual Property System for Innovation*, http://dx.doi.org/10.1787/9789264260955-en based on information provided by the National Center for Scientific and Technological Information (NCSTI).

Even more striking is the concentration of the scientific capacity in a very small number of research-performing organisations: only about 15 organisations were "active" in scientific research, i.e. they have at least 2 publications in internationally recognised journals. Leading research performers in 2014 as indicated by their publication output in the Web of Science Core Collection were KazNU Al-Farabi (246 publications), the Eurasian National University Gumilev (150), the Institute of Nuclear Physics of the

National Nuclear Center of Kazakhstan (50), Satbayev Kazakh Nazarbayev University (29), E.A. Buketov Karaganda State University (26), and the Kazakh-British Technical University (25). Taken together, these six universities and PRIs accounted for 45% of the total number of publications in 2014. The 14th top publisher in Kazakhstan published only 2 publications in 2014.

HEIs are also active applicants for patents. In 2014, the top 10 universities received more than 200 patents (Table 4.10). Satpaev National Technical University alone got 69 the same year. This represents 4.5% of the 1 523 patents granted in 2014 in Kazakhstan by residents and non-residents.

Box 4.8. **Incentives for publication in Kazakhstani universities**

Kazakhstani universities are in a transition between teaching institutions and institutions implementing the knowledge triangle integrating education, research and innovation in co-operation with industry and other societal actors. Promoting research plays a key role both for strengthening education as well as for supporting innovation. However, the universities face problems developing research activities that lead to publications in internationally recognised journals or to patents that may be exploited by industry. Many of the researchers that do publish prefer to publish in Russian-language journals and not in impact-factor publications.

Strengthening the universities' research capacities both at the institutional level and the individual researchers' level is a main challenge for Kazakhstan's innovation policy. One government initiative has the objective to intensify research activities by defining publications in impact-factor journals as criteria for academic promotion and career development.

A recent survey (Kuzhabekova, 2016) examined the effectiveness of that measure by means of an online survey among 170 faculty members from 6 representative universities. The study collected researchers' feedback regarding four aspects of the measure:

1. implementation into criteria for promotion and remuneration policies
2. difficulties of faculty in producing impact-factor publications
3. faculty's strategies towards succeeding in publishing impact-factor articles
4. opinions of academic staff about the effectiveness of the requirement.

The implementation of the new requirement had an influence on the remuneration policies of universities and was directly related to salary increases. There are also some cases where researchers' contracts were terminated when they did not publish papers according to the requirement.

The main difficulties for complying with the requirement were the lack of access to research funding, inadequate research equipment including software and library databases, deficits regarding methodological training and skills. In addition, the teaching and administrative load does not leave enough time for research. Last but not least, a lack of proficiency in English is a major barrier to the inclusion in the international research community.

The most important (basic) strategy researchers are following is to improve their proficiency in English. They familiarise themselves with the most important theories and methods in their fields and conduct literature reviews or attend conferences to learn about the state of play in their area of scientific interest. In addition, they attend courses about how to prepare good publications and seek advice from colleagues at Western universities where they look for long-term collaborations. A majority of respondents use specialised editing and translation services. A minority of faculty resort to questionable practices by paying other people to produce publications or claim co-authorship with young, more productive researchers.

Box 4.8. **Incentives for publication in Kazakhstani universities** (*cont.*)

The new requirement has a number of positive effects such as increasing international partnerships and intensifying the research activities at universities including research training at graduate level. A side effect is an internal brain drain because some staff are leaving the universities.

In general, the requirement to produce impact-factor publications has had some positive effects, especially at the level of individual researchers. However, it is by far not sufficient for strengthening the research capacity at the institutional level. In order to bring Kazakhstan's universities at an internationally competitive level, substantial investments are necessary to upgrade and modernise research equipment and libraries. Proficiency in English is a must and cannot be compensated by editing or translation services. An important issue is reducing the teaching load and leaving adequate time for research.

Source: Kuzhabekova, A. (2016), "Introduction of impact-factor publication requirement for faculty promotion: Case of Kazakhstan", https://herb.hse.ru/data/2016/03/02/1125174455/6.pdf.

Ranking of universities

In accordance with the goal set by the President, it is one of the objectives of the State Program of Education Development of Kazakhstan for 2011-2020 that two Kazakh universities should be included in international higher education rankings. Kazakh National University Al-Farabi was the first Kazakh university to enter the group of the top 300 universities in the QS,[16] ranked 299th in 2013, 275th in 2015 and 236th in 2016. All in all, nine Kazakhstani universities are included in the QS Top Universities Ranking (Table 4.11). Four universities achieved substantial progress in the period 2013-16. One university fell back, one kept its place in ranks 651-700 and three kept their positions at rank 701+.

A university like Kazakh National University Al-Farabi is now close to University Bonn, Loughborough University and University Complutense Madrid. NSRTU Satpayev is now in the "ranking vicinity" of Brunel University and the University Cologne close to Eurasian National University Gumilyov and the National Research University Higher School of Economics and Peter the Great Saint Petersburg Polytechnic University.

Table 4.11. **Kazakh universities in the QS rankings**

Institution	QS rank 2013	QS rank 2015	QS rank 2016
Kazakh National University Al-Farabi	299	275	236
Eurasian National University L.N. Gumilyov	303	371	345
Kazakh National Research Technical University K.I. Satpayev	701+	551-600	411-420
Kazakh National Pedagogical University Abaya	701+	601-650	501-550
Kazakh-British Technical University	651-700	700+	651-700
Auezov South-Kazakhstan State University	651-700	700+	601-650
Kazakh Agro Technical University Seifullin	701+	701+	701+
Kazakh University of International Relations and World Languages Ablai Khan	701+	701+	701+
Karaganda State University Buketov	701+	701+	701+

Source: Top Universities (n.d.), "Kazakhstan", www.topuniversities.com/universities/region/asia/country/kazakhstan.

Table 4.12. **Top 10 universities according to 2015 national ranking**

Rank	Institution	2013	2014	2015
1	"KIMEP" University	96.30	96.70	100.00
2	Eurasian National University L.N. Gumilyov	97.03	98.50	98.00
3	Kazakh National University Al-Farabi	95.38	98.80	98.00
4	Kazakh National Art University	91.28	96.5	94.00
5	Kazakh National Medical University S.D. Asfendijarov	68.34	96.00	92.00
6	Kazakh-British Technical University	91.19	87.10	87.68
7	Karaganda Economical University of Kazpotrebsoyuz	59.02	92.78	86.73
8	Kazakh State Women's Teacher Training Institute	73.91	55.54	84.94
9	Pavlodar State Pedagogical Institute	67.01	55.06	84.94
10	Kazakh National Research Technical University K.I. Satpayev	72.08	83.85	84.71

Source: Based on information provided by the Independent Kazakh Agency for Quality Assurance in Education (IAQQ), see http://nkaoko.kz/en.

In the context of the efforts to improve the quality of the higher education system, since 2008 the Independent Kazakhstan Agency on Quality Assurance in Education performs a national ranking of HEIs. They are assessed and ranked on the basis of an analysis of statistical indicators[17] complemented by an assessment by experts and an employers' survey. The main source of information is a self-assessment by the institution. Table 4.12 presents the ten universities that received the highest number of points out of 100 in 2015 according to this ranking. The table also provides the results of the 2013 and 2014 national rankings. In most cases, an improvement of the indicators can be observed.

Synthesis

The main achievements and remaining challenges related to the activities and performance of HEIs are presented in Table 4.13.

Table 4.13. **Achievements and challenges related to the activities and performance of higher education institutions**

Achievements and progress	Remaining challenges
Higher education	
• Increasing emphasis on the quality of the education delivered and its linkages to government development strategies and plans	• Substantial decrease of the number of students since the mid-2000s, at least partly related to demographic reasons • Low overall number of doctoral researchers in Kazakhstan by international standards, despite an increase since the 2000s • Structural problems limiting the attractiveness and quality of PhDs (low wages, restrictive conditions, balance between students' research work and other university occupations)
Research	
• Improved monitoring of researchers' performance and availability of information on scientific publication trends • New structure of incentives for increasing publication performance • Progress of four universities in the QS international ranking since 2013	• Weak scientific publication performance by international standards (number of publications, citation impacts, etc.), despite an increase since the 2010s • Concentration of the scientific capacity in a very small number of research-performing organisations • Low number of patents by a few research-performing organisations

How do HEIs transfer and valorise knowledge?

The broader framework for valorisation in HEIs

In the presidential addresses to the nation and the related government policies and strategies, the relationships between the government, industry and higher education, as well as the transfer and commercialisation of results from HEIs to industry, are seen as being central importance for the development of Kazakhstan towards joining the group of the 30 leading competitive countries of the world. In the last five years, several laws were adopted to provide the appropriate legal framework for all research activities, including their valorisation, and major strategies and programmes have been initiated to guide and finance relevant activities (see Chapter 5).

However, as shown earlier, the results in terms of commercialisation have remained disappointing (see Chapter 3). Research-performing organisations still face a number of challenges when trying to bring their projects towards commercialisation (Box 4.9).

Box 4.9. **List of barriers to the commercialisation of research results of public research organisations**

Anecdotal evidence gathered during this review and the OECD *Intellectual Property Review*, crossed with documentary evidence allows a list of the commercialisation challenges faced by research-performing organisations to be drawn:

- low quality of research performed at universities
- lack of relevance of university R&D for industry needs
- low demand for research-based technology by the business sector; tendency to purchase foreign turn-key solutions rather than looking for opportunities at domestic universities
- insufficient trust between companies and public research organisations
- excessive bureaucracy and limited economic incentives at universities
- low managerial and entrepreneurial skills among researchers, including low awareness of IP and industry needs
- limited experience of support staff in intermediary organisations supporting commercialisation in research organisations
- poor IP management and lack of funding at various stages of the commercialisation cycle due to very limited venture capital available and public support to commercialisation limited in size and duration
- a weak business sector incapable of commercialising IP generated by universities.

Source: OECD (2016c), *Boosting Kazakhstan's National Intellectual Property System for Innovation*, http://dx.doi.org/10.1787/9789264260955-en.

As suggested by the list in Box 4.9, the challenges originate from the companies and the public organisations themselves. To a large extent, companies in Kazakhstan work with outdated technologies and their demand for the development of new technologies is very limited or confined to foreign turn-key solutions. On the other side, universities are

still in the transition phase from teaching institutions to organisations with the triple mission of education, research and innovation in co-operation with and for external partners. The internationally widely applied model of "open innovation" of companies adopting innovations from different external sources are still at an early stage in Kazakhstan (Chesbrough, 2006; Dnishev and Alzhanova, 2013; Dnishev, Alzhanova and Alibekova, 2015). However, some universities, such as KazNU Al-Farabi and KazNRTU Satpayev are already successfully active in that area.

There are initiatives under way to improve the situation and establish linkages between the government, science and business. The National Chamber of Entrepreneurs has established sectoral committees acting as dialogue platforms between government and companies and contributing towards activating the triple helix of government-industry-science co-operation. Different initiatives are supported by the Ministry of Investment and Development and the Ministry of Education and Science: the National Agency for Technological Development (NATD) or the National Center for Science and Technology Evaluation (NCSTE) (see Chapter 5). Other organisations also intervene in this field, such as, for instance, the sovereign wealth fund "Samruk-Kazyna", which independently performed technology audits in several hundred companies in order to identify demand for new technologies (see Box 4.1).

Based on a survey regarding the technology needs and demands of 150 Kazakhstani companies, the NATD identified 9 groups of technologies with a total of more than 160 concretely defined technologies.[18] The results of the survey were meant to be used as a basis for searching internationally for technologies to be purchased. According to informal information, similar technology audits were also performed by other institutions. It is, however, not clear whether the results of these different audits are co-ordinated to achieve a more comprehensive analysis of the innovation potential and be able to discuss more widely ways for utilising the results.

Valorisation activities of HEIs

Well-established institutions have started to adapt to the new challenges of research commercialisation and knowledge transfer in general.

With the support of the NATD, 21 technology commercialisation offices have been established at universities, as well as in research institutes and technoparks. Commercialisation offices at universities are usually equipped with a small number of staff, sometimes only one or two persons partially financed by the NATD, including one staff specialised in patenting and licensing. Following one year of financial support from the NATD, it was expected that either the office would achieve financial sustainability or the university would cover the costs of continuing the activities. According to anecdotal evidence, some of the offices concentrated on just providing information and advice on how to prepare applications for NATD grants rather than promoting the commercialisation of the research results of their researchers, Data on a sample of 12 institutions show some success regarding support for start-ups, as well as a significant number of identified inventions, some useful models and a very small number of patent applications (IAC, 2015a).

Thanks to its specific status, the commercialisation office of Nazarbayev University is well equipped with six employees and was able to identify applicable research results that were assessed in the United States by Oak Ridge Associated Universities and marketed to companies with some success already (IAC, 2015a).

As shown in Box 4.10, besides the dedicated commercialisation offices that traditionally aim to valorise research results via IP, they have established a multiplicity of channels to transfer knowledge and engage with business companies and other actors to valorise their research results.

Box 4.10. **Examples of valorisation activities in Kazakhstani universities**

Al-Farabi Kazakh National University launched the "technological corridor" "from generation of idea to its commercialization" (Al-Farabi Kazakh National University, 2016). This initiative aims to support the conversion of R&D results into industry and other sectors of society. Established in the industrial park, services covering the whole innovation chain are provided by dedicated staff supported by students at master level.

The **Eurasian National University L.N. Gumilyov** has a commercialisation department which implements a spectrum of measures towards strengthening the links to industry and stimulating and supporting innovative initiatives. Industry is actively involved at the university, e.g. in the supervision of theses and in lecturing in courses; companies offer on-the-job training positions. Some students are educated and trained by the university at the request of industry. In all programmes, students take a course in basic of economic theory. At Masters level, a course in "Innovation Management" is offered. The university is one of the three Kazakhstani partners of the TEMPUS project "Central-Asian Centre for Teaching. Learning and Entrepreneurship", which aims to improve the quality of universities' teaching, learning and entrepreneurship activities. The project is dedicated to promote and strengthen the relations between HEIs from 17 Central Asian universities and enterprises in order to foster entrepreneurial competencies by improving the qualifications of the university teachers, while developing the competencies of students in entrepreneurship and business development.

Another project implemented at the Eurasian National University is "Strategem", which is an innovative training programme equipping researchers with transferable competences, capabilities and skills for their professional life in academia or industry or other parts of society. Training for researchers, in particular for PhDs, concentrates on skills needed for research careers. However, as a majority of doctoral graduates do not stay in academia, it is widely recognised that the focus on research and research excellence is not sufficient and researchers should be equipped with transferable skills.

The **Kazakh-British Technical University** offers programmes in IT and multimedia and finance and management, all taught in English. The university expects synergies from the very recent merger with the Kazakh National Research Technical University Satpayev and Parasat. The commercialisation department of the university screens university research regarding possible industrial relevance. Promising research results are developed internally to a certain level prior to being handed over to Parasat for upscaling and possible implementation, together with industrial partners. The approach is in the starting phase and there are hardly any experiences available yet.

The university expects that the co-operation with the Park of Innovative Technologies in Alatau will help establish contacts with industry. The co-operation is in an early stage. Other contacts are established with companies engaged in training courses, such as Emerson, Schneider Electric and Siemens. The courses focus on the use of the companies' equipment. Company representatives are also members of the Industrial Advisory Board of the university and comment on the development of curricula.

The university offers courses in technology entrepreneurship and innovation management, especially supporting interest in the recently established incubator. Projects from the university will be presented at the Echelon Contest "Technology Pioneers of Tomorrow" in Singapore. The university is starting an incubator for high-tech projects, which may be hosted for a maximum of four months before their presentation at investor days, where they can meet with angel investors.

Box 4.10. **Examples of valorisation activities in Kazakhstani universities** (*cont.*)

There are also contacts with alumni who work in Silicon Valley and are willing to act as mentors for start-ups. The university also organises a summer start-up school on mobile applications that was attended by 65 students; 30 applications were launched as a result. The summer schools are open for students from the Kazakh-British Technical University and others.

Kazakh National Research Technical University after K.I. Satpayev is the strongest university in engineering and technology in the country, whose position has been further strengthened by the merger with 12 Parasat research institutes. The university has a leading position in the national priority areas of ICT rational use of natural resources and life sciences.

The university has a technology park which hosts five incubators that have four to five staff. So far, the results of the activities are three start-ups run by scientists and students that create some income. The university enjoys intensive co-operation with industry and about 60 patents are filed per year. Four projects are currently commercialised. One in the area of oil extraction technology is supported by the World Bank and efforts towards implementation are on the way.

The university commercialisation office financed by the NATD at its inception has significantly diminished its activities since the end of NATD support. Co-operation with the Autonomous Cluster Fund "Park of Innovative Technologies" (PIT) paved the way for the launch of the first of four modules on automatisation and advanced analytics in the framework of the Center of Competences on mining and metal sector. What is more, an agreement was reached to locate the laboratory of the "PIT" Centre for new materials and additive technologies within the premises of the Satpayev university. Finally, companies are invited to open branch laboratories at the university and should discuss their problems with the university's researchers.

At **Kazakh National University Al-Farabi**, the Science, Education and Innovation Cluster[1] is being established to set an effective environment for generation of innovation. This project, which is part of "Innovative Almaty" initiative, includes an innovation cluster of engineering and high technologies as well as a medical and biological cluster. These should be financed through public-private partnerships with investments of around USD 10 million and USD 500 million respectively. The cluster of engineering and high technologies consists of the production centre, the business incubator, and the science and technology park. The medical and biological cluster is aimed at strengthening the scientific and personnel capacity of the country in the sphere of medicine and to the transfer of innovative medical technologies, as well as providing excellent working conditions for students and doctoral candidates.

Inspired by the success story of the University of Stanford and the Silicon Valley, the **Nazarbayev University Innovation System (NURIS)** is expected to operate as a cluster where interactions between science, industry and education will be the engine of the dynamics of the research centres and companies located on the university dedicated sites. The university has already established many of the key elements that will support this vision on the research and education dimensions. The next critical stage will be to generate or attract companies that will locate activities on site and engage in significant co-operative activities with the research facilities and between themselves. Within the NURIS, the Innovation Intellectual Cluster is meant to provide the institutional structure to support the integration of education research and innovation.

Nazarbayev University's institutional Intellectual Property Rights strategy provides a general framework. According to anecdotal evidence, Nazarbayev University generally focuses on science-driven projects and is not oriented towards start-ups. However, more recently, it has been trying to bring in business entities earlier in the process and seize opportunities for the creation of start-ups, for instance in the biomedical area. So far, since the establishment of the university, 200 projects have been screened for their innovation and commercialisation potential. Thirty-five were sent to Oak Ridge Associated Universities for evaluation and seven were selected for additional development towards realisation in the small (pilot) technopark of Nazarbayev University. In some cases, negotiations with companies are ongoing.

Box 4.10. **Examples of valorisation activities in Kazakhstani universities** (*cont.*)

The main components of the Innovation Intellectual Cluster are the commercialisation office, the business incubator, the prototyping centre, and the future technopark and science park. The Technopark announced in 2014 is a 2 000 m^2 site dedicated to the operational management of the fabrication of laboratory and office facilities for experimental and prototyping purposes as well as small-scale and pilot production based on research project results. The Science Park, also known as the Astana Business Campus, is meant to become one of the core elements of the Innovation Intellectual Cluster. It is an ambitious project that aims to attract some of the leading high-tech companies on a 500 000 m^2 piece of land (including 250 000 m^2 for office space, laboratories, and R&D facilities) adjacent to Nazarbayev University. When the project was announced in 2015, companies such as General Electric, Samsung and Microsoft were said to be willing to join the cluster and a total of about 90 companies were expected in the end. To date, the land has been acquired but the initial plan to have a dedicated building was postponed due to budget restrictions. In the meantime, new companies will be gathered within an existing building.

1. KazNU Al-Farabi Innovative Activities, http://www.kaznu.kz/en/15192/page.

Source: Ramazanov (2015), "Al-Farabi Kazakh National University".

Synthesis

The main achievements and remaining challenges of HEIs in transferring and valorising knowledge produced in public research organisations are presented in Table 4.14.

Table 4.14. **Achievements and challenges of higher education institutions in transferring and valorising knowledge produced in public research organisations**

Achievements and progress	Remaining challenges
• Emphasis put on the transfer and valorisation of public research results in government strategies and development plans • Several intermediary organisations founded to support knowledge transfer • Some ongoing ad hoc initiatives to foster linkages between government, science and business • Multiple channels established by leading universities to transfer knowledge and engage with businesses and other actors to valorise their research results	• Low research commercialisation performance • Focus on research commercialisation to the detriment of other modes of knowledge transfer • Numerous challenges hindering knowledge transfer deeply entrenched in public and private research performers' structure, culture and practices (insufficient science-industry trust, excessive bureaucracy, limited incentives at universities, etc.) • Limited resources of knowledge transfer from intermediary organisations (such as technology commercialisation offices) • Short duration of government support

Notes

1. Defined at the industry level based on the international average R&D-intensity of industries (OECD, 2011; Eurostat, 2016a).
2. This operation will assemble knock-down kits for the Fortuner, and SUVs in Kazakhstan (Vandenberg and Kikkawa, 2015).
3. Such data are only available for R&D.
4. It should be noted that some large firms (for example, KMG) have inherited large research departments, which in OECD countries would be classified under the non-business sector.
5. Data on business expenditure on R&D (BERD) are not available.
6. Important changes in the survey methodology do not allow a meaningful assessment of the evolution of the proportion of innovative firms. While only technological innovation was measured before 2012, innovative firms have since then been defined as enterprises implementing product, process, marketing or organisational innovations.
7. Authors' calculations based on data provided by the Committee of Statistics of Kazakhstan.
8. Note that in Kazakhstan the figures show the answers of all innovators (either product, process, marketing or management) while in the European Union they only show the answers for product and/or process innovators. While this is unlikely to introduce a large bias, smaller differences can arise from this composition effect because, in general, technological innovators are more likely to rely on university/research institute sources.
9. One explanation might be that the innovation surveys in Kazakhstan have been more selective than in other countries and that these firms are overrepresented in the sample of respondents.
10. The World Bank project "Kazakhstan – SME Competitiveness Project" provides a variety of examples (World Bank, 2015).
11. Precisely, according to the Law "on Education" (2007), a national university is "a higher educational establishment, being the leading scientific and methodical centre of the country, having special status".
12. For instance, the Department of Earth Sciences of the Academy to the Kazakh National Research Technical University named after K.I. Satpayev (KazNTU); the Department of Physics, Mathematics and Informatics to Al-Farabi Kazakh National University (KazNU), etc.
13. This centre has the status of a republican state enterprise (www.biocenter.kz).

14. It should be noted that the importance of public research institutions in terms of number of institutions and number of staff contrasts with the limited information available on their activities and the role they play in the national innovation system.

15. The gross enrolment rate in higher education is defined as the ratio of the number of students, regardless of age, studying in institutions of technical and vocational education (ISCED-5) and in higher education institutions (ISCED 6-8) to the total population aged 18-22. Female students outnumber male students but the difference decreased from 18.4% to 12.4% in the same period.

16. The Quacquarelli Symonds (QS) World University Rankings is one of the most widely acknowledged and used annual university ranking, along with the Academic Ranking of World Universities (ARWU, also known as the "Shanghai Ranking"). There was no Kazakhtani university ranked in the Shanghai Ranking in 2016 (www.shanghairanking.com/ARWU2016.html).

17. The following indicators are applied in the ranking: number of students, learning outcomes and the number of educational programmes, the quality of academic staff and faculty, research and innovation, international co-operation, provision of information, which addresses the content provided for applicants, students, academics and all interested parties (http://nkaoko.kz/en).

