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INNOVATION FOR SUSTAINABLE DEVELOPMENT REVIEW OF KYRGYZSTAN

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FOREWORD

Innovation is central to the United Nations 2030 Agenda for Sustainable Development and to economic development across the world. One of the most open and democratic countries in the region, with a strategic location, educated work force, strong legacy of applied research, competitive wage levels, ample natural resources, and vibrant and growing links with the neighbouring region, Kyrgyzstan is well positioned to benefit from untapped potential for innovation-led, sustainable growth.

This UNECE Innovation for Sustainable Development Review takes an in-depth look at a range of important factors that enable and promote innovation – including innovation performance, the economic structure, and relevant laws, policies, instruments, and institutions. In doing so, the review puts sustainable development front and centre, exploring how innovation can contribute not only to long-term economic growth, but also help address pressing social and environmental concerns. This includes building on a wide range of opportunities for Kyrgyzstan to catch up with more developed economies while avoiding, mitigating, or compensating for the risks and challenages that positive structural transformations in the economy will entail.

Innovation is a complex process that requires multi-stakeholder involvement in policymaking. UNECE advisory work in this area draws on longstanding engagement across the region. The present Review is the seventh in the UNECE Innovation for Sustainable Development Review series, after reviews of Belarus (twice), Kazakhstan, Ukraine, Armenia and Tajikistan. The Reviews take a comprehensive approach, with strong country involvement and peer review of preliminary findings. UNECE would like to thank the Government of Kyrgyzstan and the national stakeholder community for the excellent support provided throughout this project. UNECE is committed to working with the Government to assist in the implementation of the policy recommendations of the Review and to promote innovation for sustainable development.

Olga Algayerova
Executive Secretary
United Nations Economic Commission for Europe

PREFACE

The practical work on the *Innovation for Sustainable Development Review of Kyrgyzstan* began in December 2016 with a preparatory mission to Bishkek by representatives of the UNECE secretariat to establish contact and discuss the structure and content of the *Review* with the national Government institutions and other stakeholders. The main project mission took place from 30 March to 7 April 2017 with the participation of a team that included representatives of the UNECE secretariat as well as international and national experts.

This *Review* reflects the outcome of a series of consultations and discussions between the *Review* team and policymakers, Government officials, representatives of academic institutions and the business community, and other innovation stakeholders of Kyrgyzstan.

The draft text of the *Review* was submitted for comments to the authorities of Kyrgyzstan and to a group of independent international experts who had not participated in the field mission. The main outcomes of the project, including its main conclusions and recommendations, were presented and discussed during a Regional Workshop "Making innovation work for the Sustainable Development Goals" held in Bishkek from 22 to 23 June 2017 within the activities of the Working Group on Knowledge-based Development of the United Nations Special Programme for the Economies of Central Asia (SPECA). Participants included the members of the *Review* team, external reviewers and high-level representatives of the Government of the Republic of Kyrgyzstan, as well as delegates from other SPECA countries and United Nations member States.

Valuable feedback on policy recommendations was also provided by participants at the tenth session of the UNECE Team of Specialists on Innovation and Competitiveness Policies, held in Geneva from 19 to 20 October 2017. The findings and recommendations were endorsed by the UNECE Committee on Innovation, Competitiveness and Public-Private Partnerships, held in Geneva from 26 to 28 March 2018.

The final text of the *Review* was prepared for publication by the UNECE secretariat reflecting the outcome of these discussions as well as other comments and suggestions from various stakeholders.

ACKNOWLEDGEMENTS

The Innovation for Sustainable Development Review of Kyrgyzstan was prepared by a group of international and national experts as well as by staff of the UNECE secretariat. The Review was the result of a collective effort in which the lead authors for each chapter were: Mr. Anders Jönsson, Mr. Christopher Athey and Mr. Slavo Radosevic (Chapter 1), Mr. Rumen Dobrinsky (Chapter 2), Mr. Thomas Stahlecker (Chapter 3), Mr. Slavo Radosevic (Chapter 4), Ms. Helena Forsman (Chapter 5) and Mr. Ralph Heinrich and Mr. Yoram Krozer (Chapter 6). Ms. Meerim Karybaeva served as national consultant and provided excellent support to the fact finding mission. Mr. Rafis Abazov, Ms. Anna Pobol, Ms. Yelena Shevchenko, Mr. Vusal Suleymanli and Mr. Igor Yegorov reviewed the first draft of the Review and provided detailed comments. Mr. Christopher Athey and Mr. Ralph Heinrich led on the development of the conceptual framework of the Review and overall editing of the publication, with Ms. Ludmila Boichuk providing technical assistance. Ms. Sara Sanseverinati provided valuable research assistance.

The smooth work throughout the project was largely facilitated by the helpful support and cooperation of the State Service of Intellectual Property and Innovation under the Government of the Kyrgyz Republic "Kyrgyzpatent", which was the lead national partner of UNECE in implementing this project. In particular, the support of Ms. Dinara Moldosheva (Chairperson, Kyrgyzpatent) and Mr. Samat Baizakov (Deputy Chairperson), as well as the International Relations Division and Innovation Division of Kyrgyzpatent, were very much appreciated.

During the discussions at the Regional Workshop, "Making innovation work for the Sustainable Development Goals," in Bishkek in June 2017 within the activities of the Working Group on Knowledge-based Development of the United Nations Special Programme for the Economies of Central Asia (SPECA). Mr. Dosaly Esenaliev (former Chairperson, Kyrgyzpatent) and Mr. Eldar Abakirov (Deputy Minister of Economy of the Kyrgyz Republic) presented comments and suggestions on behalf of the delegation of Kyrgyzstan.