18. Construction materials; housing and utilities infrastructure; agricultural complex; food industry; non-ferrous metals industry; ferrous metals industry; chemical and oil chemistry industry; mining and processing complex; power industry.

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Chapter 5

The role of government in the system of innovation in Kazakhstan

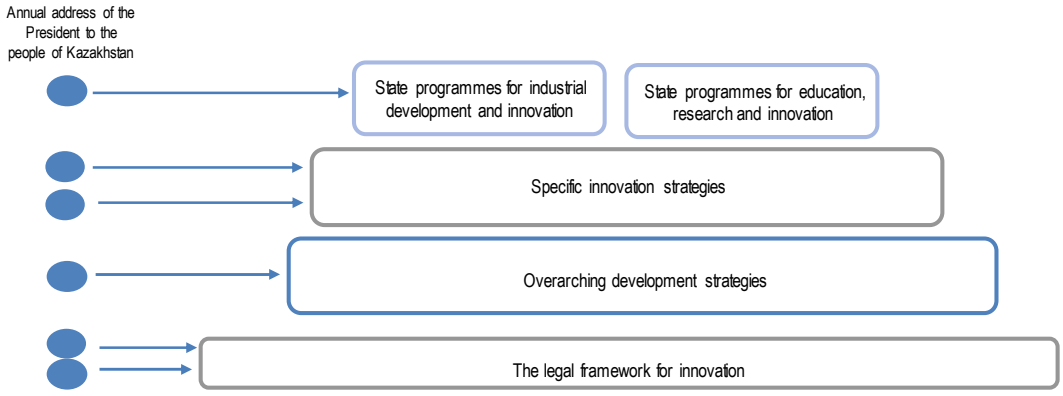
This chapter examines the role of the government in the orientation and programming of and support to research and innovation activities in Kazakhstan. It begins with an overview of the recent evolution of the legal and strategic frameworks that guide the research and innovation activities of public and private actors. It then provides a synthetic presentation of the main policy actors and governance arrangements. The chapter then reviews current policies in light of the observations made in earlier chapters and outlines areas in need of dedicated policy attention.

As in all economies where the government plays an important role in the economy and where facilitating structural change is a key strategic priority for the authorities (ADB, 2013), the government of Kazakhstan plays a key role in orientating, programming and supporting the implementation of research and innovation activities.

The legal, strategic and programmatic framework for science, technology and innovation policy in Kazakhstan

The new laws, strategies and programmes that guide the research and innovation activities of public and private actors are announced and their annual implementation described in President Nursultan Nazarbayev's annual addresses to the nation. Overarching development strategies, as well more specific research, innovation and/or industrial strategies, set the stage for all policy intervention in Kazakhstan. State programmes, generally for periods of four years, complete the policy framework by setting general objectives and launching specific new support instruments (Figure 5.1).

Figure 5.1. **Overall architecture of the science, technology and innovation policy framework in Kazakhstan**



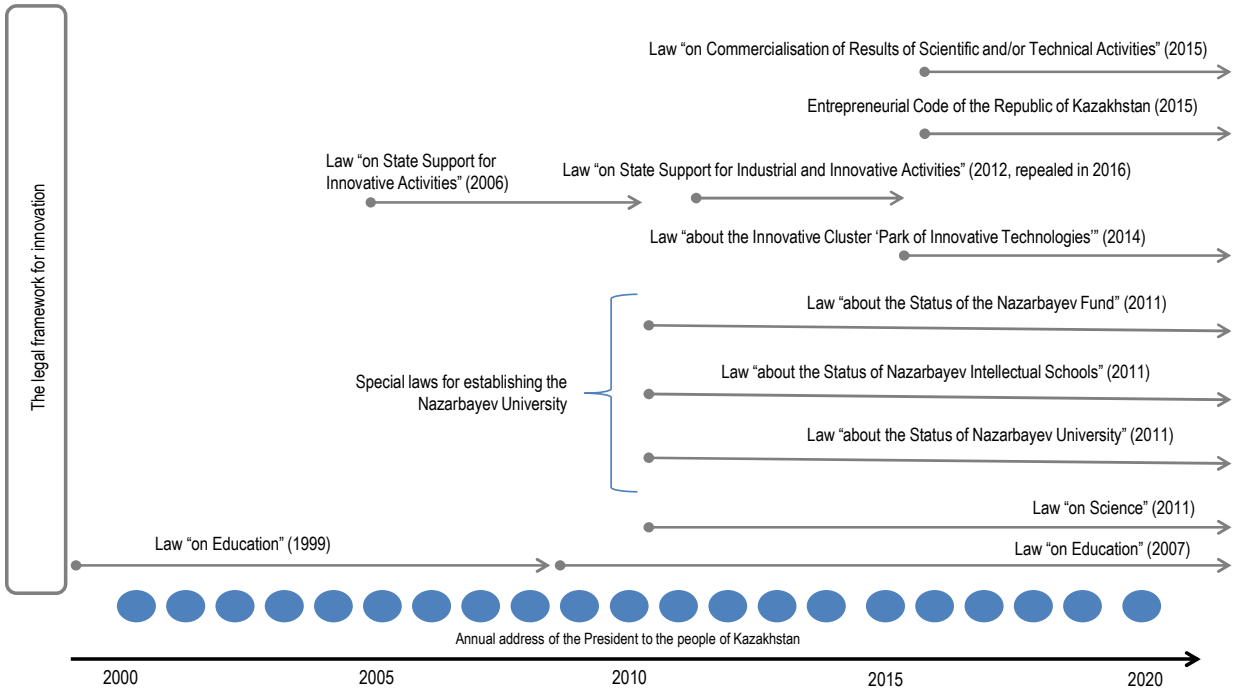
The legal framework for innovation

Soon after independence, the government of Kazakhstan started to develop the legal framework for education and, more recently, for research activities. The entire legal framework for education, science and innovation has been almost fully developed over the last few years (Figure 5.2).

The responsibilities of the different ministries with regards to research and innovation policy, primarily the Ministry of Education and Science (MES) and the Ministry of Investment and Development (MID), as well as the different types of higher education institutions (HEIs) (national research universities, national higher education institutions, research universities, etc.) are officially defined in the Law "on Education" (2007).

The Law "on Science" (2011) defines the principles of the functioning of Kazakhstan's national science system and reiterates the leading responsibilities of the MES as well as the participatory role of the authority responsible for industry – currently the MID – in the development of science and technology policies. It also sets the three forms of public funding for research and innovation: basic funding, grant funding and programme-targeted funding, which are explained in more detail below.

Figure 5.2. **Timeline of the main laws regulating science, technology and innovation activities in Kazakhstan**



The Law "on State Support for Industrial and Innovative Activities" (2012) defined the tasks of the state to create favourable conditions for the development of priority sectors of the economy and support the effective implementation of innovation and development of high-tech industries.[1]

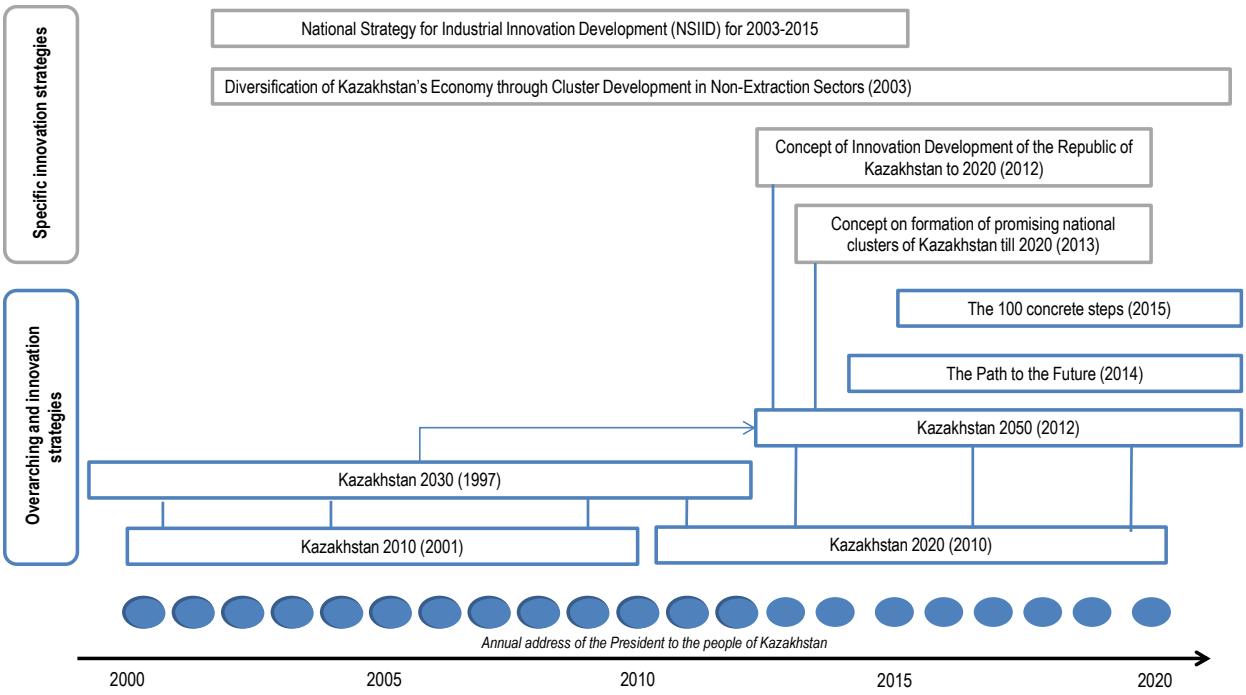
The Law "on Commercialisation of Results of Scientific and (or) Technical Activities" (2015) plays an important role in clarifying the framework conditions for the valorisation of research results in Kazakhstan. It defines the roles of the authorities for science and for industry – the MES and the MID. The law strengthens the position of HEIs and other scientific organisations, as well as the rights of authors with regard to the exploitation of their research results. The intellectual property rights on research results derived from activities funded from public budgetary sources belong to the organisations and the authors have the right to receive compensation.

Finally, the Entrepreneurial Code of the Republic of Kazakhstan (2015) simplified and streamlined the legislation related to entrepreneurial activities. It integrates six existing laws, including the Law "on State Support for Industrial and Innovation Activities" of 2012 which was repealed 1 January 2016 when the Entrepreneurial Code came into force. Although most articles are therefore not new, the definition of innovation has been changed by adopting a formulation which is very close to the standard set in the OECD *Oslo Manual* (OECD, 2005).[2]

Overarching development strategies

For more than 20 years Kazakhstan has been implementing a very elaborate system of strategic management and accountability based on the Kazakhstan 2030 and Kazakhstan 2050 strategies (OECD, 2014a; 2016a). These strategies set out the roadmap for the reforms of government policy over the long term. This has been acknowledged as a "remarkable example of a multi-year integrated development plan that applies to all levels of government and public service" (OECD, 2014a).

Figure 5.3. **Timeline of the main overarching development and innovation strategies in Kazakhstan 2000-20**



Following its independence in December 1991, Kazakhstan focused its policy on economic stabilisation and its transition from central planning to a market-based economy (Pomfret, 2014; see also Chapter 2). With the stabilisation of the economy, the policy emphasis shifted towards developmental issues. As early as 1997, despite the Russian financial crisis, the President presented an almost 35-year long-term strategy named "Kazakhstan 2030: Prosperity, Security and Ever Growing Welfare of All the Kazakhstanis" (Nazarbayev, 1997). The strategy encompassed several long-term priorities around the general goal of sustained economic development and growth. After the first three years, it was implemented by five- and ten-year strategic plans and sectoral programmes (Strategic Plan 2010, Strategic Plan 2020, etc.).

In the first years of implementation, which were heavily influenced by the Russian financial crisis, the crisis in East Asia and other regional difficulties, policy concentrated on protecting economic and societal stability, safeguarding national security and reforming the operations of the government (Nazarbayev, 1998). Science, technology and innovation (STI) were not yet stated upfront as national priorities. Industrial policy concentrated on the oil, gas and mining sectors, as well as metallurgy, mechanical engineering, chemistry, construction and building materials. Export-oriented high-technology production was also envisaged, but was not a pillar of the development strategy.

The 2001 Strategic Plan for Development up to 2010 (Strategic Plan 2010) addressed social policy, industrial and technological policy, and other policy areas, including the reform of the political system and the administration (Utegenova, 2011). In the area of education, it put emphasis on the need for closer links between HEIs and the business sector, especially in engineering, and with a specific focus on small businesses.

New priorities were defined after 2007. Innovation and the development of modern technologies were expected to play a more prominent role to support national development. The second ten-year plan – Strategic Plan 2020 – was heavily influenced by the general context of the global financial crisis. The focus was therefore on achieving economic stability and improving competitiveness. With regards to industrial policy, priority was on diversifying the economy beyond oil and gas and other natural resources. The aim was to facilitate the industrial and innovative development of the country and, by 2020, position Kazakhstan among the 50 most competitive countries with a favourable business environment, as previously set out by the President.[3]

The new long-term development strategy "Kazakhstan 2050" announced in 2012 (Nazarbayev, 2012) included many elements of the strategy relevant for different aspects of innovation, such as the further development of the two leading innovation clusters – Nazarbayev University and the Autonomous Cluster fund "Park of Innovative Technologies" (PIT). One priority project to achieve the strategy was the increase of the level of expenditures for science to 3% of gross domestic product (GDP) by 2050. An important facet of the strategy, and unique among the newly independent states which succeeded the Soviet Union, was the promotion of three languages – Kazakh, Russian and English – as a condition for integration into the wider global communities.

In 2015, President Nazarbayev set out "100 Concrete Steps" towards reforms in 5 priority areas, including 49 steps in the area of "industrialisation and economic growth" (Nazarbayev, 2015). However, as regards research and innovation activities, even in a broad sense, only nine actions are relevant. Some of them reiterated previously announced actions such as the shift towards autonomy and excellence of a number of HEIs following the example of Nazarbayev University, reiterated in this strategic framework. Among these nine actions, of particular interest is the injunction to reorient research grants and programmes towards the needs of the National Program of Rapid Industrial and Innovative Development (Step 64).

Specific research and innovation strategies

By the 2000s, industrial and innovation policy became a key part of the overarching economic policy strategy to support diversification. The Strategy for Industrial and Innovative Development 2003-2015, led by the MID, was a key comprehensive framework to guide the country's diversification away from raw materials and transition to a high added-value service economy in the long run, to be implemented through the State Programme for Accelerated Industrial-Innovative Development 2010-14 (SPAIID) and its successor, the State Programme for Industrial and Innovative Development of Kazakhstan 2015-2019 (SPIID). Several key institutions of the national innovation system were created in the framework of this strategy, such as the Development Bank of Kazakhstan in 2001 and the National Innovation Fund (NIF) in 2003 (Pomfret, 2005).

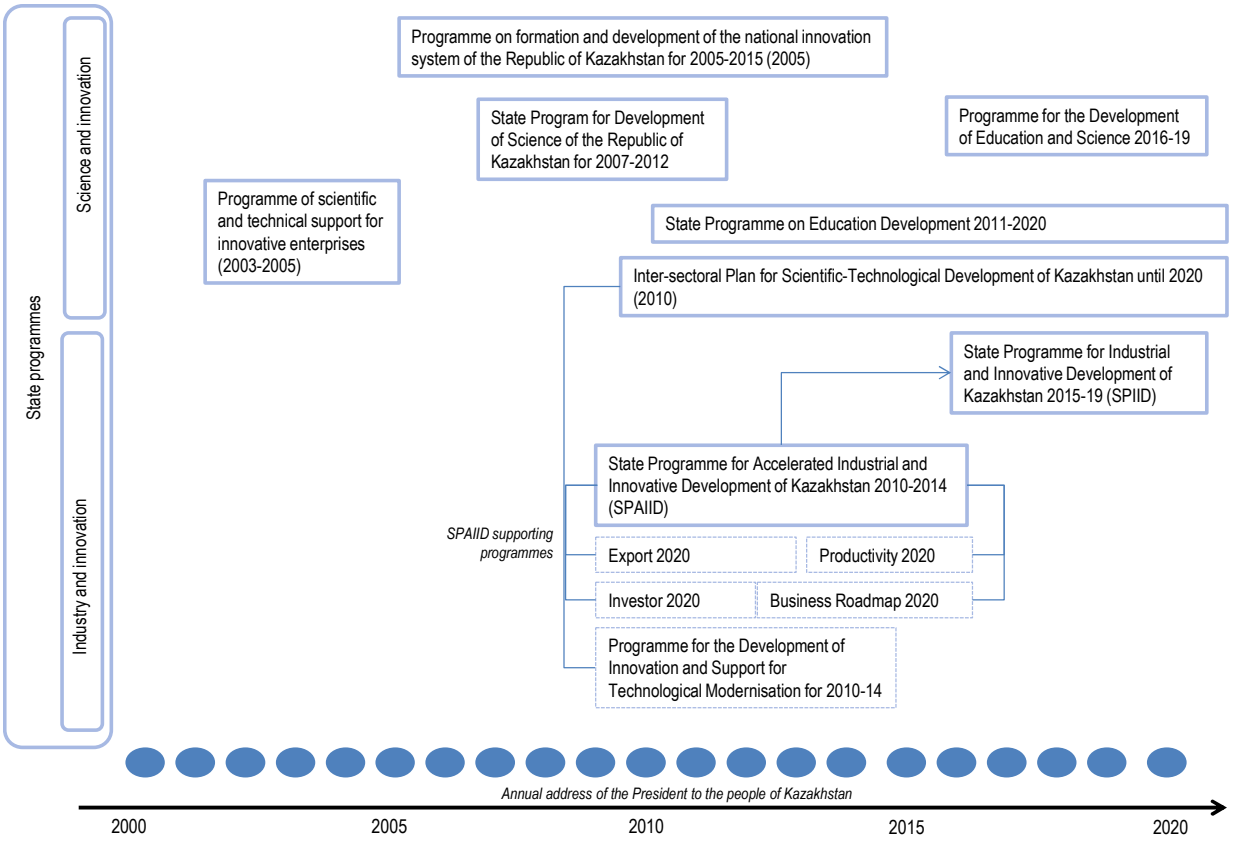
As indicated, diversification through innovation became central to economic policy in the second half of the 2000s. In 2004, the government launched the strategy "Diversification of Kazakhstan's Economy through Cluster Development in Non-Extraction Sectors". This strategy aimed at identifying sectors and geographical areas where successful clusters may operate and supporting these clusters with effective legislation, infrastructure and favourable conditions for small and medium-sized enterprises (SMEs). By 2009 seven clusters had been identified in the framework of this strategy around the sectors of tourism, metallurgy, textiles, construction, agriculture and food processing, oil and gas machinery, and logistics and transportation (IBP, 2009).

The Concept of Innovation Development of the Republic of Kazakhstan to 2020 was developed in 2013 by the MES in the framework of the Kazakhstan 2050 strategy, providing a general framework to develop further the national innovation system. The programme emphasised the implementation of flagship projects which were aimed at a transition to an innovation system led by private innovation initiatives. The programme is geared towards 21 ambitious targets on various input and output indicators, most of them requiring very substantial improvement of the country's research and innovation performance by 2020, including an increase of the R&D intensity to 2%.

Industrial and innovation state programmes

Most policy interventions and measures are included in multi-year programmes and plans (Figure 5.4).

Figure 5.4. **Timeline of the main state programmes related to industrial and innovation policy in Kazakhstan, 2000-20**



Although the State Programme on Education Development 2011-2020 (2010) deals primarily with the education sector with the goal of developing the human capital needed for sustainable economic growth of the country, it also sets several objectives and actions directly related to the still very recent role of higher education institutions (HEIs) as research-performing organisations. Priorities were set on the alignment of the higher education system with the priorities of the programmes for industrial and innovative development and the establishment of structures in universities to support the commercialisation of research results, such as business incubators, industrial parks and centres. The State Programme on the Development of Education and Science for the

Republic of Kazakhstan 2016-19, launched in March 2016, includes a wide array of measures to improve the education, including higher education, and science system.

The SPAIID and the SPIID set the principal objectives and plan for a wide range of measures to support the diversification of industry beyond raw materials and the development of indigenous innovations. To achieve these goals, several priority sectors were selected, complemented in the case of the SPAIID with a strategy for regional diversification based on regional specialisation. The SPAIID was supported by several programmes such as the Business Roadmap 2020 and the Inter-sectoral Plan for Scientific-Technological Development of Kazakhstan until 2020, which was developed in November 2010 by the MID in order to set a specific framework for STI development. The latter focused on the identification of key sectors and the assessment of the scientific, technical and technological potential of the country.

The total budget for the SPAIID was considerable, KZT 8 587 billion over the period 2010-14, which represents between 3.8% and 5% annually of the 2014 GDP (80% funded by the budget of the republic). An assessment of its achievements showed some positive trends regarding, for instance, the proportion of innovative products and services, which increased more than fourfold (from KZT 82 billion to KZT 379 billion) in the same period (Republic of Kazakhstan, 2014). Kazakhstan also significantly improved its position regarding "innovation" and "technological readiness" of the World Economic Forum's Global Competitiveness Index, reaching 59th and 56th place respectively. Public expenses for R&D reached the very low level of 0.17% of GDP despite an ambitious government goal of 1%.

Synthesis

The main achievements and remaining challenges in building the legal, strategic and programmatic framework for STI are presented in Table 5.1.

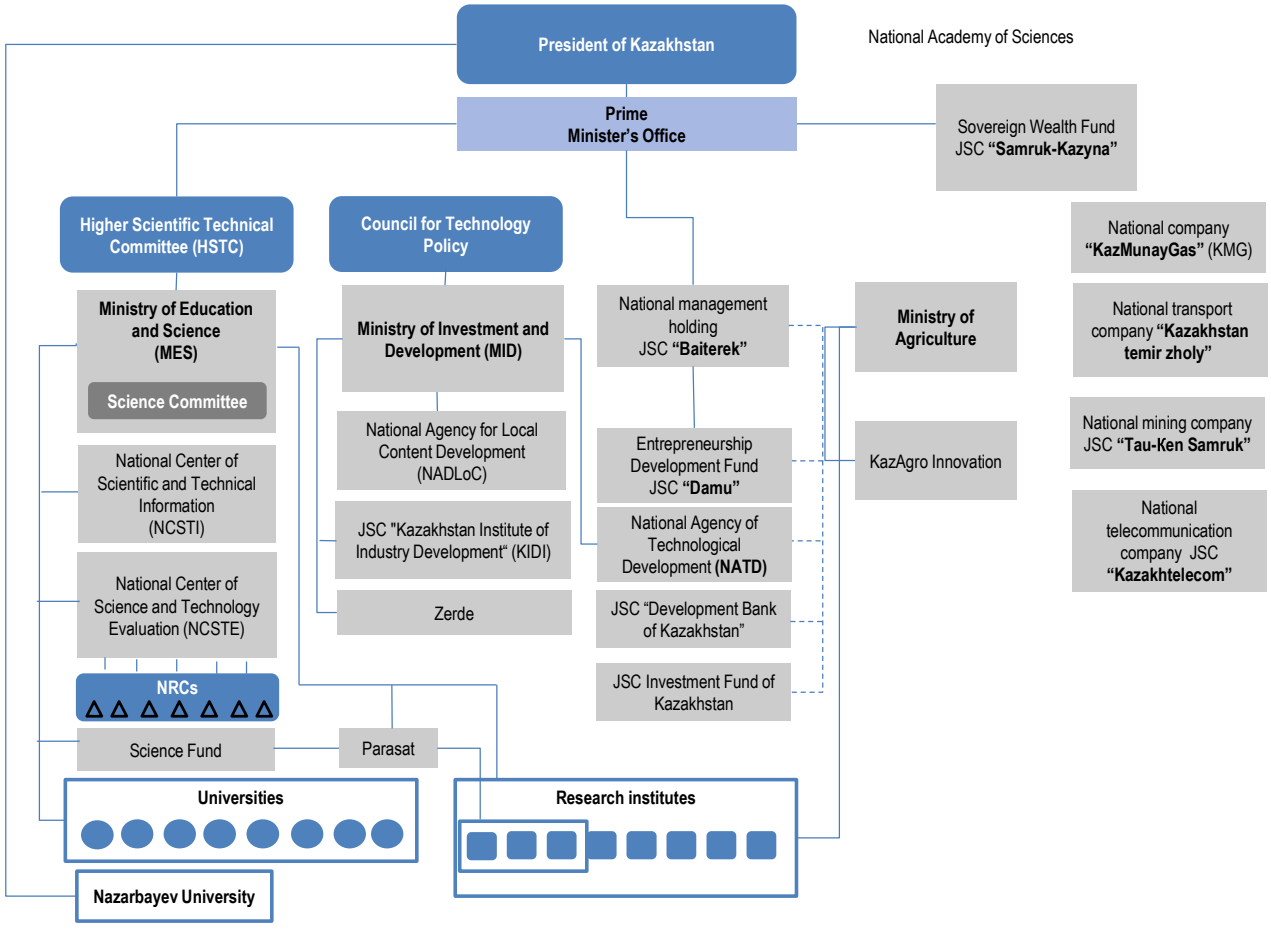
Table 5.1. **Achievements and challenges in building the legal, strategic and programmatic framework for science, technology and innovation**

Achievements and progress	Remaining challenges
Overall	
• Strong commitment at the highest level of policy making clearly and consistently put forward in bold long-term development objectives	• Limited monitoring and evaluation of the implementation of the laws, strategies and programmes • Over-ambitious objectives
Legal framework	
• Comprehensive legal framework developed since 2010 to regulate all aspects of research and innovation activities, from their funding to their implementation and commercialisation of their results • Recent significant clarifications of the legal framework through the Law "on Commercialisation" (2015) and the Entrepreneurial Code (2015)	• Strong uncertainty faced by public and private innovation actors with regards to the implementation of the legal framework
Strategic and programmatic framework	
• Public policies planned in long-term overarching development strategies with an increasingly prominent role of research and innovation • Well-designed strategies and programmes with precise targets at sectoral/thematic levels as well as on cross-cutting issues • Mid-term and long-term strategic programmes and regular reviews based on preliminary assessment of challenges and regular intermediary reviews • Policy learning (SPAIID vs. SPIID)	• Multiplicity of overlapping strategies and programmes, related to different policy actors in the system • Inflexibility and complexity due to oversophisticated strategies and programmes, remaining aspects of central planning • Unrealistic and at times difficult to monitor targets • Limited external monitoring and especially evaluation – lack of focus on results and impacts • Underdeveloped evidence base • Low level of involvement of key stakeholders

Main STI policy actors

National policies are defined by the President and implemented by the government, which is structured in 13 ministries and headed by the Prime Minister. The MES and the MID are the key ministries in charge of research and innovation policy, respectively. However, as in other countries, the latter is to a great extent a shared competency of the two ministries. These policies are implemented by an increasing number of organisations created in the frameworks of the various aforementioned strategies and plans (Figure 5.5).

Figure 5.5. **Main science, technology and innovation policy actors in Kazakhstan**



Notes: NRCs = national research councils. The dotted line represents an equity-based relationship ("owns the shares of"). The solid line represents an authority relationship ("reports to").

Strategic governing bodies

The main and highest level strategic governing body is the Higher Scientific Technical Committee, created in 2011. This committee, chaired by the Prime Minister with the Minister of Education and Science as his deputy, brings together representatives from all ministries to take high-level decisions on the prioritisation and co-ordination of the government's STI activities.

The national research councils (NRCs) are collegial bodies established in specific scientific and technological fields following the priorities identified by the Higher Scientific Technical Committee. Members of the NRCs are local and foreign scientists,

representatives of state bodies, national development institutions, national holdings, national companies, private entrepreneurs proposed and recommended by sectoral representative authorities, scientific organisations, universities and scientific associations. Membership is approved by the government of the Republic of Kazakhstan. These various stakeholders are tasked with the assessment of national needs for new scientific directions and have oversight on the whole process of competitive selection of research project and programme applications, with support from the National Center of Science and Technology Evaluation (NCSTE). Finally, the NRCs determine the form and amount of grant funding, and monitor and review the progress of the research activities.

The Council for Technology Policy, headed by the Prime Minister, was established in 2012 to determine the orientation of Kazakhstan's innovation policy and to decide upon the technology support programmes, including the updating of the Inter-sectoral Plan for Scientific-Technological Development of Kazakhstan until 2020 (Salimov, 2012; UNECE, 2012; OECD, 2012). The members are representatives of ministries, business and high-level foreign experts. According to the provisions for the creation of the council, non-governmental organisations should account for no less than two-thirds of its members. The council is serviced by the MID, with the National Agency for Technological Development (NATD) fulfilling all the related operational functions under the MID.

The council was not convened in the last year. The Entrepreneurial Code of the Republic of Kazakhstan, which took effect on 1 January 2016, announced the re-establishment of the Council for Technology Policy by the authorised body in the field of state support of industrial and innovative activities. In 2012, it was also foreseen that a number of technological sector councils would be created under this high-level body, but this decision was finally not implemented.

Main institutions in charge of the implementation of research policy

According to the Law "on Science", the MES is the authorised body in the sphere of science and the commercialisation of results of scientific and technical activities. Its tasks range from the definition of science priorities to the funding of activities and monitoring of results. Within the MES, the aforementioned Committee of Sciences is in charge of all activities related to STI, including the call for proposals, the co-ordination of scientific and technical programmes, the supervision of the 36 research institutes, 2 government agencies and 6 joint stock companies, including:

- The NCSTE was established in 2011 under the competence of the Science Committee to support the NRCs by carrying out the scientific and technical evaluation of applications for grant and programme-oriented funding. The NCSTE also offers training workshops to possible applicants about how to write proposals.
- The National Center for Scientific and Technological Information (NCSTI) was established in 1957 to provide information on and promote STI activities. The NCSTI is, for instance, the organisation that provides researchers and institutions with bibliometric data information for the purpose of monitoring. It also carries out the state registration of research reports and doctoral dissertations.

The National Academy of Sciences, founded in 1946, has seen its role changed very significantly since Soviet times, when it had the leadership in the production and co-ordination of fundamental research in institutes under its umbrella.[4] Its main role since

2003 has been to provide advice to the government, co-ordinate the preparation of the annual national reports on science, publish academic journals and contribute to exchanges with international counterparts.[5]

Main institutions in charge of the implementation of the innovation and industrial policy

The MID is the authorised body in the area of industrial innovation. It carries out a wide range of tasks, from the development of strategic plans and programmes (notably the Inter-sectoral Plan on Scientific-Technological Development and the SPIID), to the planning, implementation and monitoring of these strategies and plan. It is also in charge of practical issues such as the development and approval of the list of activities regarding the production of high-technology products, and of the rules for the provision of NATD grants. It was established in 2012 on the basis of the restructuring of the NIF created in 2003. The NATD provides grants to support innovation and commercialisation, and supports several intermediary organisations (design centres, commercialisation offices, etc.).

The JSC "Baiterek National Management Holding" was established in 2013 with the purpose of optimising the management system of several government agencies ("development institutions"), financial organisations and the development of the national economy. The holding has 11 subsidiaries including to support the development of innovative activities, the NATD JSC and the JSC Entrepreneurship Development Fund (DAMU). Since 1997 the latter has been the main actor for the support of SMEs and is supported in this task by a network of branches across all the regions of Kazakhstan.

The Kazakhstan Institute of Industry Development also operates a number of funding instruments, such as financing industrial and innovative projects' feasibility studies, reimbursement of costs associated with the training and/or retraining of staff, including senior managers, etc. It is also in charge of co-ordinating the new scheme of territorial clusters.

Several other organisations intervene on different aspects of the framework conditions for business innovation and industrial activities. The JSC National Agency for Development of Local Content NADLoC was established in 2002 to create, promote and develop local content policy. Zerde, the national infocommunication holding, was created in 2008 to strengthen the ICT sector and infrastructure.

The Ministry of Agriculture has also historically been involved in research and innovation activities in this sector, notably through dedicated research institutes and universities. As part of recent reforms, the JSC "National Agricultural Research and Education Center", created in 2015, has the objective to ensure the innovative development of the agricultural sector on the basis of training and retraining of highly skilled professionals, the development and implementation of research results, and the transfer of effective foreign technologies in agriculture (Republic of Kazakhstan, 2016). At the same time, it was decided to liquidate JSC KazAgroInnovation, which previously had a key position in supporting agricultural innovation, notably through research institutes, testing farms and technology extension centres.

Synthesis

The main achievements and remaining challenges of the actors in charge of the orientation, co-ordination and implementation of STI policies are presented in Table 5.2.

Table 5.2. **Achievements and challenges in building the architecture of the system of innovation and assigning roles between actors**

Achievements and progress	Remaining challenges
Overall	
• Transformation and redirection of the system of innovation; reforms both inspired by international good practices and embedded in the national long- and mid-term strategies and programmes	• Underdeveloped monitoring and evaluation culture and practices • Flexibility, transparency and responsiveness of innovation policy actions held back by heavy bureaucracy and red tape • Frequent organisational change, often without adequate monitoring and preparations
Strategic guiding bodies	
• Higher Scientific Technical Committee headed by the Prime Minister including representatives from all ministries to take high-level decisions on the prioritisation and co-ordination of research policy	• Limited activity and power of Council for Technological Development to ensure inter-ministerial co-ordination of innovation policy
Implementation bodies	
• Creation of new organisations and revision of roles of existing organisations to fulfil all funding and support functions	• Lack of co-ordination and co-operation between the main government actors and affiliated institutions • Lack of information on research and innovation initiatives led by "line" ministries (i.e. Agriculture, Health)

Increasing public and private investment in research

The main instruments to finance and support public and private investment in research activities addressed in this section are presented in Table 5.3.

Table 5.3. **Instruments to support research in Kazakhstan**

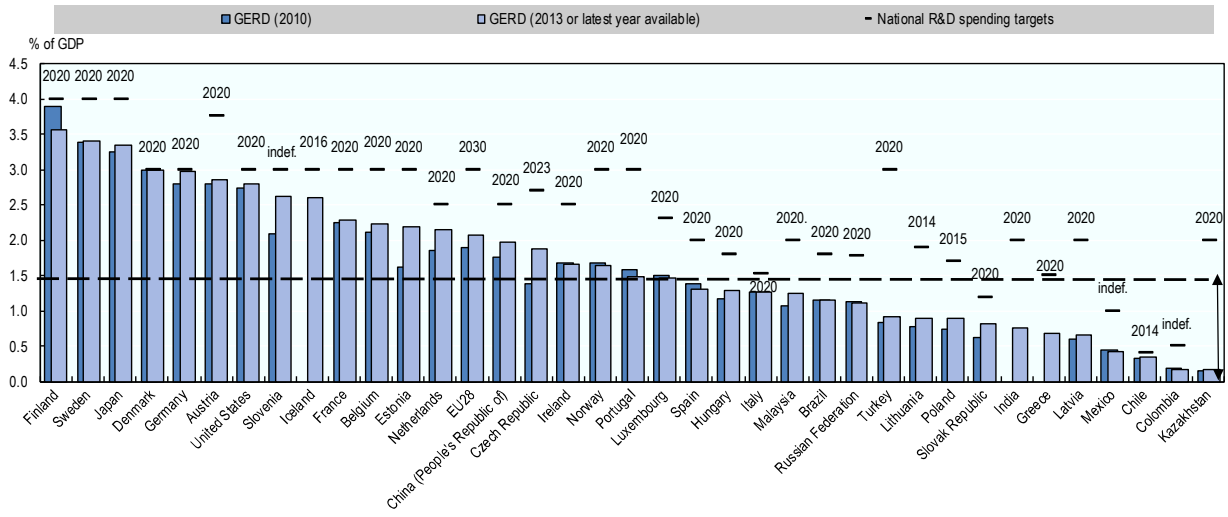
Stage	Tool	Provider	Type	Amount of funding (2012-15) KZT billion
Research	Basic funding	Ministry of Education and Science	Grant (non-repayable)	14.09
Research	Research grants	Ministry of Education and Science	Grant (non-repayable)	65.7
Research	Programme-oriented funding	Ministry of Education and Science	Grant (non-repayable)	50.4
Research	Research grant	World Bank	Grant (non-repayable)	KZT 10 069 billion (about USD 30 million)

National R&D expenditure: Ambitions and actions

In 2014, expenditure for R&D amounted to 0.171% of GDP or KZT 73.6 billion in actual terms, which falls short of the goals defined in various national programmes and strategies (NAS, 2016). The level of R&D expenditure increased substantially while R&D intensity remained rather stable, due to high GDP growth during much of the period from 2000 to 2013 (Figure 5.6). As expected, Kazakhstan's R&D intensity is far below the OECD average (2.5% in 2013) and it is even one of the lowest among a sample of emerging countries, at par with countries such as Kyrgyzstan (see Chapter 3).

Kazakhstan is also the country where the distance between the actual and target R&D intensity for 2020 is the largest. Targeted R&D intensity was 1% of GDP by 2015 in the SPAIID programme (2010-14) and 2% of GDP by 2020 in the SPIID programme (2015-20). In the Kazakhstan 2050 strategy, the goal set for expenditures for R&D to be reached by 2030 is 3% of GDP.

Figure 5.6. **R&D intensity and national spending targets in a sample of countries**



Note: GERD = gross expenditure on research and development.

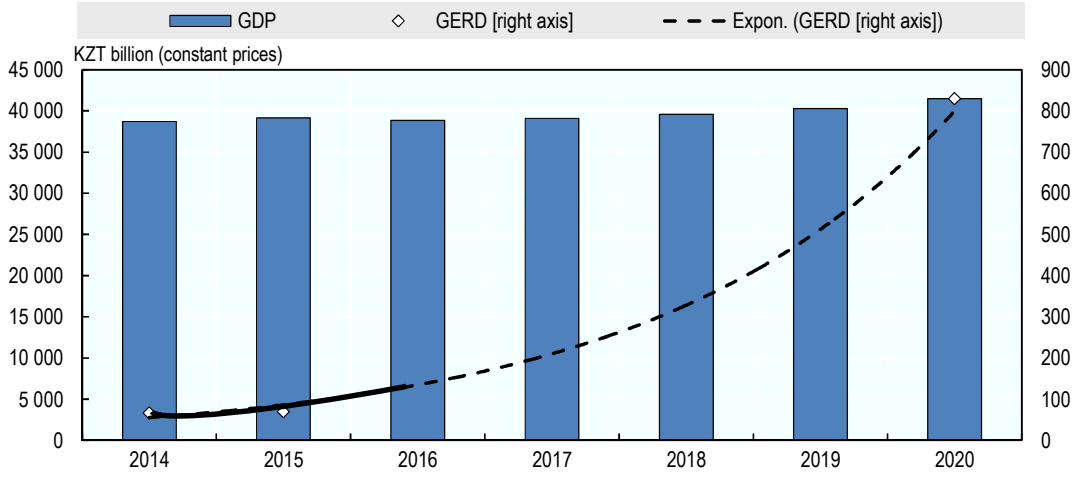
Source: OECD (2014d), *Science, Technology and Industry Outlook 2014* (database), http://stats.oecd.org//Index.aspx?QueryId=57863.

The low level of research and development (R&D) expenditures in Kazakhstan is in stark contrast with the ambitions in the official declarations at the highest level of policy making and in the national strategies. While setting ambitious targets for R&D expenditures is considered a good practice, they should also be realistic. The current level and trend of R&D expenditure are insufficient to achieve the goals set. Using GDP forecasts from the International Monetary Fund,[6] Kazakhstan's gross expenditure on research and development (GERD) in constant prices would have to be multiplied by a factor 12 by 2020 relative to its level in 2015 (Figure 5.7) in order to achieve the target. For comparison, over the last ten years, a period of significant R&D effort, the GERD increased by a factor of 3.2.[7]

Moving towards these targets will require not only a very significant financial effort, but also continued reforms on the basis of careful monitoring and assessment of progress.[8] Moreover, it is not feasible that such a huge increase in R&D expenditures be financed by government alone. Rather, the business sector would have to commit a very substantial amount of funds to research and innovation activities, but this requires sufficient opportunities for private investment. Public authorities have an important role in establishing favourable framework conditions to provide incentives and adequate support mechanisms to mitigate uncertainty and reduce the wedge between social and private returns on R&D. The leverage effect of public expenditures, i.e. their impact on private expenditure, is key in this context. Numerous evaluations have shown that a positive effect is far from automatic. Rather, it depends on many factors, spanning from features related to the context to the rules and designs of support programmes and subsidies (Edler et al., 2016; OECD, 2006). However, due to the paucity of data and the

lack of evaluation of support mechanisms, the size of the leverage effect remains unknown. Finally, and even more substantially, it should be stressed that increasing the R&D intensity to 2% in four years appears not to be desirable. Regardless of where the funds would originate from, research and innovation capacity cannot be developed in such a short period of time to the level required to absorb and execute the corresponding activities. In quantitative terms, a simple calculation based on the current level of total R&D expenditure per researcher in Kazakhstan gives a more than tenfold increase in the number of researchers necessary to execute the activities corresponding to a 2% R&D intensity reached by 2020. Given the inelastic supply of researchers in such a short period of time, this might lead to a subsequent increase in researcher wages to the detriment of the volume of R&D. In qualitative terms, anecdotal evidence tends to suggest that some research calls for proposal in Kazakhstan did not attract projects of sufficient quality. Such a surge of financing could therefore also encourage unproductive research and rent-seeking behaviours. Developing the necessary absorption capacity can only be gradual and should be envisaged as a long-term endeavour.

Figure 5.7. **GDP forecast 2014-20 and implicit GERD target in 2020**



Note: The dotted black curve represents an exponential growth starting from the two effective levels of GERD for 2014 and 2015 to the required level corresponding to 2% of the forecasted value of GDP for 2020.

Sources: IMF (2016), *World Economic Outlook Database*, https://www.imf.org/external/pubs/ft/weo/2016/01/weodata/index.aspx; NAS (2016), *National Report on Science 2015*.

Supporting excellent and relevant research in universities and public research institutes

Research funding instruments

The bulk of the research budget of universities, public research institutes (PRIs) and other public research organisations originates from the MES, via its Committee on Science. The national innovation agency, the NATD, also distributes on a competitive basis some funds to finance projects in public research-performing organisations, although its primary targets are business companies.

In accordance with the Law "on Science", the funding allocated by the Committee on Science to universities and public research organisations is divided into three public funding streams:[9]

1. Basic funding covers the costs of scientific infrastructures and property, including buildings, equipment and material, salaries of administrative and service personnel, as well as information support of scientific and technical activities.
2. Grant funding to proposals generated bottom-up is allocated on a competitive basis for research aimed at improving the level of science, the scientific and technical potential, and the competitiveness of the scientific organisations, including the commercialisation of results of scientific and technical activities.
3. Programme-oriented funding follows a more top-down approach devoted to research aimed at finding solutions to problems in areas of strategic importance for the country. Institutions or consortia of institutions prepare proposals for such programmes that are implemented through projects. Funding is allocated on a competitive basis.

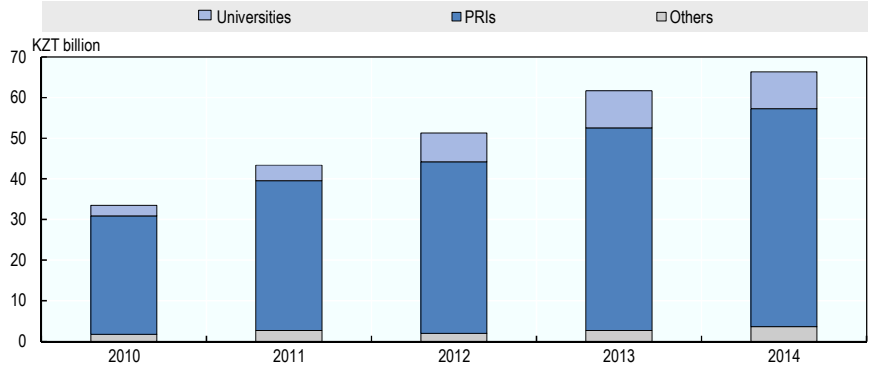
Decisions on the selection of grant proposals are taken by the Higher Scientific and Technical Commission (HSTC) following recommendations of the NRCs, based on the evaluation coordinated by the National Centre of Science and Technology Evaluation (NCSTE). Although the selection process put in place by the NCSTE follows international standards in the matter, there appears to be room for improvement with regard to the involvement of international experts in proposal evaluation (OECD/World Bank, 2011).

In total, between 2012 and 2015, only about 11% of government funds were made available as basic funding, half was distributed through competitive grants and 39% was spent on programme-oriented funding. This distribution of funds allocated by funding instruments differed substantially between the different types of organisations. Three-quarters of funding received by state universities (not including Nazarbayev University) originated from grant funding. Only about 4% came from basic funding and some 20% from programme-oriented funding with almost 30% in the case of national universities and only 2.5% for private universities.

Distribution of the funds allocated

Between 2010 and 2014, around 90% of the GERD was performed by research institutes and other research-performing organisations – in total more than 200 non-university research institutions (Figure 5.8). Very little information regarding the activities performed by these organisations is available.[10]

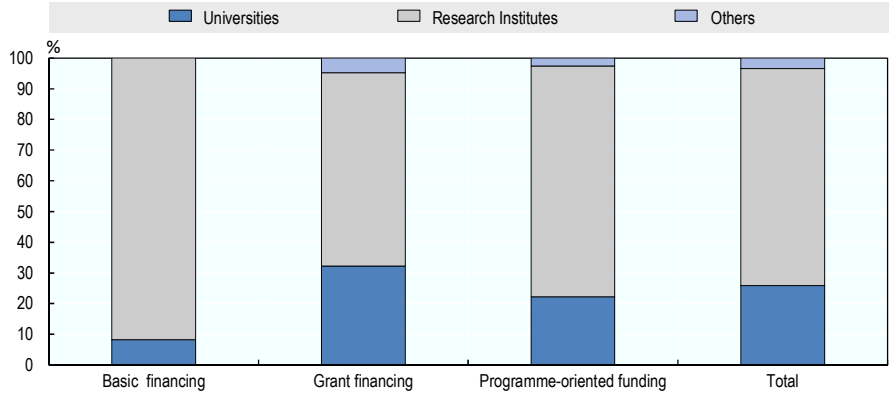
Figure 5.8. **Breakdown of annual (internal) gross domestic expenditure for R&D to research organisations, by type of organisation**



Source: NAS (2016), "National report on science 2015".

When considering only the funds allocated by the Committee on Science during the period 2010-14, research institutes also account for a considerable share of basic funding (92%) compared to universities (8%). This statement is also valid on average as research institutes receive more than six times as much as universities (Figure 5.9).