UNECE would like to express its deep gratitude to the Government of the Russian Federation for its generous financial contribution, which made possible the implementation of the project *Innovation for Sustainable Development Review of Kyrgyzstan.*

We are also grateful for the assistance provided by the UNDP Office in Bishkek at various stages of this project.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

ABBREVIATIONS

ADB	Asian Development Bank
BEEPS	Business Environment and Enterprise Performance Survey
BMWi	Federal Ministry for Economic Affairs and Energy
CEDAW	United Nations Convention on the Elimination of all Forms of Discrimination against Women
CIS	Commonwealth of Independent States
CSID 2022	Concept for Scientific and Innovative Development to 2022
DFID	Department for International Development (UK)
DTF	Distance to Frontier (World Bank Doing Business)
EAEU	Eurasian Economic Union
EBRD	European Bank for Reconstruction and Development
ECTS	European Credit Transfer System
ESRC	Economic and Social Research Council (UK)
EU	European Union
EU ACA	European Union's ACA – Asia & Central Asia programme
FEZ	Free Economic Zones
FDI	Foreign Direct Investment
FSU	Former Soviet Union
GCI	Global Competitiveness Index (World Economic Forum)
GCR	Global Competitiveness Report (World Economic Forum)
GDP	Gross Domestic Product
GERD	Gross Expenditures on Research and Development
GIZ	Gesellschaft für Internationale Zusammenarbeit (Germany), incl. former GTZ
GNI	Gross National Income
GOST	Soviet state standard system
GSP	Generalized System of Preferences
GVC	Global Value Chain
HEIs	Higher Education Institutions
HTP	High-Tech Park
ICT	Information and Communication Technologies
IMF	International Monetary Fund
IPRs	Intellectual Property Rights
ISO	International Organization for Standardization
IT	Information Technologies
KfW	German government-owned development bank
KGS	Kyrgyzstani Som
KIBS	Knowledge-Intensive Business Services
KICB	Kyrgyz Investment and Credit Bank
KNU	Kyrgyz National University
kWh	Kilowatt hour
MES	Ministry of Education and Science
MFI	Microfinance institution
MNC	Multinational Corporation
NAS	National Academy of Sciences
NBK	National Bank of Kyrgyzstan
NGO	Non-Governmental Organization
NIS	National Innovation System

OBOR	One Belt One Road
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
PhD	Doctor of Philosophy
PPP	Public-Private Partnership; or Purchasing Power Parity
R&D	Research and Development
RKDF	Russian-Kyrgyz Development Fund
S&T	Science and Technology
SME	Small or Medium-sized Enterprise
SPIP	State Programme for Intellectual Property 2017-2021
STC	Scientific and Technical Council
TFP	Total Factor Productivity
UME	Union of Manufacturers and Entrepreneurs of Kyrgyzstan
UNCTAD	United Nations Conference on Trade and Development
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
VAT	Value Added Tax
WBDI	World Bank Development Indicators
WDI	World Development Indicators
WEF	World Economic Forum
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

EXECUTIVE SUMMARY

Kyrgyzstan – a country in transition with great potential…

Kyrgyzstan has weathered a difficult transition after the fall of the Soviet Union. A complex system of interregional trade and finance mechanisms fell apart overnight, along with pervasive subsidies. By 1994, 82% of state assets had been privatised, along with 68% of real estate and 40% of manufacturing industries. At the same time, the country was the first of the post-Soviet states to push through far reaching reforms towards a market economy – indeed, Kyrgyzstan was the first country in the region to enter the World Trade Organization (WTO) in 1998.

The open Kyrgyz economy has substantial potential. Though landlocked, its location is strategic – with potential to benefit from both access to the market of the Eurasian Economic Union and the dynamism due to emerge from China's ambitious One Belt-One Road initiative. Its mining sector is booming, bringing ample foreign exchange, and major investment into hydropower promises not only to fix perennial problems concerning reliable electricity supply, but also the potential to export excess production. And with some of the most scenic landscapes of the region and centres like Issyk Kul, the well-established tourism sector should be well placed to tap into growing demand from the region, China, and the rest of the world.

Based on the United Nations 2030 Agenda for Sustainable Development, Kyrgyzstan in May 2017 signed a new United Nations Development Assistance Framework (UNDAF) with the United Nations system for the period 2018-2022. This framework defines the following priorities:

- Sustainable and inclusive economic growth, industrial, rural and agricultural development, food security and nutrition
- Good Governance, rule of law, human rights and gender equality
- Environment, climate change, and disaster risk management
- Social Protection, Health and Education

…for innovation-driven sustainable development based mainly on absorbing and adapting proven innovations

Innovation will be key to exploiting the country's economic potential and achieving its sustainable development priorities. Through the 2030 agenda, the countries of the world have committed themselves to achieving, by 2030, 17 sustainable development goals that will result in economic prosperity, within planetary boundaries, for all. Fostering innovation is one of these goals. Innovation is also recognized as a key means of implementation for achieving the 2030 Agenda as a whole. The key to sustainable development is to achieve all three dimensions together, rather than achieving one at the expense of the others. And in fact, innovation is critical for sustainable development precisely because it is our best chance to mitigate and even eliminate tradeoffs between economic prosperity, environmental sustainability and social inclusiveness. Accordingly, promoting innovation ranks high on the agenda of the Kyrgyz Government.

This review defines innovation broadly. It is always associated with the successful commercial application of knowledge. This knowledge can be created locally, and it can be new to the world. But importing a new to the market technology from abroad or introducing a new organizational model in a firm that imitates existing managerial models in established firms are also considered as innovation.

In transition economies such as Kyrgyzstan, still catching up in terms of economic and technological development, R&D-based technological innovation may not yet play a leading role. The main prospect for innovation-driven sustainable development under such circumstances is in absorbing and adopting technologies, business models, and management practices that have proven useful in other countries, adding value to and diversifying beyond the existing agri-food, tourism, light manufacturing, and garment sectors. Investments in connectivity could bring down communications and transaction costs and could thereby open up a range of opportunities in tradeable services – a sector where high transport costs pose far fewer constraints.

Specific opportunities for innovators in Kyrgyzstan include:

- The distance from the technology frontier creates opportunities for catch-up and productivity growth through technology transfer;
- Imitation and adaptation face much lower barriers than frontier innovation but require local learning capacity for knowledge diffusion and absorption;
- Grassroots innovation has great potential to support economic development in low-income countries by addressing local needs;
- The agricultural sector offers considerable opportunities for innovation for development, especially based on the introduction of new technologies;
- There is considerable scope for low cost managerial and organisational innovations.