Figure 5.9. **Breakdown of Committee on Science funding to research organisations, by type of organisation and type of financing, 2012-15**



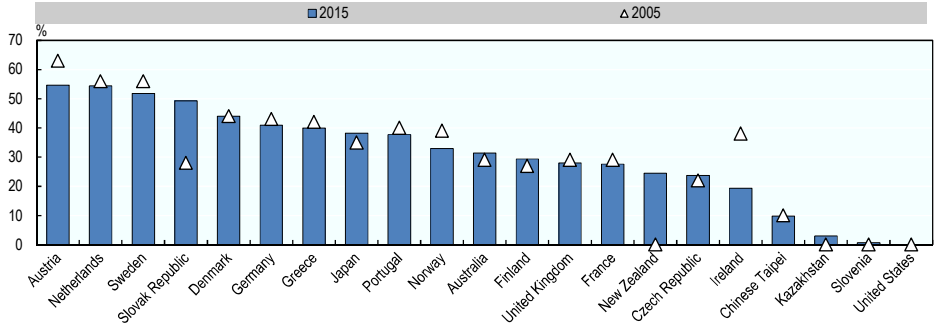
Sources: Science Committee; Ministry of Education and Science; authors' calculations.

No information is available on the configuration and size of collaborative projects.

Basic funding for research

While the allocation across research organisations is uneven, it represents only a minor share of government funding for all of them (14% for research institutes and about 7% for state universities, not including Nazarbayev University, from 2012 to 2015).[11] This level of basic funding is very low by international comparison. Although an international comparison of the balance between non-competitive (or "block" grants, institutional funding, "core" funding) and competitive funding (project-based funding) models varies widely across countries, non-competitive funding still represents a significant share of the total funds for research received by universities. Moreover, there is no clear international trend regarding the evolution of this balance over the last decade. Overall, however, the share of basic funding for research organisations is far below the amount that is allocated to universities in OECD countries, except in countries as diverse as Slovenia or the United States, where all government funding is allocated through competitive schemes (Figure 5.10).

Figure 5.10. **R&D financed from general university funds in a selection of OECD countries, Kazakhstan and Chinese Taipei**



Sources: OECD (2016g), *Government budget appropriations or outlays for RD* (database), https://stats.oecd.org/Index.aspx?DataSetCode=GBAORD_NABS2007. Data for Kazakhstan: Science Committee; Ministry of Education and Science; author's calculations.

Competitive grant schemes

Despite the scarcity of information available, it is possible to identify some noteworthy features of these schemes:

- Among universities, Nazarbayev University has succeeded in attracting substantially more funds than other national universities in competitive project schemes, in particular in programme-oriented funding (96% of funds allocated to Nazarbayev University).
- The average funding per grant was about KZT 8 million (about EUR 2 800) in 2013, which is very low by international standards. The MES competitive research scheme tends to finance a large number of very small projects led by individual researchers or small teams.
- A majority of grants were awarded in the "intellectual potential" theme. The link of this category to the national priorities remains unclear as it mixes very different projects related to fundamental and applied research in the social sciences and the humanities as well as fundamental research in the natural sciences.

The competitive research scheme of the World Bank Technology Commercialization Project

The World Bank, together with the MES, conducted a Technology Commercialization Project between 2008 and 2015. The project aimed at strengthening the science base and the commercialisation capabilities of Kazakhstani researchers by supporting high-quality R&D with the help of competitive grants. The total budget of the programme was USD 75 million, out of which USD 13.4 million was financed through a loan from the World Bank and USD 61.6 million from the government of Kazakhstan.

Scientific teams, either in universities or research institutes, from any area could apply for two types of grants: one for teams of senior scientists (with up to USD 500 000 per year over three years) and one for groups of promising young researchers (with up to USD 200 000 per year over for three years).

The competition for the grants was transparent, merit-based and peer-reviewed by three international experts. The criteria included dimensions measuring scientific excellence and commercialisation potential. Altogether 785 applications were submitted, from which 33 projects were chosen. Seventeen per cent of applications were presented by junior scientists and 83% by senior teams. Of the 785 applications, 610 teams came from universities, 109 from SMEs and 38 from individual researchers. The successful projects received both financing and consultancy services. By December 2015, when the programme came to an end, 24 out of the 33 projects reached markets and were making first sales amounting to KZT 154.7 million (World Bank, 2016a).

Another aim of the project was to contribute to the development of a competitive, interdisciplinary, problem-oriented, internationally peer-reviewed, model of financing excellent and relevant scientific research (Box 5.1).

Box 5.1. **Diffusing good practices on competitive research grants: The World Bank Technology Commercialization Project**

The establishment of an effective and efficient process for competitive selection of research projects is now widely seen as a prerequisite of any modern research system. This missing element of the research system was the focus of the first component of the Technology Commercialization Project.

The Technology Commercialization Project design embodied many key principles drawn from previous experiences of the World Bank in countries such as Chile and Uganda. The project intended to "lead by example" and diffuse these principles in the research system among researchers and policy makers. These principles and their specific implementation in the context of Kazakhstan were as follows:

- A transparent, fair and merit-based competition for resources. The project provided advice and expertise for the establishment of a USD 21 million non-refundable, non-thematic competitive grant to provide public funding to excellent research groups.
- Resource allocation based on independent review of proposals. Proposals were evaluated by an International Science and Commercialization Board composed of five renowned scientists and two experts in technology commercialisation from the business community. Each peer evaluated the short-listed proposals on the basis of four criteria: quality, impact, path to success (timeliness management and costs), and potential for commercialisation.
- Concentration of resources for the most qualified researchers. The amount distributed per project was significantly higher than any grant ever awarded in the past. Senior scientists grants were up to USD 1.5 million and junior researcher grants up to USD 600 000.
- Autonomy over use of resources by principal investigators. The complex and burdensome administrative requirements were, as far as possible, replaced by good *ex ante* selection of proposals and *ex post* evaluation of research results.
- Coherence with broader development objectives. Although it relies upon previous experiences of the World Bank, the project was designed and managed in collaboration with the government of Kazakhstan, and in particular the MES.
- Sound management. In addition to the selection of research proposals, selected projects are subject to evaluations and mid-term reviews to assess progress towards the initial objectives. Moreover, the whole project was itself subject to ongoing monitoring and evaluation. The main indicators used were the number of established and functioning senior scientists grants and junior researcher grants, the number of graduate students involved in the grants, the number of visiting professors, and the number of collaborative research projects involving groups and international research partners.

Sources: World Bank (2015a), "The Technology Commercialisation Project (TCP), Seeding the innovative ecosystem in Kazakhstan", Statistical compilation/analysis; World Bank (2015b), "Technology Commercialisation Project (TCP): Implementation status & results report".

According to an independent evaluation of the World Bank country programme, the project was "moderately satisfactory". Its effectiveness was hindered by several factors (World Bank, 2015c; 2016a):

- One problem was that most viable initiatives were related to state interest while World Bank rules prohibit the financing of projects connected to the government. As a result, this programme could operate in fewer sectors than planned, namely, solid waste management, the Almaty ring road, wind power, coal-generated electricity and financial sector transactions.
- The limited experience of many candidate research groups in preparing competitive research proposals was a problem at the project inception, as demonstrated by the low quality of the first generation of proposals, especially with regards to the commercialisation aspects. The project acted to mitigate this problem by providing mentoring and direct support to applicants in drafting the final proposal and preparing the budget.
- The lack of capacity in established funding agencies and the lack of co-ordination among ministries most engaged in innovation issues. No domestic policy makers were members of the International Science and Commercialization Board, which might have helped both in building up the capacity of administrative staff in how to run competitive funding and supporting the needed intersectoral discussions. This limitation might be corrected in the Phase 2 governance structure.

Synthesis

The main achievements and remaining challenges of the dedicated support measures that aim at increase public and private investment in research are presented in Table 5.4.

Table 5.4. **Achievements and challenges in public policies aiming to increase public and private investment in research activities**

Achievements and progress	Remaining challenges
Overall	
• Three clear public funding streams for universities and PRIs: basic funding, grant funding and programme-oriented funding	• Low level of R&D expenditures (0.17% of GDP in 2014) is in stark contrast with the high ambitions set out in the official declarations and relevant strategies • Distance to R&D intensity target for 2020 (2% in SPIID programme) among the largest internationally • Converging evidence of low leverage effect of public support instruments and incentives on business R&D investment (and no formal impact study available for policy learning)
Funding instruments	
• Well-established R&D competitive grant schemes financed by the MES and operated by the NCSTE (with project assessment by peer reviewers, including international peers) • Financial and technical commitment of the Kazakhstani government to the World Bank Technology Commercialization Project to develop a real-scale demonstrator of a competitive problem-oriented model for research funding that fulfils high international standards • Significant funding overall and by project provided by the World Bank Technology Commercialization Project	• Very limited of information available on the activities of PRIs, although they receive the bulk of research funding • Low level of basic funding for universities • Small average size of research projects funded by government research grants • Insufficient number of high-quality projects involving collaboration between science and industry

Incentivising R&D investment

The Kazakhstani government has introduced potentially effective tools to increase business R&D investment, in the form of tax credits, tax exemptions and investment requirements for subsoil users and, possibly in the future, other industry actors (Table 5.5).

Table 5.5. **Financial support instruments for business R&D and innovation in Kazakhstan**

Instrument	Aim	Target population	Modality
R&D tax credit	Stimulate business R&D expenditure/activity	All business enterprises	50% tax deduction on the cost of industrial R&D
Special economic zone (SEZ) tax exemption	Promote innovative investments in SEZs	Businesses operating in the SEZ and active in the SEZ-specific priority sectors	100% reduction of corporate income tax, 0% land and property tax, VAT exceptions, procedural benefits for up to ten years in the SEZ "Innovation Technology Park" exemption for social charges for up to five years
Tax exemption on research organisations	Incentivise research activities	Firms with research as main activity	Exemption from corporate income tax and VAT
R&D requirement for subsoil users	Channel	Mining, oil and gas companies	Require subsoil users to invest 1% of their yearly income in R&D

Fiscal incentives for R&D

The introduction of fiscal incentives for R&D is in line with recent trends in innovation policy. The availability, generosity and simplicity of use of R&D incentives, in particular R&D tax credits, have significantly increased in the OECD area and beyond over the past decade (OECD, 2016b). Like other indirect support measures, tax incentives do not allow to precisely control the nature and, even less, quality of activities that are covered, as opposed to project-based funding. They can therefore be less effective due to windfall effects and the difficulty to target certain categories of potential beneficiaries. However, an analysis of recent policy trends reveals that their relative importance *vis-à-vis* direct support has also increased in many countries' policy mix. Several impact studies have measured the effects of these schemes on R&D inputs and, to a lesser extent, on outputs and R&D performance in general (Köhler, Laredo and Rammer, 2012). These impact studies have indicated that the effectiveness of incentives to R&D strongly depends on the concrete design of the instrument, which has to be finetuned in accordance with specific national policy objectives and conditions.

Fiscal R&D incentives address one of the major weaknesses of Kazakhstan's national innovation system: low R&D expenditures and capability of the private business firms. The government of Kazakhstan routinely uses various tax incentives to attract investment, foreign direct investment (FDI) in particular. As a result, there are different types of incentives for different firms and types of investment such as exemptions, from customs duties on imported equipment or a ten-year-long tax holiday after investments in priority sectors (OECD, 2016c; see also Chapter 4). To complement these incentives, specific measures such as tax credits and tax exemptions were introduced to specifically promote business R&D investment.

R&D tax credit and exemptions

With the 2008 Tax Code, the government has launched a tax incentive (100% deduction of qualifying R&D costs) scheme on business R&D expenditures. This initiative was extended by the Law "on State Support of Industrial Innovative Activity" (January 2012) to a 150% "super-deduction",[12] as part of the general strategic framework of the SPAIID (Salimov, 2012).[13] The deduction applies to various expenditures, such as spending on R&D and technical work, buying exclusive rights to IP from HEIs, research organisations and start-up companies based on a licensing agreement or a contract of exclusive rights aimed at further commercialisation. It cannot be claimed, however, for the acquisition of fixed assets. The tax deduction is volume-based with neither ceilings nor tax brackets. The R&D activity is eligible if the following three conditions are met: 1) it results in a patent; 2) R&D expenses are confirmed by the relevant state authority; and 3) the innovation resulting from the R&D is implemented in Kazakhstan. The costs of R&D can be carried forward for ten years on account of a general carry-forward tax provision but the tax deduction is non-refundable (PWC, 2016).

External R&D expenditures are only deductible when R&D services are purchased from "higher education institutions, research organisations and start-up companies" (2008 Tax Code). Research organisations, in turn, are defined as organisations whose primary activity is scientific, meaning in practice that scientific activities constitute at least 90% of their total revenues.[14]

Tax incentives in SEZs

SEZs are geographically defined areas with tax and customs privileges, simplified procedures for recruiting foreign employees and support in dealing with domestic regulations (Kaznexinvest, 2016). They are established with the aim to attract multinationals, which leads to the creation and development of competitive industries and the alleviation of social problems. Reported indirect effects also include technology transfer and stimulation of local innovation through the development of backward linkages between the multinationals and domestic firms. Some countries, especially in Asia such as the People's Republic of China (hereafter "China"), Korea, Malaysia and Singapore have succeeded in using SEZs for transforming part of their industry (World Bank, 2010).

Tax benefits in SEZs include a reduction of corporate income tax on 100% of income resulting from activities consistent with the objectives of the SEZ, 0% land and property tax as well as some VAT exceptions and a number of procedural benefits, including simplified hiring of foreign employees and easier customs clearance procedures.[15] Such benefits apply for up to ten years. These incentives only apply to certain designated sectors in each SEZ, in most cases pertaining to different branches of manufacturing.[16]

SEZs do not generally have specific treatment for innovation-related activities. Only the SEZ called the PIT applies specific tax benefits to firms operating in the ICT sector or conducting scientific research and experimental development "in the area of information technologies, telecommunications and communication, electronics, instrument engineering, renewable energy sources, cost-effective use of resources and natural resource use, creation and use of new materials, production, transportation and processing of oil and gas" as their main activity.[17] Besides the above-mentioned benefits, firms in the PIT can claim an exemption from social charges for up to five years. There are discussions of introducing similar conditions to firms located in the other autonomous

cluster, i.e. the Astana Business Campus managed by Nazarbayev University. However, this has not been enacted yet.

Despite much effort, some assessments suggest that SEZs have only made a limited contribution to the growth of investment and SME development. Observers indicate substantial differences in the performance of the SEZs as well as their success in attracting investors (see, for example, Karzhaubayeva, 2013). The government conducted a thorough audit of the SEZ system in 2013 which identified weak infrastructure, poor management and an imperfect legal framework as the key weaknesses of the system. The government has worked out an action plan to amend the Law "on Special Economic Zones", the Tax Code and other relevant pieces of legislation to fix the identified problems (OECD, 2016c).

Specific regulations on the use of subsoil resources to fuel innovation and growth

Since the breakup of the Soviet Union, Kazakhstan has been among the new republics which have made the greatest effort to create a legal environment which regulates the use of its mineral resources transparently. In addition, it is trying to use subsoil resources to serve national strategic objectives, from the defence of national interests, more recently, innovation-based growth.[18]

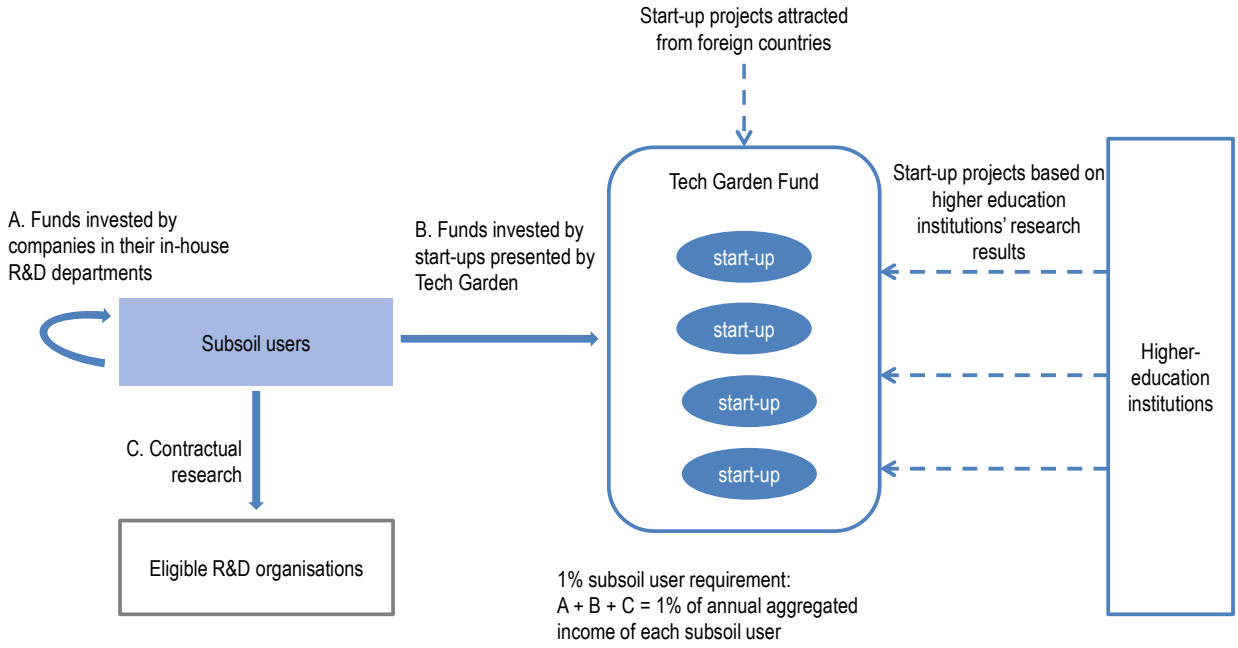
The original Law "on Subsoil and Subsoil Use" (hereafter the "Subsoil Law") was passed in 1996 in order to offer greater protection of the national interests in extractive industries. It has been amended many times in the following years, leading in 2010 to a new Subsoil Law (OECD, 2012). The new law provides national authorities with greater power *vis-à-vis* the investors by, for instance, setting stricter conditions and requirements for acquisition and transfer of extraction rights. Importantly, the new law states that the use of subsoil resources should be governed not only to protect the interests of the Republic of Kazakhstan but also to ensure economic growth (Chentsova, 2010; 2014).[19] Consequently, specific new requirements have been set in order to channel some of the income stemming from the exploitation of the subsoil towards potential growth opportunities. The law also imposed more stringent local requirements applying to subsoil users' procurement of goods and services.

The subsoil user requirement

The Subsoil Law was amended in 2012 to add a new requirement aiming at using the revenue of extractive industries to strengthen the national research and innovation capability. This amendment requires subsoil users to "annually finance research, technology promotion and/or development undertaken by Kazakhstani producers of goods, work and services in an amount of no less than one per cent of the subsoil users' aggregate annual income from contractual operations […]".[20] The penalty for not doing so can be the loss of the subsoil user extraction license.

Subsoil users can fulfil their obligations amounting to 1% of their annual income in R&D either by investing R&D internally, for those who have an in-house R&D department, or contract R&D externally to a Kazakhstani organisation. Foreign organisations qualify under this obligation only in the case where there is no domestic alternative and with the special permission of the authorities. In 2015, the government added a third potential channel by allowing subsoil users to fulfil the obligation by investing in start-up projects, via the governing body of the SEZ of the Autonomous Cluster Fund PIT (Figure 5.11).[21]

Figure 5.11. **Functioning of the 1% subsoil user requirement**



Concretely, based on the expertise of its staff and its knowledge of the scientific and industrial communities, in Kazakhstan as well as in the region more generally, the "Tech Garden" Fund aims to support subsoil users subject to the 1% subsoil user requirement in two ways:

1. As a "matchmaker" between the supply and demand of high value-added services. Subsoil users, when facing a specific scientific or technological problem, can ask "Tech Garden" to search for potential partners with the required competencies. The demands are posted on the company's website.

2. By identifying and nurturing start-up projects in need of investment to finance their growth. Every three months, the companies organise events that gather the identified start-ups and the companies subject to the 1% subsoil user requirement. The latter can then select sound and appropriate projects, in relation to their needs and activities, and finance them on a venture capital principle (Yelkhan, 2015). Originally, the start-up projects were to be sourced from the community of researchers and entrepreneurs in Almaty (about 58 universities and 70 national labs) and elsewhere in Kazakhstan. Confronted with the limits of the domestic deal flow, Tech Garden has followed a World Bank recommendation and set up a dedicated acceleration programme "Startup Kazakhstan" in order to attract start-ups from former Soviet republics and other foreign countries. Participants of Startup Kazakhstan receive USD 20 000 to USD 100 000 as well as qualitative support provided by world-class mentors and industry experts.[22] This programme, supported by the government, was inspired by the Start-Up Chile programme.[23] Projects also benefit from "mentoring" partnerships with foreign companies that are experienced in start-up development.

In both cases, the amounts of funds expensed by the subsoil users either to purchase specific R&D services or to invest in start-ups are eligible as part of their 1% requirement.

Discussions are ongoing about a potential extension to projects stemming from the other organisation with the status of autonomous cluster, namely the Astana Business Campus. As of the first half of 2016, the legal infrastructure that would enable the Astana Business Campus to source and present to subsoil users projects eligible as part of their 1% R&D requirement were not yet in place.

In 2011, it was announced that all firms owned by the Samruk-Kazyna holding have to spend 10% of their net income on R&D (Inconet, 2012; UN, 2012). However, this plan was apparently not implemented as Samruk-Kazyna firms realised KZT 333 billion net revenue in 2014, but spent only KZT 8.8 billion (or 2.6%) of it on R&D (Samruk-Kazyna, 2015). A potential extension of the list of companies subject to the 1% requirement was also discussed in 2014; it included industries such as the generation and distribution of energy, transportation, banking, and telecommunications.

Assessment of the amount of funds raised through the subsoil user requirement

There is little available information on the total amounts of funds raised through the subsoil user requirement and the respective shares of the three channels described above. Inference on the basis of partial data and anecdotal evidence indicates that the amount of funds invested in R&D under the 1% subsoil user requirement is far below expectations. Although there are about 200 subsoil users in Kazakhstan (EITI, 2014), the majority of the R&D obligation falls in practice on a relatively low number of state-owned enterprises. As of 2014, only about 50 subsoil users had invested about 1% of their annual income in R&D.

During 2012 and 2013, oil and gas firms conducted R&D for KZT 10.5 billion while mining firms spent KZT 5.7 billion during the same period (or about 0.02% of GDP per year). These numbers are much lower than what could be expected based on the total revenue of the sector. Should all obligations be fulfilled, 1% of revenues in these sectors would amount to KZT 122 billion, or about 0.33% of the country's GDP. It therefore seems that the obligation has not been fully fulfilled. [24]

The June 2015 amendments to the "Subsoil Law" have to some extent increased the amount of funds invested by subsoil users in R&D and start-up companies. In 2015, PIT signed a contract with the mining companies totalling at KZT 189.9 million. During the period January-December 2016 the total sum of signed contracts was KZT 1.156 billion. Thus, for the period 2015 - 2016 years about KZT 1.346 billion was attached from 27 subsoil companies.

With the collected funds, PIT Alatau has funded in 2015 5 start-ups totalling at KZT 21.4 million, in 2016-24 projects totalling at KAZ 791.4 million. Report on the implementation on an annual basis is sent to the MID.

Several implementation problems have reduced the capacity of the mechanism to channel subsoil resources into R&D:

- First, similar to the tax deduction, external R&D only qualifies when it is conducted by individual researchers or research organisations (with at least a 90% share of scientific activities in their sales). This latter provision may be an important constraint for many primary engineering firms. Such firms are either excluded from this scheme or they have to establish legally separate research affiliates.