At the same time, innovation based on adaptation and imitation (mainly through technological imports) can address some of the challenges and risks faced by innovators in low-income countries. In particular, the risk of market acceptance, a key risk for globally new products and services, is much lower when an innovation has been proven abroad, while time horizons are much shorter due to "skipping" early, post-invention phases such as proof of concept and scaling up. Financing requirements for R&D are lower. And since the business risks are lower and the innovation is more frequently done by established firms with a track record of revenues, expenditures and credit, there is less need for early stage innovation financing (such as business angel or venture finance).

…although legion challenges in the enabling environment remain.

So far, openness to trade and investment has not brought the fruits the country had hoped for – its growth has fluctuated widely and lagged behind other CIS countries, and the economy just recently recovered the GDP levels of 1991. Political and social turmoil held the country back for the first decade of the millennium, although the 2010 constitution heralded the restoration of relative stability.

The channel for innovation-led growth, the private sector, needs concerted efforts to build the capacities needed to compete abroad – on various measures, its ability to absorb technology

and business models is underdeveloped, making it poorly prepared to tap into the many opportunities presented by the country's openness to trade and investment.

This is in part because several shortcomings in the enabling environment create a cluster of risks that constrain entrepreneurship, especially involving new activities whose viability is uncertain anyway. The essential condition of rule of law and an efficient, neutral judiciary is only partially in place, as enforcement is an endemic challenge – complaints of expropriation and unclear rules of the game continue to deter foreign investors. Low savings and a shallow financial sector make accessing finance for innovation a challenge – credit is costly (18.4% in local currency terms on average, short-term, and tied to strict collateral obligations, while access to private or public equity is nascent at best). And despite relatively high levels of education in the work force, the quality of higher and vocational education has declined over recent decades, putting the difficulty of accessing skills among the top three constraints in business surveys.

Overall gross capital formation as a percentage of GDP has in contrast to many other CIS countries surpassed the 1990 level of 24%, reaching 35% in 2015. While this is a healthy ratio, it is not enough to meet large infrastructure needs, including on fixed and mobile broadband internet connectivity, where Kyrgyzstant currently ranks well below Eurasian average. A lack of liquid markets and investment opportunities means that remittances primarily support local consumption, but do not flow into productive investments as much as they could.

The result is an economy that falls far behind potential. Demand is driven by consumer spending, financed by remittances and resource revenue – but this spending has gone into domestic services and imports rather than manufacturing, which has dwindled continuously since the birth of the country. The gains of the economy are poorly distributed, with rural regions lagging behind in terms of economic development, infrastructure, poverty, and access to education and other public services – not only preventing its work force from reaching its potential, while raising social tensions. Informal economic activity is rampant, with estimates ranging from 25% all the way to 80%. And the heavy dependence on mining output, most of which from a single gold mine, Kumtor, and remittances makes the country inordinately vulnerable to external shocks – such as the recent economic slowdown in Russia or the falling price of gold on the world market.

The national innovation system has potential, but is underdeveloped

The national innovation system (NIS) concept sees innovation, or the successful commercial application of new knowledge, as the result of systemic interactions between research organizations (the knowledge generation sub-system), businesses, and the domestic and international market (demand sub-system). Whether innovation flourishes depends on the quality of the different sub-systems and on the strength of the linkages between them. The NIS concept applies as much to cutting edge research as to absorption of existing knowledge, the latter typically the most productive way for innovation-driven development in countries like Kyrgyzstan.

As we have seen, several features may conspire to make this difficult, starting with its landlocked location. Combined with poor infrastructure, this makes transport expensive and goods exports less cost competitive. A reliance on gold and other kinds of mining for export revenue has made the country vulnerable to shocks and relegated most of the private sector to

low productivity services and agriculture, unable to create the productive capacities to diversify the economy.

The Kyrgyz national innovation system is in its early stages of development, with many essential building blocks missing or at an initial stage. Education levels are still relatively high compared to other countries at the same stage of development. However especially after an insufficiently regulated boom in tertiary education institutions, declining educational and research quality among its 53 universities constrain the knowledge generation subsystem. The existing network of research institutes could be an excellent platform, but they remain poorly funded and staffed with few linkages to the private sector that should be the engine of innovation-led sustainable development.

At the same time, the Government is clearly and laudably committed to industrial modernisation through innovation. The "Concept for scientific and innovative development until 2022", or Concept 2022, is now the leading programme with a holistic approach to developing applied research in priority areas such as food security, Information and Communication Technologies (ICT), health, energy, and tourism. It uses the NIS concept, addresses most aspects of the system, rather than, as before, focusing on research, and embraces the notion that absorbing and adapting existing technologies is a much more realistic vision than to aim to develop expertise competitive at the global frontier. It puts the Kyrgyz manufacturing industry at the centre of efforts, aiming to bring other parts of the innovation system, notably over 70 applied research institutes, to support its modernisation. And it emphasises international co-operation, foreign direct investment (FDI) linkages, and technology transfer centres – all parts of the NIS in need of development.

With a small and inward-looking private sector, demand for research and development (R&D) services is shallow. The relatively few R&D projects that have emerged between manufacturers and institutes concern renovation, repairs, or at most partial modernisation of equipment. In-house research and development is practically non-existent; the innovation that does take place is driven by the advent of new machinery. There is a fledgling network of innovation intermediaries – incubators, technoparks, and technology transfer centers.

Innovation governance is fragmented, and resources often do not match mandates

Innovation governance in Kyrgyzstan is fragmented across multiple institutions, with a need for strategic clarity and skills and resources for implementation. The turn of the century saw the outlines of a stable legislative framework for entrepreneurship and, later, innovation emerge, such as the Law on Innovative Activity and the Law on State Support to Small Entrepreneurship. This then prompted a raft of programmes to improve education, set up a system for protecting intellectual property rights (IPRs), and strengthen the National Academy of Sciences.

But there has been insufficient leadership and co-ordination at multiple levels. The high-level Council on Innovation, set up in 2012, has not fully assumed a much-needed leadership and co-ordination role. Several sectoral public councils bring together a broader range of stakeholders to advise on public policy, notably the Public Council of Kyrgyzpatent, but these lack dedicated budgets and formal decision-making authority. A related issue is a frequent mismatch between formal mandates and the budgetary and human resources that implementing agencies such as

Kyrgyzpatent have at their disposal. There are few decentralised instruments for funding innovative activity under their control.

Kyrgyzpatent is gradually taking a leading role in public support for innovation, developing and co-ordinating the State programme for intellectual property and innovation development 2017-2022, with a comprehensive set of activities and ambitious goals. It is responsible for a new fund for public innovation grants. The Ministry of Education and Science, since 2015 through the new National Science Foundation, leads state science policy and programming, including allocating the budget for state research activities. Most of the more than 70 specialised research institutes fall under its remit.

The Ministry of Economy is at the helm of SME, entrepreneurship, and other private sector development policies. While innovation remains, formally, outside its mandate, the ministry controls many of the important regulatory levers that may promote private sector innovation, and has integrated innovation in several of its investment promotion and entrepreneurship facilitation activities.

The State Committee of Industry, Energy, and Oil use is the driving force behind energy and industrial policy. The latter should, but in practice barely does, include a raft of innovation related measures, such as export promotion, cluster development, and infant industry support. Another committee for information and communication technologies is at the helm of the national ICT policy and e-government programme.

As a small, landlocked economy with a limited domestic market and pool of researchers, international co-operation is especially important. At first glance, the picture is positive: while leading Kyrgyz universities have been active in co-operating with foreign counterparts, the National Academy of Sciences (NAS) is active in leading international co-operation platforms and has led more than 300 joint projects with donor funding since 2012. But little of this co-operation has been around commercialising applied research, whether abroad or in Kyrgyzstan, and despite new legislation on public-private partnerships for science and technology, there are very few instances of successful co-operation between NAS institutes and the private sector.

The private sector needs more policy support to develop their absorptive capacities

Long-term development, especially for higher wages and broad employment, will depend on diversification into higher value-added products and into new markets. Growth will be primarily export-led, lest it continue to rely on consumption financed by remittances. The private sector is the main driver of innovation and hence economic growth in most development trajectories.

On the one hand, Kyrgyz firms do report significant innovation activities, also compared to peer countries. According to the Business Environment and Enterprise Performance Survey (BEEPS) of 2013 over half of Kyrgyz firms engaged in some type of innovation over the preceding three years – far above the 34.6% average and bettered only by Belarus at 66.9%.

On the other hand, the private sector in Kyrgyzstan is not quite ready for economy-wide transformation. Its share in GDP has remained stagnant. Most companies operate in often informal activity in sectors with low productivity, such as subsistence agriculture, trade, and transport, while manufacturing has steadily declined and failed to upgrade. SMEs in particular

have low average levels of productivity: they contribute 32.6% of total employment, but less than 20% of GDP. Informality and corruption are discouraging innovation and capital accumulation, long-term business planning and access to finance.

Overall, there is a notable lack of well managed mid-sized firms that are prepared for the technical, organisational, and marketing challenges involved in diversifying production in tradeables. There is not enough co-operation between companies and between companies and the network of research institutions, and there are few international linkages. Few companies export their production, and although the country's liberal investment policy has drawn healthy inward FDI flows over the past decade, most of it has gone to mining or other activities with low positive spill-over effects on the domestic private sector and wider employment. The investment policy framework does not accord preferences to investments that hold stronger potential for engaging the local private sector. As learning-by-doing from foreign companies through supply relationships and other linkages is one of the leading mechanisms of technology transfer, the private sector misses out.

That the business sector is lacking in capacity to absorb innovation, be it in the shape of new products, technologies, business models, or management systems, is clear on a range of metrics. Data from the Executive Opinion Survey, the main source for the Global Competitiveness Index, from 2016 show Kyrgyzstan scoring between 3.2 and 3.4 out of seven on firm-level technology absorption, capacity for innovation, and FDI and technology transfer – behind most of its peers. The country has only 0.2 International Organization for Standardization (ISO) 9001 certificates per million population, compared to 385 in Belarus, 63 in Russia, and 2.2 in Uzbekistan (ISO 9001 database). The country does only marginally better on the metric of trademark applications by residents, which reached 146 per million population in 2015 (World Bank Development Indicators (WBDI)) – significantly lagging Georgia (1,122), Russia (904) and Belarus (756). The 2014 BEEPS survey showed that only half of Kyrgyz firms have their own web site, and only 11% used technology licensed from a third party. Entrepreneurship dynamics are low, with between 0.8 and 1.1 new firm registrations per year per 1,000 people of working age, well behind CIS peers.

All of this shows that there is not yet a critical mass of productive capabilities to diversify the economy towards higher value-added activities on a large scale, with innovation output that are modest. Firms register only around 100 patents annually, compared to 1,500 in Belarus. Gross expenditure on research and development hovers between only 0.1 and 0.2% of GDP – most of which is funded from public sources.

Concerted public policies are therefore needed to help build innovation capabilities.

There are, however, a few notable successes already which may offer opportunities for scaling up. A few technology-based start-ups have succeeded in catering to foreign clients, attracted by falling communications costs and the low capital investment needed. In 2016, 18.5% of Kyrgyz goods exports came from high-technology sectors, mostly pharmaceuticals, electronics, and optical equipment – though as a percentage of total manufacturing output, export figures remain modest. As these sectors involve productive capabilities that easily lend themselves to related or higher-value added activities, they may make up a modest platform that could lead ventures into further tradeable sectors.

There are noteworthy policy initiatives to strengthen science and academic research …

Universities and research institutes are essential actors in the innovation system, as education, knowledge generation, and diffusion are at the core of public education and science policy. A legacy of the Soviet Union has been the value the country attaches to education, and to science and technology. The existing network of scientific and applied research institutes could be an excellent platform to help the private sector upgrade and diversify their production and become competitive internationally

The Kyrgyz University system has undergone remarkable transformation, reaching 53 institutes of higher education following a boom in private universities over the past decades. But although the country has a solid proportion of tertiary graduates in the work force, the skills developed appear to be poorly suited to the needs of the private sector. There is an urgent need to raise the quality overall and adapt curricula to the needs of the economy.

There is a large base of research institutes as well. The National Academy of Sciences is the highest scientific body in the country tasked with basic and applied research in support of sustainable development, as well as a range of activities under the country's science and technology policy. Its 24 research institutes are poorly funded, and attempts to sell output to the private sector have yielded poor results thus far. Another 38 research institutes fall under different universities, while line ministries maintain nine sectoral research institutes and sixteen medical research centres. But Kyrgyz institutes struggle with stagnant or falling research funding and an outflow of qualified scientists. There are only a few examples of successful co-operation with the private sector, and no central co-ordination between NAS and higher education.