- Second, there is still some ambiguity about the exact obligations required by this law. Several oil and gas organisations, gathered in Kazenergy, have called for a strengthening of the mechanism for use of these funds and their concrete utilisation in R&D activities (Kazenergy, 2011). They argue that the somewhat ambiguous definitions contained in the actual legislation generate uncertainty among subsoil users with regard to the eligibility of projects. Detailed regulation and some bylaws for the implementation of the 1% requirement are claimed to be missing.
- Third, the government does not seem to monitor the law, which limits its enforcement. There does not seem to be any systematic data collection or reporting on the fulfilment of the obligation of the different subsoil users.

Lessons learned from similar regulations worldwide

There are a number of international examples that could expand the range of potential options for implementation (Box 5.2). Schemes differ according to the intensity and type of obligations (what percentage of what firms performance measure), the scope of the obligation (applying to all or selected firms in the defined sectors), the degree of centralisation of the process (investment via a common fund or at the level of each regulated firm) and the eligibility conditions for recipient R&D investment (labelled or not; external R&D or internal R&D). These experiences provide some lessons:

- It is important to define the rules very precisely and apply them in a consistent and transparent way. Monitoring and evaluation are, therefore, key elements of the system
- The obligation can hinder small firms, which need more flexibility in the use of their revenues
- Countries have developed different options, including a centralised model (a central fund allocates the collected money to relevant R&D projects) and a decentralised model (firms that fall under the R&D obligation decide upon the allocation of the money they have to spend on R&D projects). Both models have their respective strengths and weaknesses. Firms may have stronger incentives to spend the money effectively in projects of higher market relevance while government agencies may be better at identifying projects with greater social benefits.

Box 5.2. **Sectoral R&D obligations**

Historically, sectoral R&D obligations, whereby a specific regulation set a minimal investment in R&D applying to all or part of business firms in the sector, first appeared in the telecommunications sector in a few countries. The economic argument for such a regulation was that firms with dominant market power are likely to underinvest in innovation, which harms consumers.

In **Canada** such an obligation was introduced in 1983 for winners of spectrum auctions and required these firms to spend 2% of their adjusted gross revenue on R&D. In 2014, however, the regulator decided that this requirement represented a significant administrative and financial burden for smaller firms and removed the requirement for firms with less than CAD 1 billion revenue from wireless services (Government of Canada, 2014). Similar obligations are applied to fixed telecommunications providers in **France, Japan and Korea.** France Télécom, now Orange, was obliged to spend 4% of its gross revenue on R&D, which is similar to its historical level of R&D spending.

Box 5.2. **Sectoral R&D obligations** (*cont.*)

However, the amount of R&D has not followed the pace of growth of the company's revenues and as early as 2003 it represented only 1% of the company's turnover, which means that the obligation was not properly enforced. The requirement that applied to NTT in Japan was more binding, and represented a larger burden. It has been criticised because this requirement was not well-specified (Fransman, 2002). According to more recent proposals, specific regulations would create an obligation for privately owned electric utilities to invest in green technologies (Sterlacchini, 2012). This system has not yet been applied.

Countries with large mineral wealth have also put in place sectoral R&D obligations. The underinvestment argument in this case is strengthened by the fact that such resources are non-renewable. It may, therefore, be optimal in a dynamic framework to save and invest in research some of their proceeds to expand the range of future options. This can be done through specific regulations obliging firms to contribute to a common fund whose proceeds are then invested in research, or to invest in R&D themselves. In the first case, the government can nominate experts from science and/or business to decide upon the use of these funds. This model allows the co-ordination of priorities and the funding of projects with higher social and economic externalities.

Colombia and Norway are examples for this approach. In **Norway**, a Research Investment Fund was created in 1999 to provide extra funding for science from the revenues of natural resources financing both large research projects and the setting up of centres of excellence (Smaglik, 2002; OECD, 2008). In 2011, **Colombia** set a new law stipulating that 10% of royalties from oil, coal, gold, platinum and other mineral resources should be invested in the new General Royalties System, a dedicated fund to finance R&D projects (OECD, 2014c).

The second model follows a more decentralised approach, whereby firms, which are supposedly better informed and have stronger incentives to conduct R&D that might be perceived as directly relevant for their activities, decide upon the use of the "earmarked" funds. Such decentralised decision making may also generate stronger links between businesses and researchers, making the national innovation system more cohesive.

Besides Kazakhstan, this second option was chosen by Brazil, which in 2005 introduced an R&D obligation for extraction field concessionaires, above a certain threshold of volume of production, to invest an amount equal to 1% of their gross production income in R&D projects (Belchior, 2013). An important requirement is that up to one-half of this amount can be directed to the development activities in the concessionaire's own fields, while the other half should be invested in institutions accredited by the National Agency of Petroleum. The aim of this provision is that the R&D spending should strengthen these research institutes and the links between these and the subsoil users. Under this obligation, 17 firms contributed around USD 500 million to Brazilian R&D in 2012. Recently, the policy has been evolving in two directions (WIPO, 2014). First, from 2013, the government started to play a more active role in determining research priorities by setting up a committee. Second, new policies will widen the scope of investigations to areas beyond gas and oil related areas.

Synthesis

The main achievements and remaining challenges of the dedicated support measures that aim at providing incentives for R&D investment are presented in Table 5.6.

Table 5.6. **Achievements and challenges in public policies aiming to incentivise R&D investment**

Achievements and progress	Remaining challenges
Fiscal incentives for R&D	
• Generous R&D tax relief rate and tax deduction mechanisms; generous tax benefits in SEZs, set up throughout the country	• No information on the amount of R&D eligible costs and corresponding foregone revenue, the beneficiaries and no evaluation to assess its effectiveness to raise private firms' R&D investment • Large administrative burden for beneficiaries of R&D tax credit • Restrictive eligibility rules: exclusion of expenditures related to capital investment and of external R&D from firms not conducting research services as their primary activity • R&D deduction mechanism still unclear to potential beneficiaries • No specific treatment for innovation-related activities in SEZs, apart from the "Park of Innovative Technologies" (PIT)
Regulations affecting R&D investment	
• Ambitious regulation requiring that subsoil users spend 1% of their annual aggregate income in R&D • Subsoil user requirement opened to investment in start-ups since 2015 via Park of Innovative Technologies (PIT). Ongoing discussion to extend this mechanism to projects originating from the future Astana Business Campus	• Limited amount of subsoil resources channelled in R&D in practice, due to subsoil user requirement implementation problems • Effectiveness of the subsoil user requirement reduced by restrictive application provisions (notably with regards to external R&D) and ambiguity of the rules (eligible expenditures, etc.) • Enforcement of the regulation limited by weak monitoring • Potential inconsistency between the amount of resources to be raised for R&D through the regulation and the limited number of R&D and start-up investment projects to invest in

Raising the domestic business sector innovation capability

Numerous instruments are used by the Kazakhstani authorities to help innovative small and young firms (Table 5.7).

Table 5.7. **Instruments to support small and medium-sized enterprises in Kazakhstan**

Instrument	Type	Aim	Target population	Input/output indicators
NATD innovation grants	Various innovation grants	Support a wide range of business innovation-related activities (development of new products, patenting in foreign jurisdiction, technology transfer and commercialisation, etc.)	Grant (non-repayable)	51 grants in 2015
DAMU innovation grants	Grant on innovative business ideas	Support innovation in SMEs	Grants (maximum KZT 3 million per firm; non-repayable)	668 entrepreneurs supported between 2012 and September 2015

Table 5.7. **Instruments to support small and medium-sized enterprises in Kazakhstan** (*cont.*)

Instrument	Type	Aim	Target population	Input/output indicators
DAMU SME loan guarantees	Financial subsidised loan guarantees	Provide finance for SMEs	SMEs	KZT 132 million guarantee from 2009
DAMU centres for entrepreneurship	Non-financial service provision	Provide SMEs with business services, information and advice	All firms	150 000 clients served through 250 000 sessions
EBRD support of women entrepreneurs	Financial + non-financial service provision	Provide women entrepreneurs with advice and access to capital	Women entrepreneurs	Just started. 2 000 women-led SMEs are planned to benefit
EBRD SME business support programme	Non-financial service provision	Provide SMEs with consulting	SMEs	Just started. Target: 850 SMEs will receive support under the programme, while 500 business owners will benefit from sector-focused activities and 250 local consultants will receive training in five years
World Bank SME project on building linkages	Non-financial service provision and technical assistance	Build capabilities to strengthen linkages between government, large firms and SMEs	Government, large firms and SMEs	Just started. Main indicators by year 5: 1) 100 SMEs become "accredited suppliers" to large companies; 2) 75% of participating SMEs reporting improved management and business practices; 3) four cluster competitiveness action plans for which implementation has begun
World Bank SME project training “business advisors”	Non-financial curriculum development, training	Improve capabilities of business advisors in DAMU centres for entrepreneurship	Business advisors	New curricula will be developed, and several hundred advisors will receive training
Business Training of SME managers (DAMU, National Chamber of Entrepreneurs)	Non-financial training	Provide SME managers with business skills	SMEs	2 800 managers trained through the basic programme and 353 in the extended programme, 1 700 managers took the course at Nazarbayev University (until 2015)
Industry design bureaus	Non-financial	Service provision	Provide design services	Up to 2016, 18 projects worth more than KZT 200 million
KazAgroInnovation Extension Centre network	Non-financial	Training and service provision	Diffuse technologies in agriculture	Training of over 12 000 local producers (2009-14)
Local content requirements	Regulatory	Require target companies to source a certain share of their intermediary goods from and/or transfer technology to national suppliers	Apply to companies sourcing components from abroad	Instrument being gradually phased out

Innovation grants

NATD innovation grants

The NATD, the innovation agency under the authority of the MID, operates a variety of instruments to support business innovation in a broad sense. In 2010, four different types of grants were provided under the SPAIID, on the implementation of development activities and/or risky applied researches, on preparation of innovation project feasibility study, on the patenting of IP and on the purchase of innovative technologies.

Under the Law "On state support of industrial innovation", adopted in 2012, the list of measures of State Support to Industrial Innovative Activities was extended. The list of innovative grants increased to nine to cover additional specific needs and gaps companies face when engaged in innovation activities (Table 5.8): the training of technical staff abroad, the involvement of foreign engineers and technicians as well as project and engineering companies/consultants and, finally, the implementation of management and production technologies (Danabayeva and Shedenov, 2013).

Table 5.8. **Types of innovation grants in Kazakhstan in 2015**

Grant	Aim	Description	Beneficiaries	Support provided as a share of cost (%)	Maximum amount (KZT million)
Grant for Commercialisation	Early-stage financing	Three-stage: 1) proof of concept; 2) industrial sample; 3) test production	Universities, researchers and firms	Stage 1: 95%; Stage 2: 80%; Stage 3: 60%	Stage 1: 5 Stage 2: 50 Stage 3: 100
Grant for Training of Technical Staff	Supporting skills	Supports training of employees	Firms	40%	2
Grant for Involvement of Foreign Engineers and Technicians	Knowledge acquisition	Supports the cost of hiring foreign consultants for production reorganisation	Firms	40%	9
Grant for Involvement of Project and Engineering Companies/Consultants	Knowledge acquisition	Supports the cost of purchasing consulting services	Firms	30%	30
Grant for Introduction of Managerial and Production Technology	Process and organisation innovation	Reimburses the costs of introducing new managerial and production technology	Firms	40%	15
Grant for Technology Acquisition	Technology transfer	Reimburses the costs of purchasing patents and/or licences	Firms/universities/researchers	50%	150
Grant for Industrial Research	R&D support	Support of industrial R&D	Firms/universities/researchers	40%	30
Grant for High-tech Goods Production at the Initial Stage of Development	Financing of introducing new high-tech products	Support for starting production of high-tech products	Firms/universities/researchers	70%	50
Grant for Patenting Abroad	IP creation	Support for the costs of filing for and maintaining patents	Firms/universities/researchers	95%	6.25

Source: NATD (2016), NATD website, www.natd.gov.kz.

In line with the consolidation of policy tools under the SPIID framework, from 2016 onward the nine types of grants will be consolidated into three: grants for commercialisation with the joint participation of scientists and managers with a 20% co-payment; grants for technological development and technology transfer; and grants for technological development of sectors for consortium of firms, universities and foreign partners.

The number of grants has varied markedly since the creation of the NATD, with a peak in 2011, followed by a strong decrease in the number of grants applied for and awarded in 2013-2014 (Table 5.9).[25] During these years, only a few firms benefited from NATD grants. In 2014, only 38 projects were supported, mainly in the most developed

parts of Kazakhstan, including 29 commercialisation grants and only 9 for the other 8 types of grants (NATD, 2016). While NATD grant schemes are the main instrument in support of business innovation, the number of selected projects remained modest, around 40-50 each year with a total funding of KZT 0.8-1.5 billion. Moreover, there have been a variety of schemes, but relatively few applicants for most of them.

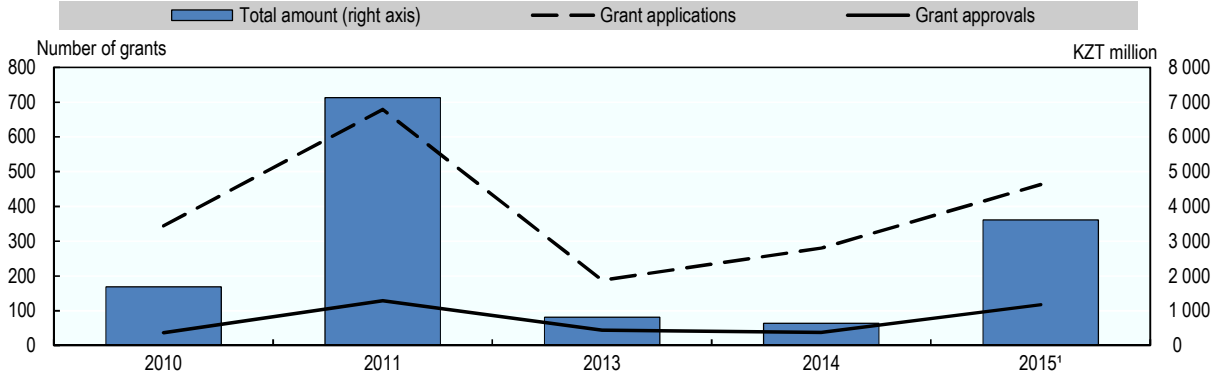
Table 5.9. **Number of applications and approved NATD grants by type of grant, 2014**

Grant type	Grant applications	Grants awarded
Commercialisation	180	29
Training of technical staff	5	0
Involvement of foreign engineers and technicians	7	2
Involvement of project and engineering companies/consultants	16	2
Introduction of managerial and production technology	9	1
Technology acquisition	19	2
Industrial research	5	0
High-tech goods production at the initial stage of development	28	2
Patenting abroad	11	0
Total	280	38

Source: NATD (2014), "Annual report 2014", www.raexpert.kz/docs/annual_contest/natr/AR_NATD_2014_ru.pdf.

The number of grant applications and awarded have increased recently, as in 2015 alone the NATD received 463 applications, of which 117 were approved for a total funding of KZT 3 619 million (Figure 5.12).

Figure 5.12. **Number of NATD grants applied for and approved, and corresponding total amounts awarded, by year**



1. Grant applications made in 2015 and financed in 2015 and 2016.

Note: Data for 2013-15 is provided by the Kazakhstani side.

Source: OECD (2016d), "Background document on the venture capital market in Kazakhstan".

The grant procedures follow the best international grant application and selection practices. The selection for the commercialisation grants is performed in two stages by committees consisting of eight members delegated by the industry or chambers of

commerce. The main selection criteria are: 1) the innovativeness of the project; 2) the quality of the team; 3) the vision about the future; and 4) the budget.

According to the NATD self-assessment, the 328 grants distributed so far generated 955 permanent jobs, produced goods for KZT 76.8 billion, and paid KZT 3.8 billion of taxes.[26]

Since the introduction of these grants, the NATD has implemented many changes to improve its process. Firstly, the aforementioned planned consolidation of grant schemes may enhance the functioning of the system. Another key step was the gradual increase of the co-financing requirements. Since 2012, the NATD requires co-financing by all applicants. According to anecdotal evidence, this condition was not fulfilled in all cases or the effective co-operation between the firms and the laboratories remained limited in practice. The NATD also improved the practicalities of its schemes, reducing the amount of required documents by 50%, providing funds in several instalments and allowing the coverage of researchers' salaries. The scheme was also criticised by academics who, although they can submit applications, have to register as a company in order to be eligible for funding. The effectiveness of the NATD grant scheme was also hindered by the very stringent regulations imposed on contractors, under which very harsh penalties could be imposed even in the case of very short delays of reporting leading to cancellation of the grant, repayment and a 10% penalty. In the meantime, these rules were changed and the conditions were mitigated. The NATD has also become more proactive in looking for and visiting potential clients. It has also intensified its communication towards potential recipients, in particular companies, through the Internet and dedicated events, and broadened the sectoral coverage of its grant schemes.

DAMU innovation grants

DAMU has introduced a grant scheme that aims to support innovation in SMEs and small-scale projects in the framework of the SPAIID and Productivity 2020. DAMU is well-placed to implement such a grant scheme thanks to its large network of offices across the country and its close contacts with SMEs through its non-financial programmes.

The DAMU innovation grants, introduced in 2012, cannot exceed KZT 3 million. They can be spent on fixed assets, capital goods, intangible assets, technology acquisition and franchises. The grants reimburse the costs of these activities and require 10% co-financing from the side of the entrepreneur. Small businesses with new business ideas in priority sectors and manufacturing are eligible to apply. Firms can submit applications from any sector from rural areas and single-industry towns are also eligible for financing. The application process is competitive, with regional co-ordinating councils deciding and financing the grants. Applicants should also complete a business course, also provided by DAMU (DAMU, 2016).

Between 2012 and September 2015, DAMU distributed grants to 668 entrepreneurs in the amount of nearly KZT 2 billion. Importantly, the regional distribution of the grants is more dispersed than that of the NATD grants. As a result, the small DAMU grants are able to reach more small businesses and entrepreneurs, even in remote regions of the country, complementing NATD grants in this respect.

Support to SMEs

Recent support to SMEs is provided in the framework of the overarching "Business Roadmap 2020".[27] The main aim of this programme is to support entrepreneurial activity in Kazakhstan through financial and non-financial instruments.

Training of SME managers

One key constraint for entrepreneurship can be the lack of basic business skills. Such bottlenecks are quite typical in middle-income countries, and especially in former socialist countries (OECD, 2016e; Hübner, 2000; Cheng and Robinson, 2005). Even after a transition, it takes time to establish education providing strong management skills. The relatively low level of such skills has been recognised by Kazakhstani policy makers, and a number of programmes have been initiated to help managers improve their skills. Many training programmes have been organised by DAMU, and more recently, by the National Chamber of Entrepreneurs of Kazakhstan, mainly as part of the Business Roadmap 2020 programme (DAMU, 2016; Atameken, 2016; OECD, forthcoming, 2016c).

The "Business Connections" course organised by the National Chamber of Entrepreneurs is a three-week course on management and foreign trade for senior managers of priority sector SMEs. Additionally, some selected participants continue their training in Germany another four weeks. Altogether, nearly 2 800 managers participated in the core programme and 353 benefited from the extension by the end of 2015. Another initiative by the National Chamber of Entrepreneurs, the "Senior Seniors" programme, includes support for inviting retired foreign experts, who provide training as well as advice on how to manage a firm more effectively (DAMU, 2016; Atameken, 2016).

DAMU organises training courses for senior SME managers at Nazarbayev University. This includes three days of intensive coursework, followed by online seminars and the task of developing an actual business plan. The most successful plans are forwarded to investors. Through the end of 2015, nearly 1 700 managers had taken part in this programme (DAMU, 2016).

Subsidised loans and loan guarantees for SMEs

One constraint for the growth of the SME sector (see Chapter 4) is the lack of financing, with difficult access to bank loans and high interest rates. One report did find that existing SME schemes did not offer sufficient support for SMEs (OECD, 2012).

Since the first half of the 2000s, DAMU has been providing state support for SME financing via three instruments: lending money to commercial banks (KZT 5.7 billion since 2009), supporting the interest rate (KZT 567 million since 2009) and loan guarantees (KZT 132 million guarantee from 2009). In 2016, additional crisis measures were introduced, providing an extra KZT 200 billion, half of which could be spent on general SME financing and half on financing working capital and refinancing loans (OECD, 2016c). These instruments do not aim directly at innovative firms, but at those in priority sectors – mainly in manufacturing. The majority of DAMU clients operate in trade and other non-innovative services.

Technical assistance and advisory services

DAMU operates a network of 18 fixed and 14 mobile centres for entrepreneurship set up during 2012-14 across Kazakhstan. These operate as business development centres to provide free expertise to local businesses, public organisations and local executive

authorities on various matters, including on starting businesses, writing business plans, and on legal and accounting issues. These centres, and the "business advisors" working there, have provided consulting for more than 150 000 clients through 250 000 sessions.

A key factor determining the efficiency of such a service is the level of capabilities of the business advisors in this extensive network. The first component of the 2015-20 "SME Competitiveness Program" (World Bank, 2015d) aims at enhancing the capabilities of these advisors. The Business Edge curriculum will be adapted to local requirements by a leading university or training centre. As a result of this programme, several hundred business advisors will receive competency-specific training. In addition, a number of "master trainers", i.e. teachers with skills to teach more business advisors, will be trained. Designing such a curricula and the training of teachers will also contribute to the increased quality of business education in Kazakhstan and the development of the business advisory services market.

In 2015, the government of Kazakhstan and the European Bank for Reconstruction and Development (EBRD) agreed to co-finance three new programmes to provide technical assistance and advisory services for SMEs for a total budget of EUR 41 million for the whole of the programmes' duration. The commitment of Kazakhstan to support the capabilities of SMEs is reflected by the fact that Kazakhstan is one of the few governments which contributes financially to a technical assistance programme with the EBRD (Wilson, 2015). Through the EBRD's SME business support programme, for instance, operated since the 1990s and extended to the period 2015-17, local consultants and international experts provide advice to SMEs to become more competitive and grow faster. Utilising a budget of EUR 22 million for five years, the programme plans to support 850 SMEs, carry out sector-focused activities with 500 business owners and train 250 local consultants in order to build capacity for business advisory services in the longer term (Wilson, 2015). Another programme, "Women in Business", will support eligible women-led micro, small and medium-sized enterprises in Kazakhstan. The aim is to promote women entrepreneurship and access to finance (EBRD, 2015; Witte, 2015a; Pyrkalo, 2015).

Local content requirements and industrial linkages

As many emerging economies, Kazakhstan has set local content requirements with regard to the share of intermediate goods to be sourced from domestic suppliers, SMEs in many cases. This type of measure aims at protecting or strengthening domestic capabilities, ensuring a flow of activity and, in some instances, linkages and knowledge transfer between domestic suppliers and locally operating foreign-owned firms.

An increasing number of local content requirements have been included in laws, regulations and contracts in the recent past, in particular in the extractive sectors in order to build upon their expansion when the price of commodities was especially high. For many years, strong local content requirements have been the dominant policy instrument to increase or preserve the domestic added value and support linkages between multinationals and Kazakhstani companies.

However, extensive and relatively inflexible local content requirements have added significantly to the administrative costs of doing business in Kazakhstan, especially because local suppliers often lack certain skills, technology or sufficient quality to serve multinationals locally (OECD, 2012; 2013a; 2016c). They are poorly co-ordinated with actions which would guarantee that there is adequate local supply for the goods needed. Moreover, these requirements have often been combined with administrative restrictions

for hiring expatriate staff, which has served as a deterrent for FDI. The National Agency for Local Content Development was founded in 2010 to co-ordinate this system, but it seems to have limited resources or power to monitor and co-ordinate.