An ambitious effort, under the 2015 Concept for reform of the science system, aims to strengthen scientific research by pooling resources around specific pockets of expertise, as well as to put in place mechanisms to ensure that results are commercialised systematically. The Academy's dual role as research hub and one of the implementing agencies for innovation policy is currently debated, and its policy-making functions may be removed.

… but more needs to be done to encourage institutions for higher education and research and development to join forces with the private sector

Industry-science linkages are poorly developed – especially given that the country, in contrast to most lower middle-income countries across the world, already has a network of applied research institutions in place with many of the capabilities needed for companies to experiment with absorbing new technology. Business executives note that academia is divorced from the problems they face, and researchers point to a lack of articulated demand. While a few universities have managed to join forces with the private sector on a few occasions, funded inter alia by the Kyrgyz Innovation Fund, other calls for proposals resulted in only a handful of projects deemed viable for funding. There is a strong need for concerted government efforts to help supply meet demand and catalyse funding for strategic initiatives to signal their value.

The policy instruments and institutions in place require reform to strengthen innovation

Although there are a range of instruments and institutions in place to support innovation, there are substantial gaps and problems with implementation. As discussed above, among these is

the need to promote linkages with the country's extensive network of research institutes and universities to put their expertise to better use. This requires programming and coordination.

There is also a need to broaden the reach of innovation policy to include building productive capabilities through absorption – not only of technology, but of any new way of doing things, such as business models. Broadly, innovation policies are heavily focussed on research and development – with little attention paid to the essential subsequent steps: commercialising ideas in the market place. This is a major issue, with most potential for productivity-enhancing innovation driven by companies absorbing technology from abroad. Equally problematic is the focus on the ICT sector: ICT is essential as a tool, but the economic boost it can bring will often lie in sectors falling outside the scope of innovation policy – even in the US, most appeared in the retail sector, as ICT proved extremely valuable in keeping track of inventory and optimising the supply chain.

Overall, there is a need to align innovation policies better with policies and instrument in other, related areas. There are a range of policies and donor-funded initiatives in place to promote SMEs and entrepreneurship, but the focus is often on firm creation and survival rather than promoting new activities or modernisation. Several instruments to provide concessional finance to SMEs are in place as well as a microfinance network, but there is no mechanism for financing the risk involved in innovation through venture capital, business angel investment, or other sources. While the country has set up a liberal investment regime and a dedicated agency for investment promotion under the Ministry of Economy, there is no clear strategy for linking FDI to technology inflows or spill-over effects for the domestic economy more broadly. There are, however, notable exceptions, such as co-operation with Intel to promote microchip manufacturing.

Technoparks, incubators, technology transfer centres and similar institutional infrastructure are useful to bridge the gap between science and business, to support technology transfer, and to promote innovation. Several technoparks and incubators already exist, and further initiatives by EBRD and Turkish Manas University are underway, although there is no dedicated law. The country has five Free Economic Zones, with the largest, in Bishkek, hosting 324 enterprises that benefit from a range of exemptions, accelerated procedures, and low rents. But although the law gives preference to innovative activity, there are no concerted efforts to promote technology transfer or research and development – the focus is clearly on production and employment.

Having acceded early to the WTO in 1998, Kyrgyzstan remains very open to trade. While essential elements of trade facilitation, such as harmonised product standards, IPR protection, and competition policy are in place, there is no dedicated body tasked with export promotion, and IPR enforcement remains patchy – with counterfeit goods being a particular challenge. In addition, infrastructure and regulatory barriers make it relatively expensive and time-consuming to export goods.

To compensate for problems with the enabling environment and wide-ranging market failures, innovation policy in such a context requires concerted vertical measures targeting specific sectors or projects that bear strong potential for positive social returns. There is substantial potential in reviewing, improving, and expanding such efforts. One promising avenue would be initiatives to introduce new products to the market, initially substituting imports but, with time, building the capacities needed to be competitive in export markets. Another may be to

turn the large Kyrgyz migrant labour force to an advantage, encouraging them to put the knowledge and capital they have gained abroad to use in the local economy. A central feature should be to improve linkages between stakeholders in the NIS, through joint projects that the Government could subsidise in the beginning. While building up a stronger pipeline of promising projects, the Government also needs to fill a number of gaps in access to finance – credit to the private sector is low, and seed and early-stage financing and venture capital are practically non-existent.

Policy recommendations

There are important policy implications of "innovation for sustainable development" and a broad understanding of innovation as including novelties in the local context of low- and middle-income countries:

- A multitude of positive socio-economic outcomes: jobs and income growth, skills development and economic diversification;
- A need to target specific innovation capabilities: imitation and adaptation should be central to the policy focus;
- Prioritization of technology diffusion and adaptation and the required local capabilities, in particular learning;
- Policy instrument can include metrology, standards and quality control, extension services, information and training programmes, demonstration and pilot projects;
- A narrow economic specialization can be turned into an opportunity, identifying natural starting points for innovative ventures in already established economic sectors;
- Policy should support the most promising and successful innovation practices (such as grassroots innovation), including by promoting demand for local innovation;
- Innovation for development tends to be bottom up; the rationale is to establish an enabling environment and incentives for local innovative entrepreneurs;
- Resource constraints in low-income countries dictate a gradualist approach, tailored to local context.

To fully realize the potential of Kyrgyzstan for innovation-led sustainable development, policy makers should focus on improving the governance of the national innovation system, strengthening the linkages between the various parts of the system, including with foreign partners, and strengthening the capacities of enterprises to absorb and adapt technologies.

On improving innovation governance, there is a clear need for better co-ordination under the oversight of the Council on Science and Innovation or other body with high-level support. The focus of innovation policy should be broadened from science and technology to all kinds of absorption of innovative ideas. There is a clear nfeed for a unified innovation policy that makes this point clear and outlines how it should be put into practice. As this involves both improving firm capacities and promoting linkages, the Council should carefully review all institutions involved in the NIS to determine which gaps need to be filled, both inside and outside its direct remit. The Council needs a secretariat with appropriate authority and means of implementation; if Kyrgyzpatent is to fill this role, it will need additional resources.

The Council should have a clear role in monitoring the enabling environment for innovative entrepreneurship. This involves identifying the specific obstacles that stand in the way, such as cumbersome business registration, inordinate investor risks, licensing requirements, or

inefficient commercial arbitration. It also means monitoring framework conditions and setting priorities in consultation with the private sector, pushing for necessary reforms and spending in areas such as educational quality and transport infrastructure. It should also advocate that the Government play a role in creating demand for innovation, notably through public procurement.

As for improving innovation infrastructure, there should be a clear focus on connectivity and linkages. This applies especially to research institutes and universities, which should be incentivised to forge linkages with the private sector – with public support playing a catalysing role. On-going reform efforts should be turned in this direction, drawing on good practices such as Fraunhofer in Germany or RISE in Sweden. The country's free economic zones should be turned into innovation centres, with new services and benefits to encourage technology transfer and linkages to domestic SMEs. A law regulating technology parks, incubators, and similar initiatives is needed to ensure quality and determine the public support needed.

A clearer focus on entrepreneurship is needed, aligning innovation policy with SME and entrepreneurship promotion. Concerted efforts are needed to support access to finance for innovative entrepreneurship, which often involves risk profiles that are not amenable to concessional credit funding. This should include measures to encourage venture capital investment, including government co-investment where it is likely to play a major catalysing effect to make innovation happen.

It is also important to promote the right kinds of investment and make better use of the positive effects that they could bring. This should involve measures to attract technology-intensive activities with the potential to raise productive capacities in the economy through employee training, supplier relationships, and co-operation with research institutes and universities. There will be ample upcoming opportunities as integration activities progress under the Eurasian Economic Union (EAEU), and as the One-Belt-One-Road initiative comes on stream.

Finally, mainstreaming sustainable development is essential. This involves creating demand through public procurement, standard setting, and promoting sustainable products and services.

In order to create appropriate incentives for businesses to invest in the creation of innovative sustainable products, services and business practices, and for consumers and customers to adopt these innovations rapidly and on a broad scale, it is also critical for supporting policies to be consistent and for them to reinforce rather than to counteract each other. Policy consistency is especially important because the goal of sustainable development is to achieve several policy goals simultaneously, including economic growth, environmental sustainability and social inclusiveness. This will require policies in very different spheres to be coordinated, including in the social sphere, e.g. progressively reducing consumer and producer subsidies for fossil fuels and water use and moving towards market prices, and providing additional financial support to lower income citizens to cushion the impact of price increases.

Policy recommendations

As well as the over-arching recommendations already discussed, each of the chapters of this Innovation for Sustainable Development Review contains a list of recommendations, which cover multifaceted areas for policy action with distinct time horizons and sequencing. Because the recommendations are addressed to different Government agencies and institutions,

coordination amongst ministries will be crucial for successful implementation. Table 1.1 presents a summary list of recommendations with related policy actions.

Table 1.1. Summary of Recommendations

Chapter 2: Innovation governance: Framework conditions, policies and instruments		
	Recommendations	*Related policy actions*
1.	Develop an Action Plan to strengthen innovation infrastructure and innovation support institutions	a) A needs assessment of innovation intermediaries and support institutions and programme for setting up the necessary institutions, with donor support; b) Programmes of technical assistance (including to facilitate access to finance) to innovative entrepreneurs, SMEs and grassroots innovation initiatives implemented by public innovation intermediaries and support institutions; c) An experimental technology transfer centre, possibly jointly between a number of higher education/research institutions, as a public-private partnership with industry participation to facilitate technological upgrading projects in industry; d) A special programme to support private innovative entrepreneurship at universities and facilitate university start-ups and spinoffs; e) Regular competitive grant financing to support innovative start-ups and ventures; measures of public support to private business angels and/or venture capital firms.
2.	Initiate policy measures to improve linkages in the national innovation system (NIS) through appropriate policy instruments.	a) Introduce grant project funding allocated through competitive open calls to support innovation and technology upgrading projects; such funding should cover the full innovation cycle, from R&D to developing new products and bringing them to the market; b) To improve connectivity and linkages, innovation project funding could be made conditional on the establishment, at the project planning stage, of collaborative linkages among innovation stakeholders, in particular between R&D and industry; c) Consider with other members of the Eurasian Economic Union possible joint instruments aimed at supporting cross-border innovation projects engaging partners from several countries; d) Complement these measures with non-financial coordination instruments to support connectivity (facilitating networking and information sharing among potential stakeholders) that facilitate inter-firm linkages and linkages between industry and R&D institutions; e) Ensure the selection criteria applied by the above policy instruments match national strategic priorities and policy objectives.
3.	New policy instruments aligned with and supporting the policy orientation towards industrial modernisation through technology transfer.	a) Incentives for the business sector (such as tax and tariff relief, access to subsidized credit, government guarantees, etc.) targeting technological upgrading of production facilities and acquisition of equipment as well as the creation of virtuous supply-demand feedbacks, client-supplier interactions and clusters; b) Design and introduce mechanisms facilitating cost and risk sharing among business partners as well as public-private partnerships in implementing modernisation projects; engage collective technology transfer centres in this process; c) Discuss with the Russian-Kyrgyz Development Fund the development of a special programme for industrial modernisation whereby the government would commit to provide additional incentives for projects that target national priority areas.