Recently, however, primarily because of accession to the World Trade Organization, Kazakhstan has moved away from such policies. The country has started to adopt new legislation and regulations which modify and phase out earlier local content requirements, especially in the field of labour. Derogation to the World Trade Organization's rules allows the use of local content requirements in extractive industries until 2020, under certain conditions.

In the absence of such regulation, it is crucial to develop alternative policy tools which can foster the creation of such linkages by developing skills, providing matching services and co-ordination (OECD, 2016c). Presently, some measures support linkages between large and small firms. The most prominent of these are the already mentioned financing, training and business advice measures provided mainly by DAMU, as well as the Business Advisory Services programme of the EBRD. Recently, the Ministry of Regional Development has developed a Partnership Programme to facilitate the development of links between "system-forming companies" (i.e. large state-owned enterprises rather than multinationals) by using a combination of financial and non-financial tools. Another attempt to adapt more flexible and efficient linkages policies is provided in the World Bank's "SME Competitiveness Program". The three sub-components of this initiative, which runs from 2015 to 2020, aim at developing linkages in established industries, newly developed industries and defining the strategic, regulatory and operational needs to implement financing of such linkages. The specific instruments applied for developing linkages include capacity building within the government, large firms and the SMEs, as well as technical assistance and the establishment of a national supplier database for use by large buyers (World Bank, 2015d).

As early as the 1980s South American countries and Malaysia put in place a number of initiatives in manufacturing to create greater linkages and integration between SMEs and the multinationals that located facilities in Malaysia. These programmes have progressively replaced former development strategies which made use of instruments such as protectionist measures and local content requirements for import substitution and development of domestic industry. International experience shows that successful programmes follow a hands-on approach, whereby SMEs are supported throughout the whole process of learning and transfers. This support is not only financial, but non-financial as well, following a well-structured partnership approach involving the three main stakeholders of these initiatives, i.e. multinationals, SMEs and the state (OECD, 2016f).

Technology extension services programmes

Technology extension services are critical for traditional SMEs that often lack knowledge of and access to readily available technologies that could improve their productivity or help resolve a particular problem at the later stages of their innovation cycle. Extension services are carried out by organisations, most often technology centres, with relatively close relations with universities and PRIs, focused on direct support to local firms. They aim to promote and support innovation in these firms through a variety of services, from information and awareness-raising activities, to training, R&D services and technology adoption. Given that such centres combine both commercial activities with public mission background work, the cost of extension services are covered by both

public and private funds: the government pays for the structural costs of the technology extension services, the public mission background work and part of projects with individual firms – possibly by a system of vouchers[28] – as in the Netherlands (OECD, 2014b) or Malaysia (OECD, 2016e).

Kazakhstan has developed such services almost exclusively in the agriculture sector, based on the system set during the Soviet era, when extension services were provided in each administrative area by technical staff appointed to organise specialised courses and training, and to introduce the new technologies originating in the agricultural research system (OECD, 2011a). From 2009 onward, Kazagroinnovation has started setting up a number of extension centres across the country. By 2013, this network consisted of ten centres with plans to establish one centre in each region. These centres provide different services, including free seminars on modern technologies, distance consulting by phone and direct consulting via farm visits. The centres aim at diffusing domestic and foreign best practices to farmers (OECD, 2013b). By 2014, over 12 000 local producers were trained by these centres (Strategy 2050, 2015). In addition to these centres dedicated to technology extension services, 160 knowledge dissemination centres have also operated as part of the branches of Kazagromarketing. In order to disseminate foreign best practices in particular, Kazagroinnovation has been operating an international extension centre in North Kazakhstan together with Hohenheim University (OECD, 2013b).

The Philip Morris Centre of Agribusiness offers an interesting example of a private initiative aimed at improving the productivity of farm workers as well as offering them entrepreneurship training (Philip Morris, 2015). Against this backdrop, a dedicated extension service centre was established in Almaty region in July 2013. The Agribusiness Center provides seminars for farmers on various topics, including for instance on advanced technologies of crops cultivation and the development of entrepreneurial skills. This centre also runs the programme "Farmers of Chilik", launched in 2014 to increase small-scale farmers' theoretical knowledge and practical skills. Small-scale farmers represent about 80% of all farmers' enterprises in Almaty region and face a number of challenges, including lack of resources, knowledge and skills. In order to resolve these issues, the centre has assembled a study group consisting of agriculture and innovation experts from the University of Florida as well as Kazakhstani agriculture and marketing specialists. The main objective was not only to train farmers, but also to implement the best practices throughout the whole farming cycle. Following public acknowledgement of the programme by President Nazarbayev, who encouraged co-operation with the Ministry of Agriculture (Witte, 2015b), the Agribusiness Center received government funding in 2016. In 2016, the programme received the award for the Most Innovative Education/Training Program in Kazakhstan from the American Chamber of Commerce (Philip Morris, 2015).

The design bureaus, operated by the NATD, aim to assist businesses in the creation of new or enhanced products. These bureaus conduct a wide range of activities, including assistance to technology transfer, consulting and engineering services, support to tests, and certification of new or improved products, etc. The majority of design work took place in the mining and metallurgical equipment field. Also, the bureaus were much more active in developing new designs relative to acquiring existing designs (NATD, 2014). The bureaus provide services and infrastructure for businesses in exchange for the payment of a royalty up to3% of the revenue generated by the products resulting from the co-operation with the bureaus. On the basis of the services rendered by design offices, between 2009 and 2016 the industrial enterprises sold products amounting to more than

KZT 8.1 billion. In 2015, the NATD announced that these design bureaus will be privatised (NATD, 2016).

Numerous international experiences provide valuable insights on the different possible options and the basic principles to increase their effectiveness.

Box 5.3. **Lessons learned from international experiences of technology extension services**

International experience suggests that the following principles should be adhered to when implementing a national technology extension service:

- The technology extension service should be capable of providing guidance, service quality control and analysis of results of activities and services offered at regional and local levels. The technology extension service should therefore be staffed with experts who are familiar with SMEs and the delivery of industrial extension services. It is likely that most academic researchers will not fit the purpose. Forcing academic researchers to be more relevant to industry by changing their incentives has failed in many countries. They can, and should, be part of the technology extension service environment but cannot be the core field engineers. The ideal candidates must have knowledge of technology and of the business environment of companies, as well as the ability to communicate in interpersonal relationships, since extension services are rendered by means of direct, face-to-face interaction with company leaders and employees.
- The desired impacts of the technology extension service should be achieved by leveraging local and regional resources through wide participation of and collaboration with all sectors of industry.
- The technology extension service should have the analytical capacity to study demand and monitor implementation and assessments at all levels.
- It should have sufficient administrative flexibility to link with the programmes of other agencies and integrate the technology extension programme into the broader (national) innovation policy framework.
- It should be demand-oriented and results-oriented in its entire operation.
- Evaluation of programme performance and its impact should be systematised.

It is recommended to start with a pilot project, with some modularity in the implementation of programme components to assess the most promising combinations before taking on the large-scale programme.

Examples of technology extension services are, for instance, the Japanese technology service centres (offer a specific menu of services in every prefecture), the Canadian Industrial Research Assistance Program (makes field engineers available in every province), the Manufacturing Extension Partnership in the United States (supports centres in every state), productivity promotion centres in China (2 200 public productivity promotion centres across the country assisting SMEs), the French *Réseaux de développement technologique* (structuring industries, strengthening SME performance, attracting foreign investors, in every region). Some countries, such as Germany, the Netherlands, Scotland and more recently Malaysia, strengthen such organisations by supporting companies who request their service, notably through a system of vouchers.

Source: Rogers (2013), "Technology extension services", https://www.innovationpolicyplatform.org/sites/default/files/rdf_imported_documents/TechnologyExtensionServices_0.pdf.

Synthesis

The main achievements and remaining challenges of the dedicated support measures that aim to raise the domestic business sector innovation capability are presented in Table 5.10.

Table 5.10. **Achievements and challenges in public policies aiming to raise the domestic business sector innovation capability**

Achievements and progress	Remaining challenges
Overall	
• Comprehensive portfolio of instruments to support innovative domestic firms, in particular to small firms	• Limited scale and scope of most instruments • Lack of transparent monitoring and evaluation
Innovation grants	
• Significant reforms of the NATD grant schemes, including the consolidation of grant types, the introduction of co-financing, cutting the administrative burden, easing sectoral restrictions and speeding up the process • Ambitious objectives of the NATD for performance in future years, reflected in the agency's key performance indicators • Despite the limited number of grants, significant results reported by the NATD (746 new jobs, including 343 in start-ups, resulting from 2015 grants) • DAMU innovation grants linked to business training and other services, in line with the specific needs of beneficiaries, small businesses and entrepreneurs in major cities and in regions	• Limited number of innovation grants allocated by the NATD in practice
Other financial and technical specific support to small and medium-sized enterprises	
• Dedicated programme to support domestic SMEs ("Business Roadmap 2020") • Numerous training programmes organised by DAMU and other organisations such as the National Chamber of Entrepreneurs of Kazakhstan • Extensive networks of DAMU's centres for entrepreneurship and regional offices to provide technical assistance and advisory services to local businesses • Investment to improve the level of capabilities of the business advisors in this extensive network, notably with the support of the World Bank and the European Bank for Reconstruction and Development • Uncertainty about the future of NATD industry design bureaus due to their potential privatisation	• Various facilities to provide subsidised loans and loan guarantees for SMEs, but are not linked to programmes supporting the upgrade of their innovation capabilities • Local content requirements are not adapted to domestic suppliers' capabilities, barely used to facilitate technology transfer and not linked to linkages programme to support relationships between multinationals and local firms • Limited monitoring and, especially, evaluation of support instruments • Underdeveloped extension services, in particular in manufacturing

Providing equity and venture financing

As demonstrated by the innovation surveys of many countries, access to finance is a key challenge for innovative firms. The availability of different types of early-stage funding including seed and venture capital is key for financing innovation and experimentation in the economy (OECD, 2010a; 2014a). Recent OECD work has also shown that the increased availability of early-stage venture capital is associated with stronger flows of resources (or reallocation) to more innovative firms (Andrews, Criscuolo and Menon, 2014).

Kazakhstan has made a substantial effort to establish such tools. Similar to other post-Soviet countries, private investment, including venture capital, was almost non-existent before 1990. Sensing great opportunities after the transition, a few venture funds entered Central Asia in the 1990s. The number of these funds decreased after the Russian crisis in 1998, and by 2000 only three international funds remained in Kazakhstan. Presently, private equity and venture financing plays a limited role in Kazakhstan. The ratio of private equity fund investments to GDP was 0.06% of GDP (average for 2008-12), compared to 0.17% in Brazil, and 0.23% in India and the Russian Federation. Similarly, venture capital investment amounted to 0.02% of GDP, compared to 0.07% in Brazil and 0.15% in India. These patterns are also reflected by the fact that in 2015 Kazakhstan ranked only 71st out of the 120 countries for which the "Venture capital and private equity country attractiveness index" was available (OECD, 2016d).

Table 5.11. **Instruments for financing innovative start-ups in Kazakhstan**

Stage	Tool	Provider	Type	Number of firms
Seed/early stage	Autonomous Cluster Fund	PIT	Investing via financial instruments – interest-free convertible loan (SAFE)	
Early/later stage	Venture funds	Kazyna Capital Management	Equity funding	29 (but not only start-ups)
Early/later stage	Venture funds	NATD	Equity funding	18 (but not only start-ups)
Early/later stage	Direct investment	NATD	Equity funding	8 (but not only start-ups)
Early stage	Planned venture fund	World Bank	Equity funding	Not started

NATD direct and indirect equity financing

NATD is a "pioneer" in the acquisition of venture capital experience through participation in the seven domestic and seven foreign venture funds. Currently, the NATD portfolio includes three domestic and three foreign venture capital funds, as well as eight investment projects. According to the results of the analysis of the investment portfolio of the NATD the overwhelming share of investment projects and domestic venture capital funds have lost most of their value or run the risk of doing so. The priority is currently to ensure the highest possible yield or at least minimise the possible loss. The above factors resulted in the suspension of the investment activities of the NATD in 2015 and the implementation of anti-crisis measures.

Kazyna Capital Management (KCM) venture funds

Kazyna Capital Management is a fund of private equity funds owned by the Baiterek Holding. It aims at attracting foreign capital to the Kazakhstani economy to provide equity financing for domestic firms. It assists in the implementation of government programmes by creating a private equity infrastructure through participation in the equity of domestic and foreign investment funds and project companies (KCM, 2016). According to its vision, its funds will help diversification, modernisation and the sustainable development of the economy. In 2016, its strategic portfolio consisted of 12 private equity funds, with KCM participation ranging from minority to a controlling

stake. The value of KCM's portfolio amounted to USD 2.7 billion with financial commitments of USD 610.5 million by the end of 2014. Between 2007 and 2014, the KCM fund participated in 40 investment projects with a total worth of about USD 925 million, from which nearly USD 280 million was invested into Kazakhstani firms in non-extracting sectors.

Significantly, most of the funds aim at attracting investment into priority sectors in general. Many of the investments made by these funds are not "classic" venture fund targets. Frequently the projects are aimed at technology transfer or modernisation without much novelty in the technology (Azylkanova and Sazonov, 2015). Some of these funds also "rescue" projects facing solvency or liquidity problems even if the activity is not innovative at all.[29] From KCM's portfolio, only the so-called "venture capital" funds aimed specifically at innovative industries and firms. In 2015, this fund amounted to USD 25.5 million and should increase to USD 210 million by 2023, representing about 10% of KCM's portfolio (OECD, 2016d).

Baiterek's venture fund is the largest existing venture capital fund in KCM's portfolio. It is fully owned by KCM and was founded in 2014 with a capital of KZT 12.7 billion. Although this fund is meant to invest in new projects pertaining to the priority sectors, its mandate also includes investment into risky projects involving restructuring to recover distressed assets. Other funds barely invest in innovative projects.

KCM's 12 funds have invested in 22 Kazakhstani projects altogether, less than 2 per fund, reflecting a small supply of possible projects. According to Almas Agibaev, the Chairman of the Board, the main obstacle for venture financing is the lack of potential innovative projects: from 100 projects considered in the initial stage only 2 to 3 can be funded. According to Agibaev, some of the key issues are problems with corporate governance, non-transparent ownership structures and the lack of sound financial management (OECD, 2016d).

The World Bank venture fund

One component of the recently started World Bank project "Fostering Productive Innovation" is the creation of an early-stage venture fund. The planned hybrid public-private fund will provide both grants for concept development (up to USD 15 000 per project) and equity financing up to USD 1 million per project. The venture fund will be created together with a private partner with the project contribution of up to USD 10 million (funding up to 50% of the total funds required). The total budget of this component is USD 13 million.

Based on the experience of earlier such initiatives in India or Turkey, the objective of this project is to create a demonstration effect that will attract the relevant investors to initiate, with the support from the state, a venture capital industry able to invest in risky early-stage projects. Given the very limited deal flow in Kazakhstan, the World Bank intends to also intervene on the project "supply side" by setting up a small group of privately managed deal flow agents who will assist start-ups in developing ideas into projects suitable for venture capital financing. The "deal flow" promoters would be tasked with assessing the technological viability of the project, estimating the commercial potential of the innovation and, finally, generating, presenting and marketing new information about the project.

The targeted total value of the fund is USD 16 million at the end of the five-year project. The fund is expected to be liquidated after eight to ten years, once it has created commercial returns (World Bank, 2014; 2016b).

Autonomous Cluster Fund "Park of Innovative Technologies"

As previously mentioned, the "Park of Innovative Technologies" (PIT), which started to operate in 2015, is supposed to channel the 1% payments of subsoil users to innovative projects and firms nurtured in the framework of the innovation cluster PIT (Almaty Tech Garden) on a venture capital basis. PIT works based on four principles. First, projects should involve private capital. Second, the cluster should operate as an open platform, consolidating demand for innovation with the supply of projects, research and financing. Third, it should utilise the existing infrastructure of PIT. Finally, it should provide support through the whole innovative cycle. The activities of the Autonomous Cluster Fund include both the management of infrastructure, financing of projects, and attracting potential investors and partners (OECD, 2016d).

In particular, PIT aims at creating a favourable environment for innovative companies. To achieve this, the cluster fund plans to utilise two sources of knowledge: 1) the knowledge available at its universities, research institutes and businesses; 2) key multinationals (so-called anchor companies) which may provide both knowledge and demand for innovative products. According to its ambitious key performance indicators, PIT should create 50 new technological companies, not less than 200 high-skilled jobs as well as 5 Centers of technology development on a co-financing basis by 2019.

However, as yet, the amount of investment of this fund in start-ups is limited because of the already mentioned implementation problems of the 1% subsoil user requirement and the shortage of projects. Its strategy to use the equity funding instrument in combination with both an incubation programme and an acceleration programme could be instrumental in dealing with the latter issue. The fund is also actively prospecting potential start-up projects in foreign countries.

Synthesis

Financing young, innovative firms is a key issue of innovation policy in every country. Market failures, including those due to externalities and asymmetric information, are significant sources of inefficiency in the financing of young firms, and government intervention can often help in such circumstances (OECD, 2010a; 2014a). This is especially the case in Kazakhstan given the limited availability of different funding tools provided by market actors (UN, 2012; World Bank, 2015d; Abdygaliyeva et al., 2007; OECD, 2016d). The main achievements and remaining challenges of the dedicated support measures and organisations that aim at providing equity and venture financing to business companies are presented in Table 5.12.

Table 5.12. **Achievements and challenges in equity and venture financing in Kazakhstan**

Achievements and progress	Remaining challenges
Overall	
• Wide range of instruments to provide equity and venture financing, in particular to small firms • World Bank project "Fostering Productive Innovation" to serve as a demonstrator of an early-stage venture public-private fund, active on both the supply (deal-flow) and demand (financing) side of start-up projects	• Few fully private funds; many funds with government ownership, which cannot reach sufficient scale • Most government-owned funds invest in ongoing, low-tech projects • Limited availability of early-stage finance, most funds focusing on expansion and development stages

Table 5.12. **Achievements and challenges in equity and venture financing in Kazakhstan** (*cont.*)

Achievements and progress	Remaining challenges
Overall	
• PIT provides start-ups with possibilities of private funding in combination with qualitative support (incubation and acceleration programmes)	• Lack of experts with required experience in technology-based companies and venture capital investment • Limited deal flow of potential high-tech projects

Enhancing technology transfer

The commercialisation of publicly funded research has raised increasing interest in all economies in the two last decades, and in Kazakhstan more recently. The reasons for this are manifold, from the increase of the national competitiveness and the need to find additional revenues to cover the increasing cost of scientific research to the growing share of business outsourcing of business R&D (OECD, 2015). These drivers are reinforced by the structure of incentives set by government at institutional and individual researcher levels and the programmes put in place to support technology transfer. In Kazakhstan more specifically, the economy's distance from the technology frontier, its strategic focus on diversification, which often require going beyond incremental innovation and drawing on the results of academic research, and the large number of SMEs with low productivity make both technology transfer and diffusion crucial. Many strategic documents, including the SPAIID and the SPIID, define technology adoption as a key priority. Key institutions and instruments promoting technology transfer were set up in the second half of the 2000s (Table 5.13).

Table 5.13. **Instruments to support incubation and entrepreneurship in Kazakhstan**

Instrument	Type	Aim	Modality	Target population
NATD Grant for Technology Acquisition	Financial	Support technology transfer	Reimburses costs of purchasing patents and/or licences	Firms
International technology transfer centres (NATD)	Non-financial	Support international technology transfer	Service provision	All firms
Technology commercialisation offices (NATD) (discontinued)	Financial and non-financial	Support introducing new products to market, increase deal flow for innovation financing	Service provision	Innovative projects, start-ups
NATD innovation competition	Financial and non-financial	Incentivise innovation and provide prizes and services for the best projects	Competition	Innovators
Technology Commercialisation Office (World Bank)	Financial and non-financial	Help administer World Bank programmes, support policy making, provide training in commercialisation	Administration, training and policy support	Innovative projects, start-ups, policy makers
Technology transfer centres at universities (World Bank), forthcoming	Non-financial	Support technology transfer via universities, increase deal flow for innovation financing	Service provision	All firms

NATD support to technology transfer

From the nine types of grants provided by the NATD in 2015, four relate, to a lesser or greater extent, to technology transfer elements, including the acquisition of technology, the introduction of new management and production methods as well as the employment of foreign engineers and consultants. The main limitation of these grants, however, is that – similarly to the whole NATD grant scheme – there are few applications and even fewer (less than 10-20 per year taken together) financed projects in these categories.

The NATD also supports 26 technology commercialisation offices established at universities.[30] Following the definition provided by the Law "on State Support for Industrial Innovative Activity" (2012), the technology commercialisation offices provide comprehensive services for the commercialisation of technologies (the search for and evaluation of technologies for commercialisation, market research and consulting services for the protection of IP, etc.). Commercialisation offices at universities are usually equipped with a small number of staff, sometimes only one or two persons partially financed by the NATD, including one staff specialised in patenting and licensing. After one year, financial support from the NATD was discontinued, as it was expected that either the office would achieve financial sustainability or the university would cover the costs of continuing the activities. According to anecdotal evidence, some of the offices had to concentrate on providing information and advice on how to prepare applications for NATD grants rather than promoting the commercialisation of the research results of their researchers. Data on a sample of 12 institutions show some successes regarding support for start-ups, as well as a significant number of identified inventions, some useful models and a very small number of patent applications (IAC, 2015).

The NATD has also been operating international technology transfer centres together with China (2014), France (2010), Korea (2011), the Russian Federation (2015) and the United States (2013). These centres were set up in co-operation with foreign governments (often at high level) and/or government agencies. For example, the Kazakh-Korean Centre was set up by the NATD with the Innopolis Fund, and the agreement was signed by the two presidents. The main aims of these centres are: 1) the dissemination of information and search for investors, partners and technologies; 2) the initiation and co-ordination of joint projects; 3) the identification of investors; and 4) the organisation of joint training and personnel development co-operation programmes. An important characteristic of the operation of these centres is that their services are complemented by the other activities of the NATD, namely, suitable projects identified are often facilitated with grants from the NATD. Two types of projects were implemented: 1) joint research projects; and 2) technology projects. At the end of 2014, the NATD reported eight collaborative research projects and six technology projects in mechanical engineering, mining, metallurgy, energy, biotechnology and pharmaceuticals (NATD, 2014). From the 18 active projects in 2015, mainly operated by the Kazakh-Korean Centre (7 projects) and the Kazakh-Russian Centre for Technological Cooperation (5 projects), 5 were also supported by NATD technology transfer grants (NATD, 2014). This international network of international TTOs, however, was discontinued in 2016. According to plans, the network will be reorganised into a unified technology transfer office within the National Institute for Development, which will implement the activities of the offices from Kazakhstan. The cited reasons are: 1) administrative issues (late signing of an agreement of the operation of centres); 2) increased co-operation with the Russian Federation; and 3) increased costs of maintaining the system after the devaluation of the tenge.

The accelerated development program for start-up projects, organised by the MID and NATD, was completed in October 2015. 345 applications from 16 countries were collected to participate in the programme of accelerated development "Technation". Ten teams of winners completed a two-month accelerated development programme in Kazakhstan. What is more, 8 teams out of 10 were sent to a 21-day programme of accelerated development of innovative start-up projects in the United States. Currently, all the winners' projects are successfully implemented. Moreover, the annual National Innovation Competition was organised in 2015, it was presented in the following categories: "Best Young Scientist"; "Best rationalization decision of the Year"; "Best system of support in the enterprise"; "Best Innovative Project among schoolchildren"; "Best journalistic material on the innovation."