4.	Measures to improve governance of the NIS.	a) Undertake a critical review of NIS governance and define the functional responsibilities of all public bodies tasked with innovation policy design and implementation; b) Define a clear mandate for the Council on Science and Innovation as the highest decision making public body tasked with innovation management and policy coordination and the steering of national innovative development; c) The Council on Science and Innovation should become an operational body holding regular sessions to implement a work plan approved by the Government; d) All line bodies tasked with innovation management would report to the Council on their activities; where needed, the Council would coordinate policy implementation among line bodies; e) If Kyrgyzpatent remains the main line body tasked with innovation management, it should be assigned with responsibilities and autonomous decision-making power to manage new innovation policy instruments to be introduced as per recommendation 2.b; f) All other line bodies responsible for innovation management should also be equipped with policy instruments matching their responsibilities; g) All public NIS bodies need to be staffed and resourced adequately to be able to perform their functions; the authorities may consider a special capacity-building programme to this effect.
5.	Develop a special plan for undertaking the planned reform of the science system in Kyrgyzstan, based on a gradualist approach.	a) Consult all key stakeholders involved (in particular MES and NAS) on the scale and scope of the reforms, their sequencing and speed of implementation with a view to building consensus; b) Stage the reforms in steps, starting with an experimental phase where the envisaged reorganisation is only applied to selected parts of the science system; invite volunteers for this experimental stage by offering them incentives to participate; c) Review the results and outcomes of implementing the experimental phase and, based on lessons learned, make necessary amendments to planned reforms; d) Continue with the following phases of reform following a similar, gradualist approach; e) The reform process may imply the need for parallel science management models whereby the old management model will be gradually phased out as the new model is introduced.
6.	Consider establishing an economy wide, microfinance-based entrepreneurship support scheme to drive development based on innovation and entrepreneurship.	a) Liaise with international donor organisations to discuss the scheme concept and invite them to support its operations; b) Consider special incentives for attracting remittances to the scheme, including privileges for microcredit applicants who attract match funding from remittances; c) Entrepreneurship in agriculture and food processing can be a specific target; d) Include scheme options for entrepreneurial support to young people, including support to university start-ups and/or spin-offs; e) Target economy wide scheme coverage, with centres catering to local needs; facilitate local entrepreneurs in identifying their local development niches.

Chapter 3: Knowledge generation and diffusion, industry-science linkages and innovation financing		
	Recommendations	*Related policy actions*
1.	Policy measures to increase innovation in the business sector and boost knowledge generation and absorption capacities, with particular attention to internationalization and FDI. There are a number of promising sectors for policy interventions.	a) Identify sector-specific R&D and innovation capacities and support these through modernisation of technical equipment and by initiating specific R&D and innovation projects (with domestic, international or scientific partners); b) Implement an independent innovation fund to support investment in R&D (see also chapter 2) and increase R&D expenditure as a share of GDP (SDG indicator 9.5.1). Support from international donors could be requested for this purpose; c) Identify the "driving factors" of successful companies and draw lessons for improving innovation framework conditions. Consider an awareness-raising campaign on the social benefits of innovation; d) Take a systematic approach to attracting foreign technologies or technology-oriented firms by promoting Kyrgyzstan's unique capacities in terms of existing firms, societal needs and scientific potential; e) Actively support export-oriented companies; and f) Help innovation-oriented companies to find suitable technologies abroad and support their adoption and adaption.
2.	Strengthening and restructuring of the science sector with a focus on specific local technological needs.	a) Improve framework conditions for scientific research by increasing institutional and competitive funding; applied research for companies could be rewarded by additional grants, with possible support from international donors; b) Implementing a system of incentives and performance criteria in the science sector to improve outputs and processes; c) Reduce legal impediments to commercialization of scientific results, including the possibility to establish start-ups at scientific research institutes; d) Consider reducing the number of research institutes and universities (53) to larger and more focused units; "mini-institutes" with only a few researchers should be merged with other institutes to achieve a "critical mass" of competencies; e The future university landscape could be differentiated into a group of research-oriented universities (with possible industry linkages) and teaching universities; funding mechanisms should be reconsidered to ensure adequate financing so universities can focus on their core missions of teaching and/or research; f) Promising (but currently fragmented) approaches at specific universities and institutes to cooperate with the enterprise sector could be strengthened through "pilot projects"; support should also be provided for student internships; g) Consider favourably in the recruitment process evidence of (international) business contacts of university professors; h) Provide financial support to create technology transfer centres at HEIs, and patent exploitation departments to support scientists on IPR issues. This could be in cooperation with donor organisations and the private sector.
3.	Systematic and programmatic support measures for new enterprises to drive economic modernization, including regulation to	a) A start-up programme for innovative companies, including the necessary infrastructure (e.g. establishment of incubators at research institutes), improvement of financing conditions for new companies and advisory services;

	allow the establishment of new companies in the science sector.	b) Creating a culture of entrepreneurship in the science sector and administration; motivate local investors to be open to new technologies and innovations; c) Strengthen existing and successfully operating private initiatives by supporting their specific approaches and models; d) Consider the potential role of the Kyrgyz diaspora as investors, scientific and business contacts abroad (see chapter 1); e) Support teaching and research institutes in introducing entrepreneurship education in their curricula.
4.	Strengthened education and human resources to support the transition to a knowledge-based and innovative society.	a) Improvement of human resources development programmes and qualifications at all levels as a policy priority; b) Expansion of engineering and technical programmes at universities, with improved quality standards; c) Establishment of business schools at universities where students of technical disciplines can receive a complementary education, building on efforts made at the Kyrgyz National University; d) Improved vocational training matching business needs, and of suitable length and intensity (currently two months in Kyrgyzstan compared to two years in many countries); e) Continued cooperation with foreign institutions on vocational training (e.g. Germany) and adoption of good practices.
5.	Development of business services and intermediaries needed for a modern innovation system.	a) Providing the legal and financial basis to create Technoparks at selected universities or research centres with existing business linkages or commercialization activities; b) FEZs should be supported to also become innovation centres with international linkages. Support should be provided to build managerial and institutional capabilities and establish functional linkages with domestic research institutes; c) Existing plans to establish incubators at universities (e.g. the Kyrgyz Turkish Manas University) should be strengthened and transferred to other research institutes; d) Technology transfer centres, start-up centres and a (private) venture capital or business angel culture should be initiated, with the support of international organizations or donors (e.g. Eurasian Development Bank plans to establish a Technopark for ICT).
Chapter 4: Innovation capacity from an international perspective		
1	A strategic approach to FDI and integration into Global Value Chains (GVCs), including new opportunities such as the Eurasian Economic Union and "One Belt, One Road"	a) Identifying promising sectors for further support through a process of "smart specialization" and public-private dialogue; b) Building on existing free economic zones; c) Tailor made packages to attract investors in key sectors like textiles, food, call centres, etc., including skills and training programmes that may be based on cost-sharing with foreign investors or international donors; d) Assist export promotion in the textiles and food industries linked to improving quality and meeting health and safety and international export standards in collaboration with industry associations and international donors; e) A specific package of support measures for companies willing to meet quality and other requirements within an internationally assisted programme of technology upgrading.