799 applications for participation were received in total. The total prize amounted at KZT 18.6 million. Also, non-monetary rewards were organised in the form of a study tour to the United Kingdom for the winners in the nomination "Best Innovative Project among school children".

World Bank support to research commercialisation

As mentioned in Chapter 4, one component of the World Bank Technology Commercialization Project (2008-15) was to establish a Technology Commercialisation Office in 2013 to promote contacts and partnerships between the scientists and teams of selected projects who received innovation grants and to support the commercialisation of their research results. In addition, the Technology Commercialisation Office provided services for developing commercialisation strategies and offered training on business models and investor relations both for scientists and entrepreneurs, and helped to train a cohort of technology commercialisation managers (World Bank, 2014; 2015e; 2016a). During the project period, CRDF Global[31] provided methodological support and advice and organised trainings and workshops about commercialisation as well as a brokerage event to present sub-projects to companies. It also offered consultancy and advice for scientists and investors.

The Technology Commercialisation Office also provided advice to the government. It performed a technology audit of the state and perspective of the science and technology base in Kazakhstan which was due to be reported to the government by the end of 2015. The legal framework for commercialisation was reviewed and compared with international best practices. Based on these results, the Technology Commercialisation Office was able to play an important role providing input to the drafting of the Law "on Commercialisation of Scientific and Technological Activities" (World Bank, 2014; 2015e; 2016a).

As part of the World Bank's "Fostering Productive Innovation" project, which is the follow-up of the Technology Commercialization Project, a network of five to six technology transfer offices (TTOs) will be established at major Kazakhstani universities (for a cost of USD 10 million). The project aims at enhancing the capabilities of the existing TTOs by reaching a critical mass of projects and capabilities. In particular, the programme will finance goods and training for the existing offices. One aim of this project is to increase the deal flow to venture funds and grants, including these instruments in the same World Bank project (World Bank, 2014; 2016a).

Synthesis

The main achievements and remaining challenges of the dedicated support measures and organisations that aim at enhancing technology transfer are presented in Table 5.14.

Table 5.14. **Achievements and challenges in public policies aiming to enhance technology transfer in Kazakhstan**

Achievements and progress	Remaining challenges
Overall	
• Technology commercialisation offices created and supported financially and technically in several universities • First generation of successful initiatives important to diffuse learning and promote research commercialisation	• Insufficient magnitude and duration of support to technology transfer organisations • Limited demand for technology transfer services due to reduced deal flow, lack of capability in and culture of commercialisation of research results • Tendency to focus on commercialisation via patenting and licensing at the detriment of other channels for knowledge transfer from universities to business firms (mobility, collaborative research, contract research, etc.)
Specific instruments	
• Significant portfolio of support instruments dedicated to knowledge transfer operated by the NATD • The World Bank Technology Commercialization Project's technical support to researchers and policy makers with regards to the design and operation of the technology transfer system in Kazakhstan • Future support of the World Bank to a network of TTOs in major Kazakhstani universities, in the framework of the "Fostering Productive Innovation" project	• Uncertain future of the NATD network of international technology transfer centres • Limited number of deals and size of projects • Small financial and human resources of technology commercialisation offices

Building on local dynamics to enhance innovation and economic development

Research shows that innovation is a major factor affecting regional economic performance and regional policies and, more generally, "place-based" policies can be instrumental in supporting diversification and growth through innovation. Based on their intimate knowledge of the regional challenges and opportunities and proximity to local actors, public authorities and intermediary organisations are in a favourable position to support non-conventional forms of innovation originating from SMEs, including "low-tech" firms, as well as start-ups and entrepreneurs by offering them customised services. These target groups often require tailored support schemes that combine financial and non-financial (qualitative) measures. Regional authorities are also well-suited to play the role of a facilitator and broker to expand the scope, density, fluidity and sophistication of linkages, networks and other forms of co-operation (OECD, 2011b).

Over the past decades the national government of Kazakhstan has implemented a top-down approach with little focus on adapting investment to the needs and the priorities of regions, despite some steps towards decentralisation (OECD, forthcoming). In this context, the involvement of regions in the support to research and innovation has remained limited, although decentralisation has been more present in policy discourse in the past 15 years. Kazakhstan 2050, launched in 2011, included specific proposals to

devolve responsibilities and increase fiscal transfers to regions. Subnational authorities have also been granted authority in shaping the design and implementation of regional development policies and programmes (OECD, forthcoming). This is notably evidenced by the 2012 Law "on State Support of Industrial Innovative Activity", which provides regional authorities with the opportunity and the competence to actively participate in the innovation policy development and implementation process.[32]

Regional prioritisation in strategic programme

The government has not yet developed a strategy for regional development and smart specialisation, i.e. a plan to select a limited number of priority areas for knowledge-based investments, focusing on their strengths and comparative advantages.

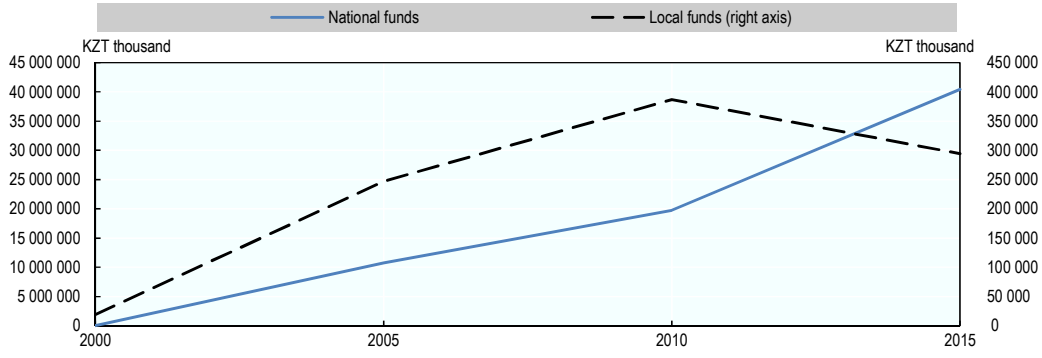
In the Strategic Programme for Innovative Industrial Development 2015-2019 (SPIID) (Republic of Kazakhstan, 2014), five priority sectoral programme activities were defined: metallurgy, chemical and petrochemical industry, engineering, construction materials, and the food industry. These 5 priorities were divided into 14 sub-sectors, which served as the level of reference for the prioritisation at the regional level on the basis of regional structure of specialisation and the experience from the implementation of the SPAIID during the period 2010-14. The two factors considered in this prioritisation process were the market prospects for each sector and the possibilities of this sector in Kazakhstan, including the current level and the prospects of development. No information is available yet on how these sectoral priorities have concretised in specific actions implemented at the regional level.

The programme "Forecast Scheme for Spatial Territorial Development (FSSTD) up to 2020", adopted in 2011 and updated in 2015, also supported competitive regional specialisation. Five city hubs were to become centres of national and regional co-operation in financial, technological and cultural areas and act as powerhouses for the rest of the region.

Regional funding of R&D

National funds account for the bulk of the funding of R&D, far ahead of any other source of funding, including regional funding until 2010 (Figure 5.13). Although the latter increased at an even higher pace than national R&D funding, it has remained about 100 times lower. Moreover, it has decreased in the last five years, which contrasts with the pattern observed in most other countries, where subnational authorities have gained additional competencies in research and/or innovation competencies.

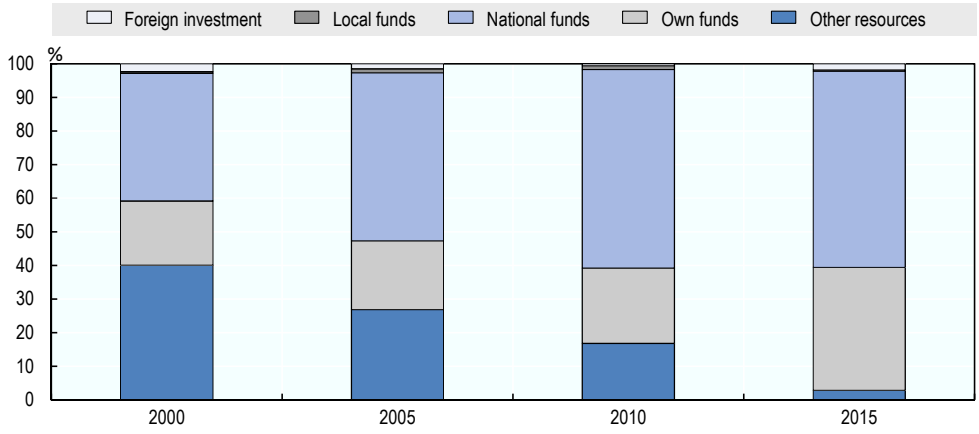
Figure 5.13. **National and local public funding of R&D**



Source: Committee on Statistics (2016), "S&T activities in the Republic of Kazakhstan", www.stat.gov.kz/faces/wcnav_externalId/homeNumbersScience?_afrLoop=4952775577197201#%40%3F_afrLoop%3D4952775577197201%26_adf.ctrl-state%3D18563fjho0_50.

The limited significance of local funds is even more striking when all sources of funds are considered. Their share in the total GERD evolved from 0.4% in 2000 to 1.2% in 2010, before reverting in 2015 to the level it was at in 2000. National funds have remained stable slightly under 60% since 2010 (Figure 5.14). Although there is very little information on the use of local funding of R&D, a clear pattern relates to the increase of the share of HEIs (receiving 47% of local funds in 2015) and, to a lesser extent, PRIs (33%), as beneficiaries of the funds.

Figure 5.14. **Breakdown of government expenditure on research and development by source of funds**



Source: Committee on Statistics (2016), "S&T activities in the Republic of Kazakhstan", www.stat.gov.kz/faces/wcnav_externalId/homeNumbersScience?_afrLoop=4952775577197201#%40%3F_afrLoop%3D4952775577197201%26_adf.ctrl-state%3D18563fjho0_50.

Place-based support to innovation

Place-based policies to foster innovation have become increasingly prominent in many advanced and emerging countries in order to benefit from the numerous positive effects of geographic proximity between innovation actors and, more generally, build on local dynamics. Among the most frequent are the technology parks and the various forms of clusters (OECD, 2015).

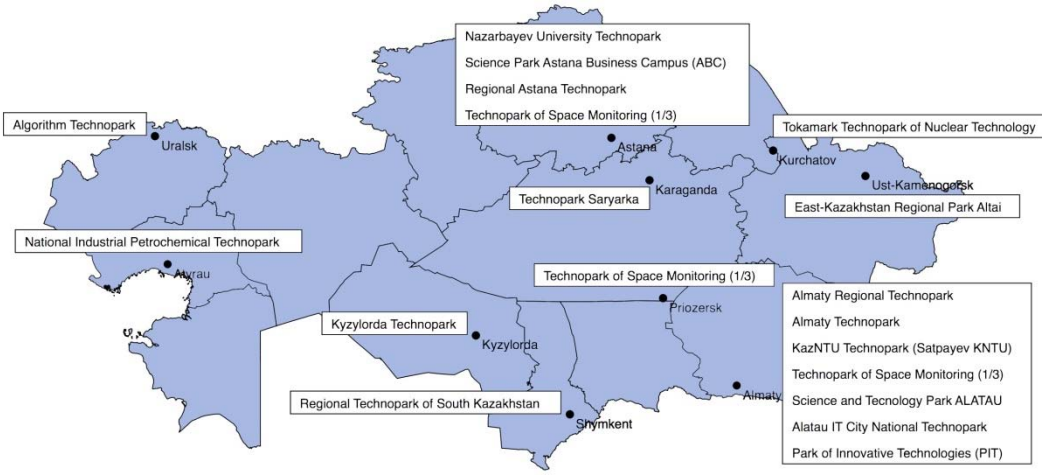
Table 5.15. **Place-based instruments to support innovation in Kazakhstan**

Instrument	Type	Aim	Modality	Target population
Technology parks	Non-financial	Service provision	Provide SMEs with business services, information and advice	All firms
National, regional and territorial clusters	Non-financial	Service provision	Provide SMEs with business services, information and advice	All firms

Technology parks

Nineteen technology parks operate in Kazakhstan, 11 of which are located in Astana and Almaty, some of which (8 in 2014) are operated by the NATD (OECD, 2016a).

Figure 5.15. **Map of technology parks in Kazakhstan active in 2015**



Source: OECD (2016f), "OECD Kazakhstan: Innovation Policy for Competitiveness (IPC) project – the Kazakhstan Commercialisation Compass".

Although according to the Law on "State Support for Industrial Innovative Activity" (2012) the main activity of technological parks is business incubation, they in fact perform a wider range of activities. They support co-operation, form regional scientific and industrial infrastructure, and provide facilities for the implementation of innovative projects and technology commercialisation (UN, 2012).[33] Recently, as part of the new privatisation plans, the NATD attempted to sell its share in the techno parks. A number of largely unsuccessful attempts were made to sell the shares, but demand still seems to be lacking (MID, 2015b).

Clusters

The cluster approach was introduced in Kazakhstan in the 2000s, to better exploit the potential of the oil and gas industry (Porter, 2005) but also to try to diversify away from oil production. Clusters have since then become prominent in the policy debate, as evidenced by the works of the Institute of Economics under the MES and annual presidential addresses to the nation. They have served as a foundation for a range of policy tools in Kazakhstan, notably in strategic plans such as the 2010-14 and 2015-19 State Programs of Accelerated Industrial and Innovative Development of the Republic of Kazakhstan. As discussed in Chapter 4, two "research-oriented clusters" have become quite important recently in Kazakhstan's innovation system, i.e. the "Park of Innovation Technologies" (PIT), which attempts to build an innovative ecosystem based on the locational advantages of Almaty, and the 1% paid by subsoil users and Astana Business Campus Science Park, which will be built around Nazarbayev University and should open its doors in 2018.

More generally, there are four main types of clusters: national clusters, autonomous innovative clusters, and the bottom-up regional and territorial clusters:

- So far, only one national cluster has been established (in 2015) by the government and the state-owned enterprises operating in the oil and gas sector. This cluster is divided into three subclusters: "Engineering for the Oil and Gas

Industry" (WKO), "Services to the oil and gas industry" (Mangystau) and "Oil and oil-gas" (Atyrau).

- Regional clusters have emerged independently or have been established with some form of support from the state or regional authorities in various eastern and central regions (see Figure 5.15). Some of these clusters are built upon technoparks and SEZs. However, most of these regional clusters operate in various agricultural sectors (meat, fish, horticulture, grain processing, etc.). Very little information is available on the cluster partners and the type of services provided by the cluster organisation, if any.
- The SPIID programme planned for the creation of three territorial clusters in market-oriented sectors of the manufacturing industry, which will be chosen by the results of bidding procedures (MID, 2015a). This new type of cluster will be established with support from the Kazakhstan Institute of Industry Development further to an analysis of the value chain in potential cluster business areas and the identification of the specific "collective" needs to be addressed via the cluster development.

Synthesis

The main achievements and remaining challenges of the dedicated support measures and organisations that aim at supporting innovation at regional level are presented in Table 5.16.

Table 5.16. **Achievements and challenges in regional policies to support research and innovation**

Achievements and progress	Remaining challenges
Overall	
• New competencies of local authorities in the implementation of programmes to support research and innovation activities defined in the 2012 Law "on State Support of Industrial Innovative Activity" • Prioritisation of industrial and innovative activities at the regional level in the SPIID programme	• Very low share of subnational funds in the total funding of R&D • Insufficient incentives for entrepreneurship and innovation set at the local level • Limited contribution of social-entrepreneurial corporations to regional development via innovative projects
Clusters and technoparks	
• Technoparks disseminated throughout the territory of Kazakhstan • Adoption of the cluster approach at the highest level of policy making, reflected in legal, strategic and programmatic frameworks • New "bottom-up" territorial cluster scheme planned in the SPIID programme	• Uncertain activities and performance of existing clusters due to lack of information and evaluation • Top-down approach to the creation of clusters • Unknown future of NATD-supported technoparks due to ongoing privatisation plans

Weaving international knowledge linkages

The benefits of international co-operation for a country at Kazakhstan's level of development are manifold. First of all, it is a rational strategy to build upon the knowledge accumulated for decades by countries "ahead of pack" and to avoid having to follow the same trajectory. This fast-track strategy allows, in the best case, a rapid transfer of knowledge, which is then adopted and adapted to the specific domestic needs. International co-operation is a way to access new technologies developed in advanced

and emerging countries. As in other countries, it also allows sharing the increasing costs of research infrastructures, which are key to scientific performance in some fields. Finally, it is a condition to addressing some of the most pressing global challenges, such as climate change and ageing. The challenges of international co-operation have also been well documented, from the crucial issue of the lack of absorption capacity of some of the least developed countries that try to bridge the knowledge gap to cultural problems and political contingencies.

International co-operation is firmly rooted in Kazakhstan's strategies, legal framework, and STI programmes and schemes. The legal basis for universities' international co-operation activities was laid by the Law "on Education" and the Law "on Science". The international dimension is also prominent in the main state programmes that serve as overarching strategic frameworks in the area of education and innovation-based economic development. The Astana Economic Forum[34] and the EXPO 2017 "Future Energy"[35] also show the extent of the government's ambition with regards to the internationalisation of Kazakhstan's STI system.

Co-operation with international organisations

Co-operation between Kazakhstan and the European Union is grounded in the areas of research and innovation through the Partnership and Cooperation Agreement of 1999 and the Enhanced Partnership and Cooperation Agreement between the European Union and the Republic of Kazakhstan signed in 2016[36]. The new agreement provides an all-encompassing framework for all kinds of STI collaborative initiatives between the European Union and Kazakhstan.

Kazakhstan has been participating in EU research, technology and innovation activities for more than 20 years (Magzieva, 2015). Its co-operation with the European Union started in 1995 with the signature of the Agreement of Scientific Cooperation between the government of Kazakhstan and the International Association for the Promotion of Cooperation with Scientists (INTAS) from the New Independent States. From the start of Kazakhstan's involvement in the INTAS until 2006, more than 220 teams of Kazakhstani scientists – co-funded by the European Commission with about EUR 15 million in total – performed collaborative projects together with European partners (Magzieva, 2015). The funding also encompasses some projects funded under the specific programmes for international co-operation of the EU's Fifth and Sixth Research, Technological Development and Demonstration Framework Programmes. The INTAS was an important learning experience for Kazakhstan – first for the participating scientists but also for the responsible ministry and the National Information Points implementing an efficient approach for participating in European research and technology programmes.

Since the foundations of the International Center for Science and Technology (ICST), another collaborative programme with the European Union of more than USD 1 billion has been invested in the support of more than 2 000 R&D projects and more than 70 000 tax-free grants to former weapons scientists. In 2015, the ICST's headquarters were moved from Moscow to Astana's Nazarbayev University. Funds were shared as follows: 75.2% to the Russian Federation, Kazakhstani scientists received the second largest share of funds at 8.5% (USD 75.7 million) on the basis of calls for proposals and peer review followed by Armenia, Georgia, Belarus, Kyrgyzstan, Ukraine and Tajikistan (ISTC, 2015).

Kazakhstan also has scientific collaboration in the framework of the Organisation of Islamic Cooperation. It uses its membership for a spectrum of initiatives in the area of STI, such as for buying scientific equipment with a specific grant from the Islamic Development Bank and attracting students from other member countries.

Research and education-related bilateral agreements of Kazakhstan with other countries

International co-operation in research and education is addressed in several bilateral agreements between Kazakhstan and Central Asian, Asian and European countries, as well as with the United States. Kazakhstan also has specific agreements covering education, higher education, and science and technology with Eastern European and Central Asian countries. Most important are the agreements with the Russian Federation, Belarus, Ukraine and Tajikistan (IncoNet CA, 2016). Relations with Latin America and Africa are in a developing stage.

Two of the most important bilateral co-operation agreements, in financial terms, with the United Kingdom are:

- The British Council Newton-Al-Farabi Programme provides significant funds for promoting research co-operation between Kazakhstan and the United Kingdom through joint workshops, travel grants, postgraduate mobility and institutional links. In 2014 and 2015 more than GBP 3 million were awarded.
- The Industry-Academia Partnership Programme is an agreement between the Royal Academy of Engineering and the NATD to strengthen collaboration in engineering curricula and educational programmes, as well as collaborative research and knowledge-sharing Awards provide funding of between GBP 1 000 and GBP 50 000 for applying consortia to conduct activities in support of the programme's objectives. The deadline of the first call was January 2016.

The internationalisation of Kazakhstan's universities

The leading universities in Kazakhstan are internationally oriented and nurture close co-operation with foreign partner universities. This trend is in line with the government strategy, as it is clearly apparent in the establishment of Nazarbayev University. The new university is international "by constitution", as a significant proportion of its teaching and academic staff comes from the best foreign universities and all departments, centres and laboratories have woven close co-operative links with international research and education partners (Nazarbayev University, n.d.). Nazarbayev University also has an external international mission as it has been tasked to stimulate the international orientation of Kazakhstan's system in education, research and innovation by promoting partnerships and co-operation. Other universities also have the international dimension integrated in their structure or legal status. The Kazakh National University Al-Farabi, for instance, has a strategy for international co-operation and a specific department[37] supporting related activities of students and academic staff.[38] The university also has numerous partnership agreements with foreign universities and is active in Erasmus+ and was active in Erasmus Mundus and TEMPUS.

The international Kazakh-Turkish University has the official status of "international university". In the other institutions, the international dimension is developed and realised to different extents. Some of them, such as the Kazakh-German University, receive some financial support from partner countries. Their potential for playing specific roles in a

national internationalisation strategy for the higher education system in Kazakhstan could be explored.

The Bolashak Programme, which aims at training in an international context highly qualified professionals capable of conducting the necessary reforms in Kazakhstan and representing the country in the international arena, provides further evidence of the priority Kazakhstan has put on human resource development by educating its youth at the best universities in the world. High-performing students from Kazakhstan get the chance to engage in graduate studies in the best foreign universities. Upon completion of their studies, Bolashak scholars are required to return to work in Kazakhstan for at least five years. The OECD *Review of Higher Education in Kazakhstan* (OECD, 2017) assessed the Bolashak Presidential Scholarship Programme as an international best practice. Its contribution to the development of the country is enhanced by the Bolashak alumni network that is now well positioned in all sectors of the economy. This added value should be reinforced following the recent strengthening of the links of the programme to national priorities.

Box 5.4. **The Bolashak Programme**

The Bolashak ("Future") Scholarship Programme for international study was established in 1993 by decree. This initiative is designed to train future leaders in business, international relations, law, science, engineering and other key fields.

When the strategies "Kazakhstan 2030" and "Kazakhstan 2050" were launched, the programme was adapted in order to contribute to achieving their objectives, in particular in the context of improving governance and administration in Kazakhstan.

In 1994-97, Bolashak scholarships were granted primarily to the graduates of Kazakhstani universities holding degrees in economics and humanities. At that time, the number of graduates of technical faculties among the scholarship holders was quite small mainly due to the lack of proficiency in English. However, later on, the rules were changed and applicants with technical and engineering degrees were permitted to partake in the competition for the Bolashak scholarship regardless of the foreign language proficiency requirement.

In the first years of the programme, scholars studied in four countries only – France, Germany, the United Kingdom and the United States. Later, the geography of the countries was expanded first to 13 countries and now the programme works with 630 recommended universities in 32 target countries in Asia, Europe and the United States. Countries and universities are selected in accordance with their expertise in areas important for Kazakhstan.

While 780 scholarships were awarded to study in 13 countries from 1994 to 2004, President Nazarbayev announced in 2005 the goal of sending annually 3 000 young talented Kazakhstanis abroad to study at the leading HEIs of the world. The basis for such an ambitious target was the acknowledged need of national specialists in key sectors of the economy. Following the presidential announcement, 2 574 scholarships were awarded in the academic year 2005/06 – a record in Bolashak history.

In 2005, the JSC Center for International Programs was established[1] to implement the Bolashak Programme and a range of other international programmes on personnel training, retraining and qualification upgrading abroad. The centre currently has representative offices in China, Germany, Great Britain, the Russian Federation and the United States.

Since 2011, the training of bachelors, for which content was defined in co-operation with the employer and the centre, was discontinued and a new programme-targeted approach was introduced for training specialists in accordance with specific requests from an employer.

Box 5.4. **The Bolashak Programme** (*cont.*)

Since 2014, the requirements for language proficiency have been increased, pursuing the aim of improving the quality of the selection process. In addition, arts and mass media professionals have been established as new categories for master programmes. At the same time, the requirements for foreign host universities, defined in terms of minimal positions in international university rankings, have been raised.

Since 2015, candidates with Kazakhstani master/PhD degree can access foreign master/PhD programmes. The new Split-PhD programme has been integrated in the educational process of state universities chosen for training professionals. Also, scholars take language courses in accordance with the "6+6" model – 6 months in Kazakhstan, another 6 abroad.

Since the establishment of the programme, Bolashak scholarships have been granted to 11 126 Kazakhstan citizens for study in top universities abroad. At the VIII International Going Global Conference in Miami in 2014, "Bolashak" was named the best among 11 academic mobility programmes.

1. See: http://bolashak.gov.kz/en/o-kompanii/o-kompanii/249-about-cip.html.

Source: JSC Center for International Programs (n.d.), "History of the program", http://bolashak.gov.kz/en/o-stipendii/istoriya-razvitiya.html.

Dual degree programmes are of specific importance for the internationalisation of higher education, providing students with the opportunity of studying abroad and benefiting from experiences in other countries. About 2 000 students from the Kazakh National University Al-Farabi study abroad annually, taking language courses in other countries or embarking on research projects at partner universities. Every year, more than 600 members of academic or administrative staff attend international conferences or follow invitations to visit institutions of higher education and research abroad.

The OECD *Review of Higher Education in Kazakhstan* (OECD, 2017) has made an assessment of the current limitations and identified some signs of positive developments with regards to the internationalisation of Kazakh universities.

Box 5.5. **Specific issues of international co-operation of universities, research institutes and individual researchers**

Building on the OECD higher education review and insights from the present exercise, some deficits and positive aspects can be presented:

- The Bologna process has been implemented with limited international orientation and a lack of acknowledgement of the need for developing special skills for the knowledge society, such as entrepreneurship, innovation management, interdisciplinarity.
- Limited consideration is given to global aspects in curricula.
- Except for Nazarbayev University and KIMEP, there is only a small number of international academic staff.
- There is a limited number of foreign students at universities.
- There is a need for professionalisation of support services for international mobility and co-operation; no national network of internationalisation officers; few contacts at international level.

Box 5.5. **Specific issues of international co-operation of universities, research institutes and individual researchers** (*cont.*)

- Proficiency in English is a huge challenge. Without English, internationalisation beyond the Russian-speaking domain will not be possible.

On the positive side, the following points can be mentioned:

- Kazakhstan is very well organised for participating in European research and innovation activities founded on experienced national contact points. The positive experience of FP7 can form a basis for intensifying the involvement in Horizon 2020 when national co-funding is provided.
- The experiences of research institutes and universities in the INTAS and International Science and Technology Center (ISTC) have the potential for enhanced co-operation with foreign partners.
- The yearly progress in international university rankings contributes to greater visibility of leading Kazakh universities.
- The establishment and operationalisation of quality assurance in higher education is a step in the right direction and will contribute towards strengthening and consolidating the higher education system, including making it better prepared for international co-operation.

Source: OECD (2017), *Higher Education in Kazakhstan,* Reviews of National Policies for Education, OECD, Paris.

Synthesis

The main achievements and remaining challenges of the dedicated support measures and organisations that aim at promoting international knowledge linkages are presented in Table 5.17.

Table 5.17. **Achievements and challenges in the internationalisation of research activities**

Achievements and progress	Remaining challenges
Overall	
• Genuine commitment of the government to support the internationalisation of research activities via several multilateral and bilateral co-operation programmes • Numerous international linkages of the major Kazakhstani universities • Nazarbayev University created as an international university • Higher visibility of the major Kazakhstani universities in international university rankings	• Research system still insufficiently internationalised despite efforts and progress
Higher education	
• Success of the Bolashak Presidential Scholarship Programme • Kazakhstan's participation in European research and innovation activities, founded on experienced national contact points • Quality assurance process in higher education implemented in Kazakhstan on the basis of international experiences • Very ambitious presidential initiative to support the transition to trilingual education of all schools by 2018	• Several structural problems with regards to internationalisation of higher education programmes (e.g. limited international orientation of the implementation of the Bologna process in Kazakhstan, limited numbers of foreign students at universities, etc.)

Notes

1. The law was repealed 1 January 2016 and its text has been integrated – with some adjustments – into the Entrepreneurial Code of the Republic of Kazakhstan (2015).
2. Innovation is defined in Article 142.2 as follows: "Innovation is the introduction in the use of any new or considerably improved product (the goods or service) or the process, the new method of marketing or the new organizational method in business practice, the organization of workplaces or external relations", which is practically identical with the definition given by the *Oslo Manual* (OECD, 2005).
3. In 2006, the President had defined the goal of Kazakhstan becoming one of the "50 most competitive, dynamically developing countries in the world".
4. In 2003, the 40 institutes under the aegis of the National Academy of Sciences were transferred to the MES. Since then about half have closed down or merged with other institutes (NAP, 2007).
5. See, for example, Ministry of Education and Science and National Academy of Science of the Republic of Kazakhstan (2016).
6. Gross domestic product growth rates (constant prices): 1.16% (2015); -0.76% (2016); 0.56% (2017); 1.32% (2018); 1.74% (2019); 2.94% (2020) (IMF, 2016).
7. From KZT 21.5 billion in 2005 to KZT 69.3 billion in 2015 (NAS, 2016).
8. Sheehan and Wyckoff (2003) list the main policy areas where structural reforms are needed to achieve high R&D intensity targets, with the bulk of the increase funded by private sources: improving the environment for innovative businesses, enhancing the ability of research institutes and universities to serve as sources of industrially-relevant, fundamental research; and cultivating, attracting and retaining high-skilled workers.
9. Law "on Science" (2011), Articles 25, 26 and 27.
10. The number of these organisations remains itself unclear. According to information from the Science Committee, 126 research institutes and 87 other research organisations (213 in total) received grant, basic and programme-oriented funding during the period 2012-15. According to information from the NCSTI, 119 research institutes and 47 research centres (166 organisations) received grant funding during the period 2011-15. All calculations in this chapter are performed on the basis of data originating from the Science Committee of Kazakhstan.
11. Neither Nazarbayev University nor private universities receive any basic funding.
12. Taxpayers can claim a corporate income tax deduction for their R&D expenses multiplied by a coefficient of 1.5.
13. Important amendments to the Tax Code have been added in 2016.

14. Research organisations are defined by the Law on Science as those whose principal activity is research (Law "on Science", Article 8/1). The term "principal activity" is described in more detail by the Tax Law as activities that represent "at least 90% of the total annual income" of the concerned organisations (Tax Code, Article 135).

15. Tax Code, Article 150.

16. In particular, a firm is eligible for the tax exemption if: 1) it is registered by the tax authorities operating in the SEZ; 2) it has no structural subdivisions outside the SEZ; and 3) at least 90% of its aggregate annual income originates from activities (sectors) which are consistent with the objectives of the particular SEZ (these activities are defined by the Tax Code, Article 151-4 specifically for each SEZ).

17. 100% reduction of corporate income tax as well as the exemptions from all taxes and levies on land plot usage as long as they generate at least 70% of their annual income from such activities (Tax Code, Article 151-4).

18. State ownership of mineral wealth is declared in the Constitution while mineral use had been regulated by the Law "on Petroleum", dated 28 June 1995 and by the Law "on Subsoil and Subsoil Use", dated 27 January 1996.

19. Article 4/1, 2010 Law on "Subsoil and Subsoil Use".

20. Law "on Subsoil and Subsoil Use" (Law of the Republic of Kazakhstan dated June 24, 2010, No. 291-IV "on Subsoil and Subsoil Use"), Article 76/1/12-1.

21. The tax law ("Code of the Republic of Kazakhstan on Taxes and Other Obligatory Payments to the Budget") was also appended to include this possibility with Article 108-1: Deduction of expenses of a subsoil user to transfer money into an autonomous cluster fund.

22. About 40 start-ups are expected to participate in the acceleration programme in the 2016 session.

23. Start-Up Chile is a programme created by the Chilean government to attract early-stage, high-potential international entrepreneurs to create their start-ups in Chile. The selected start-ups receive a grant amounting to about USD 30 000 ("Seed" programme) or USD 90 000 ("Scale" programme), in addition to qualitative support, working spaces, etc. (see Start-Up Chile, 2016).

24. Estimate based on the revenues of the mining sector of KZT 12 200 billion in 2014 (for a volume of production in the mining industry of KZT 11 060 billion), according to data from the Committee on Statistics. See also Yelkhan (2015); Dzhantureyeva (2012); Elyubaeva (2016).

25. The surge of grants in 2011 results from the fact that the NATD implemented a specific R&D grant scheme ("Implementation of development-design work and/or risky research [R&D]"). One hundred three such grants in the amount of nearly KZT 200 000 were awarded that year. No data on NATD grants are available for 2012.

26. Data provided by NATD to the OECD in January 2017.

27. The programme was approved by Decree of the Government of Kazakhstan No. 168 dated 31 March 2015.

28. Innovation vouchers are small lines of credit provided by governments to SMEs to purchase services from public knowledge providers with a view to introducing

innovations (new products, processes or services) in their business operations (OECD, 2010b).

29. The PARASAT Holding also owns a venture fund but most likely it does not operate at a large scale.

30. The 26 commercialisation offices have been established in 16 universities, 5 research institutes and 5 technoparks (NATD, 2014: 36).

31. CRDF Global is an independent non-profit organisation that promotes international scientific and technical collaboration through grants, technical resources, training and services. CRDF Global is based in Arlington, Virginia with offices in Moscow (Russian Federation), Kyiv (Ukraine), Almaty (Kazakhstan) and Amman (Jordan). The mission of CRDF Global is to promote peace and prosperity through international science collaboration. For more information see CDRF Global (2016).

32. The Law "on State Support of Industrial Innovative Activity" (2012) notably entitles local executive bodies of regions as well as the cities of republican significance and the capital to "ensure the coordination of the implementation of branch programs in the sphere of industrial and innovative activity within the relevant territory".

33. This also includes a detailed description of the various clusters.

34. "Innovation and technology" and the "knowledge economy" were two focus areas at the 2016 Astana Economic Forum. International experts were able to discuss with Kazakhstani officials and stakeholders key issues such as energy futures, sustainable development, the challenges of the digital divide, and the roles of modern universities in innovation and entrepreneurship.

35. About 100 countries have committed their participation to the EXPO 2017 "Future Energy" that will be held between 10 June and 10 September 2017 in Astana. The renowned forum will convene world experts to take stock of the global energy situation and develop visions for the future.

36. The 1999 and 2016 agreements are available respectively at: http://eeas.europa.eu/delegations/kazakhstan/eu_kazakhstan/political_relations/agreements/index_en.htm and https://ec.europa.eu/anti-fraud/sites/antifraud/files/kazakstan_en.pdf.

37. See: www.kaznu.kz/en/326/page for a description of the department and its activities.

38. See: www.kaznu.kz/en/16239/page for examples of academic mobility to and from European and other partner universities.

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Annex A

List of institutions, laws, strategies and programmes

Institutions:

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Annex B

List of people interviewed during fact-finding missions

Organisation	Name	Designation
Al-Farabi Kazakh National University	Darkhan Akhmed-Zaki	Vice-Rector
Al-Farabi Kazakh National University	Tlekkabul Ramazanov	Vice-Rector for Research and Innovation Affairs
Almaty Tech Garden	Askar Sembin	CIO
Almaty Tech Garden	Kassymkhan Kapparov	
Almaty Tech Garden	Leonard Bari	Portfolio Manager
Almaty Tech Garden	Sanzhar Kettebekov	CEO
Almaty Technological University	Maigul Kizatova	Vice-rector on Science and Innovation
American Chamber of Commerce in Kazakhstan	Doris Bradbury	Executive Director
Astana Innovations	Bakhtiyar Khakim	Head, Innovation Support Center
Astana Innovations	Margulan Tustikbayev	Managing Director, Smart Astana Project
Astana Innovations	Bakhtiyar Zhakupov	Chief Manager, Smart Astana Project Center
Astana Innovations	Nurlan Kurmalayev	Vice Chairman of the Board
Center for Commercialization of Technology	Erik Azulay	Chief Expert
Center for Commercialization of Technology	Ruslan Matkarimov	Commercialization Manager
Center of Physico-Chemical Methods of Research and Analysis, CPCMRA	Michael Nauryzbaev	Director
Center of Physico-Chemical Methods of Research and Analysis, CPCMRA	Bulat Kenessov	Deputy Director for international relations
Center for transfer and commercialisation of agrotechnologies “Agroinnovation”	Kurmangazy Omarov	Director, Technology localisation
Center for transfer and commercialisation of agrotechnologies “Agroinnovation”	Zeilhan Tagaev	Intellectual Property Manager
Committee on Statistics	Sara Nukusheva	Chief Expert, Division of Energy and Service Statistics
Committee on Statistics	Zifa Yakupova	
Committee on Statistics	Dina Suleimanova	Director, International Cooperation Division
Delegation of European Union to Kazkahstan	Thierry Deloge	Project Manager, External Relations, Director General for International Cooperation and Development
Delegation of European Union to Kazkahstan	Karmen Velichkov	Head of Political, Press and Information Section
Deloitte	Mark Smith	Managing Partner, Caspian Region
Eltex Alatau	Nurlan Zhanibekov	CEO
Ernst & Young	Erlan Dosymbekov	Managing Partner, Kazakhstan and Central Asia
Ernst & Young	Natalya Kozlenkova	Director, Brand Marketing, Communications
Eurasian National University	Malik Kokarev	Chief Specialist, Commercialization Department
Eurasian National University	Abzal Taltenov	Doctor of Chemistry, Professor
Eurasian National University	Berik Tankimov	Manager
Eurasian National University	Aigerim Shilbekova	Director
Eurobak	Julie Kussidi	Executive Director, Board Member
Institute of Polymer Materials and Technology	Sarkyt Kudaibergenov	Head of Laboratory, Director of the Institute
JCS Center of Earth Sciences, Metallurgy and Ore Benefication	Bagdaulet Kenzhaliyev	President

Organisation	Name	Designation
JSC National Company "KazMunayGas"	Mukhit Saurambayev	Managing Director for Geology
JSC National Company "KazMunayGas"	Pavel Markman	General Director
JSC National Company "KazMunayGas"	Zhaksybek Kulekeyev	Adviser
JCS National Managing Holding "Baiterek"	Daulet Yermekov	Head, Entrepreneurship and Innovation Department
JSC "Tau-Ken Samruk"	Kylyshbek Izbaskhanov	COO, Deputy CEO
JSC "Tau-Ken Samruk"	Damir Karim	Managing Director, Strategy and Business Transformation
JSC "Tau-Ken Samruk"	Elnar Kenzhaliyev	Managing Director of perspective development
JSC "Tau-Ken Samruk"	Mazhit Turmagambetov	Chairman of the Board
JSC Entrepreneurship Development Fund "DAMU"	Andrey Romanov	Director, Department of training and service support
JSC Entrepreneurship Development Fund "DAMU"	Serik Hamidullah	Manager, Department of Marketing and International Cooperation
JSC Information-Alalytic Center	Marat Kamzoldayev	Vice-president
JSC Information-Alalytic Center	Ainur Azhibekova	Project manager
JSC Information-Alalytic Center	Alan Utegulov	Expert
JSC Information-Alalytic Center	Sergey Gorlov	Expert
JSC Information-Alalytic Center	Murat Sartbayev	Consultant
JSC Information-Alalytic Center	Aina Adirbay	Manager
JSC Information-Alalytic Center	Serik Irsaliyev	President
JSC Information-Alalytic Center	Meirgul Alpysbayeva	Deputy Director, Department for Higher Education Development
JSC National Information Technologies	Ruslan Ensebayev	Chair
Karaganda State Technical University	Dmitriy Khrustalev	Director, SRI "New Materials"
Kazakh Agro Technical University after S.Seifullin	Aigul Nurmukhanbetova	Head, Commercialization Department
Kazakh Agro Technical University after S.Seifullin	Saltanat Meiramova	Director, International Cooperation and Multilingual Education Development Center
Kazakh-British Technical University	Timur Umarov	Acting Vice-Rector for Academic Affairs and Information Technology; Dean, Faculty of Information Technology
Kazakh-British Technical University	Zhanserik Ilmaliyev	Deputy Vice-Rector on Innovations
Kazakh-British Technical University	Kaiyrzhan Kozhaly	Deputy General Director, Institute of Petroleum and Information Technologies
Kazakh National Research Technical University named after K.I. Satpayev	Rinat Iskakov	Vice-Chancellor for Academic Affairs
Kazakh National Research Technical University named after K.I. Satpayev	Ainur Issayeva	Director, Center of International Cooperation and academic mobility
Kazakhstan Industry Development Institute	Gulzhanat Mukhambetkaliyeva	Chief Expert, Industrial Policy Center
Kazakhstan Industry Development Institute	Marat Idrissov	Deputy Chairman
Kazakhstan Industry Development Institute	Saltanat Jumabekova	Director, Center of industrial policy
Military and Technical Consortium	Aset Durmagambetov	Chief Science Specialist, Responsible Secretary
Ministry of Education and Science	Takir Balykbayev	Former Vice-Minister of Education and Science
Ministry of Education and Science	Lyazzat Kussainova	Deputy Chairman, Science Committee
Ministry of Education and Science	Rashitdin Kokenov	Head of division, Science Committee
Ministry of Education and Science	Didar Dossayeva	Chief Expert of Higher, Postgraduate Education and International Cooperation Department
Ministry of Education and Science	Zhanat Kukambayeva	Head of Strategic Planning & Coordination Division
Ministry of Education and Science	Nurdaulet Karakulov	Chief Expert, Finance Department
Ministry of Education and Science	Anar Esmakanova	Acting Chairman, Committee on Science
Ministry of Education and Science	Dinara Sekerbaeva	Acting Director, International Cooperation Division
Ministry of Education and Science	Elmira Asan	Main Expert, International Cooperation division, Department of Higher Education and International Cooperation

Organisation	Name	Designation
Ministry of Education and Science	Svetlana Ismagulova	Deputy Director, Department of Higher and Postgraduate Education
Ministry of Education and Science	Anara Yesmakanova	Deputy Chairman, Science Committee
Ministry of Education and Science	Amadyk Teleshov	Science Fund
Ministry of Education and Science	Anatoly Kim	Chief of Center of Project Management, Science Fund
Ministry of Investment and Development	Zhanibek Mukhmejanov	Head, Department of Technological and Innovative Development
Ministry of Investment and Development	Rakhim Oshakbayev	Former Vice-Minister
Ministry of Investments and Development	Ilyas Ospanov	Head of Innovative Development Policy Division, Technological and Innovative Development Department
National Agency for Technological Development	Zhumatay Salimov	Deputy Chairman
National Agency for Technological Development	Ainura Baikadamova	Development Expert, Center for Technology Transfer
National Agency for Technological Development	Baglan Sarsebayev	Office of Commercialisation of Technologies, National Center on Complex Processing of Mineral Raw Materials
National Agency for Technological Development	Aiman Kyrbassova	Expert
National Agency for Technological Development	Baurzhan Alin	Managing Director
National Agency on Development of the Local Content, NADLoC	Dmitry Usov	Deputy Director, Center of Subcontracting
National Analytical Centre	Dmitry Maskauskas	Deputy CEO
National Analytical Centre	Talgat Zhaminov	Deputy CEO
National Center for Biotechnology	Kasym Mukanov	Deputy Director General
National Center for Scientific and Technical Information	Tamara Kubiyeva	Director, Department of integration of scientific and technical information
National Center for Scientific and Technical Information	Kamarsulu Yeleukenova	Director, Department of formation of information resources
National Center for Scientific and Technical Information	Ivan Voitsekhovsiy	Director, Department of public relations and printing
National Center for Scientific and Technical Information	Yelena Golikova	Leading scientific specialist, Technology Commercialisation Division
National Center of Science and Technology Evaluation	Elena Zhevchenko	Expert
National Center of Science and Technology Evaluation	Arman Ashkin	Head, Foreign Evaluation Management Division
National Center of Science and Technology Evaluation	Asel Karbayeva	Expert
National Center of Scientific and Technology Information	Ruslan Zhangazy	Director, Technology Commercialization and International Cooperation Department
National Telecommunication Holding “Zerde”	Kuralay Yeleussizova	Vice Chairman of the Management Board
National Chamber of Entrepreneurs ATAMEKEN	Olzhas Ordabayev	Deputy Director, Human Capital Development Department
Nazarbayev University	Asylzhan Upasheva	Specialist of scientific park, NURIS
Nazarbayev University	Shigeo Katsu	President
Nazarbayev University	Kanat Baigarin	Vice-president for innovation
Nazarbayev University	Dennis de Tray	Advisor to the President, Board Member
“Parasat” Venture Fund	Baurzhan Imanaliyev	Board Chairman
“Parasat” Venture Fund	Shokan Azhikhanov	Investment Projects Manager
Parasat” Scientific Technical Center	Alexander Kim	Director, Technology Commercialization Center
Republican Collection of Microorganisms	Zakaria Kunsuly	Depity General Director of Science
Republican Collection of Microorganisms	Aslan Temirkhanov	Academic Secretary
Republican Collection of Microorganisms	Serik Shaikhin	Director, Laboratory of Genetics and Biochemistry of Microorganisms

Organisation	Name	Designation
Republican Collection of Microorganisms	Akhan Abzhalelov	General Director
Rio Tinto	Galym Alniyazov	Commercial Manager, Russia/Central Asia
Rio Tinto	Gary Hodkinson	Director, Central Asia District
Sovereign Wealth Fund Samruk-Kazyna	Ablezov Assan	Chief expert, Directorate of mining, smelting and power assets
Technology commercialization center	Daniyar Doskarayev	Director
Technology Commercialization Center	Abdilda Shamenov	Deputy Director General
Technology Transfer Development Center	Olzhas Bilyalov	Deputy Director
The Library of the First President of the Republic of Kazakhstan – Leader of the Nation	Mikhail Mironenko	Head, Strategic Research and Prognosis Office
The Library of the First President of the Republic of Kazakhstan – Leader of the Nation	Nurzhan Begalin	Lead specialist
World Bank	Yeraly Beksultan	Private Sector Development Specialist, Global Practice for Trade Competitiveness
World Bank	Adina Mamrayeva	Consultant, Global Practices for Trade and Competitiveness

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Kazakhstan is aware of the importance of innovation for its socio-economic development, including the diversification of its resource-based economy. Since the start of the millennium, Kazakhstan has put in place key components of a modern research and innovation system. This has helped improve scientific output and resulted in some successes in technology commercialisation. Further commitment and effort will be needed to strengthen innovation capabilities and make the most of Kazakhstan's advantages. This requires further reforms in order, notably, to strengthen the funding model of universities, intensify and broaden knowledge transfer, improve the governance of the research and innovation system, and increase the effectiveness of innovation incentives and policies, with a focus on implementation and evaluation.

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