2	Investment and strengthened industry-science linkages to drive modernization of the science and research sectors, including greater collaboration with SMEs.	a) A programme to transform existing research institutes into a network of technology institutes that support industry, in particular SMEs; b) Using technology institutes to create small but profitable improvements by extending established technologies to smaller firms; c) Support to SME demand for innovation support from research institutes and the knowledge-intensive business services sector through appropriate policy measures such as innovation vouchers and tax incentives; d) Upstream scientific institutes in areas closer to basic research should be integrated into universities, improving teaching quality and building on existing formal and informal collaboration between research institutes and universities.
3	Continued investment in education to drive improved quality standards.	a) Increasing quality of education with a programme of international training for teachers; b) As recommended in Armenia and Tajikistan, the authorities could consider a similar scheme to Kazakhstan's Bolashak programme for teachers, based on highly competitive selection followed by promising career opportunities. The Government could approach the donor community and propose funding based on cost sharing; c) Educational curricula should be modernized in consultation with industry to ensure they correspond to the needs of employers. Harmonization with the EU Bologna process should be considered.
4	Public procurement as an instrument of innovation policy.	Public procurement as an instrument of innovation policy is undeveloped and is a missed opportunity to couple local demand in public sector development to local technological capabilities. In a small economy with limited local demand and problematic access to foreign markets, innovation-focused public procurement should be a priority. A first application could be in the ICT sector, given demands linked to eGovernment reforms, and could include local content requirements in public procurement contracts with foreign operators.
5	Improved innovation statistics.	Coverage of innovation statistics should be expanded to include Structural Business Statistics (SBS); Trade by Enterprise Characteristics (TEC) and Entrepreneurship Indicators (Business Demography, BD) to give policymakers a better understanding of business dynamics and micro-level industrial changes.
Chapter 5: Innovation in the enterprise sector		
1	Improving the business environment by tackling corruption and informality in both public and private sectors, e.g. eGovernment.	Recommended actions to improve the business environment in the short term are to: a) Reduce corruption and crime through more efficient enforcement of legislation b) Reduce red tape by streamlining administrative processes, including for cross-border trade c) Improve transportation infrastructure and its maintenance d) Publish regular progress reports on actions taken Recommended actions to improve the business environment in the long term are to: a) Develop a culture of professional integrity and accountability b) Strengthen public attitudes and demands for anti-corruption c) Implement ethical codes of conduct in both private and public organizations d) Develop business sustainability indicators and monitor progress against them

2	Embracing innovation and entrepreneurship as key vehicles of economic diversification, in particular through support of knowledge-intensive start-ups.	Recommended actions to support knowledge-intensive start-ups in the short term are to: a) Improve incentives to start formal businesses, and regularize informal ones b) Establish business acceleration and incubation activities at universities and other training institutions c) Monitor Government procurement and introduce measures to encourage the participation of SMEs d) Consider eGovernment initiatives as a tool to support a promising local ICT start-up community e) Set up a cooperative scheme to support emerging entrepreneurial communities and knowledge-technology intensive sectors Recommended actions to support knowledge-intensive start-ups in the long term are to: a) Develop cooperation schemes for funding and sharing costs and risks between enterprises and research institutions b) Facilitate university-industry collaboration to expose students to entrepreneurial opportunities c) Integrate entrepreneurship into education at all stages to strengthen entrepreneurial attitudes, knowledge and skills
3	Targeted measures to enhance innovation in enterprises, addressing specific policy needs across four "innovator profiles", each with specific policy needs: Low Performers, Incremental Performers, Radical Performers and High Performers.	Recommended actions to enhance innovation in enterprises in the short term are to: a) Increase awareness of policymakers and implementers of the range of innovations and innovators b) Develop instruments for identifying potential innovators and their specific problems c) Develop a collection of policy instruments to respond to these problems d) Identify the systemic impact of different kinds of innovations and innovators e) Raise awareness of positive case studies to serve as role models, particularly for future female managers and innovators f) Establish cooperative schemes for business foresight activities and to develop internal innovation cultures in enterprises, strategic planning and client orientation Recommended actions to enhance innovation in enterprises in the long term are to: a) Improve strategic understanding of innovation in both private and public organizations b) Increase awareness of the systemic view of innovation policy c) Develop a comprehensive toolbox of policy instruments with support targeted to each profile of innovator
Chapter 6: Innovation for Sustainable Development in Kyrgyzstan		
1	Stimulating demand and create markets for innovative sustainable goods and services in order to provide a clear medium-term frame of reference for innovators and investors.	a) Mainstream sustainability into primary, secondary and higher education in order to raise the awareness of the population about sustainability issues, thereby preparing the ground for consumer demand for innovative sustainable products. This requires training of teachers on sustainable development issues and the development and updating of relevant teaching materials. b) Define sector-specific targets for environmental performance to be reached within e.g. ten years. Different targets should be set for different sectors, including industry, construction - including commercial and

		residential buildings - agriculture, mining, tourism, and transport – including public and private individual transport. c) Create a nation-wide system of monitoring of progress towards these targets using key performance indicators. The results of the monitoring should be used to adjust targets and supporting policies as necessary over time. d) Promote the development and adoption of voluntary standards and labels for energy efficiency, emissions of pollutants, and recycling. This should also include the development of independent certification processes for Kyrgyz producers. e) Where necessary, complement targets and standards with mandatory regulations, including monetary penalties for non-compliance and liabilities for damages to the environment. f) Integrate these standards and targets in all Government procurement programs. Sustainability should be made a criterion used alongside more traditional criteria such as price and quality to select vendors.
2	Facilitating access of Kyrgyz innovators to international markets for sustainable products and services	a) Facilitate the adoption by Kyrgyz producers of existing international standards and eco-labels. As in the case of voluntary national standards, the Governments can support compliance by facilitating the access of Kyrgyz producers to internationally recognized testing and certification services. b) Create international promotion campaigns raising awareness abroad about sustainable products from Kyrgyzstan on the basis of internationally recognized standards and labels. c) Work with the nascent tourism industry to develop eco-branding and to promote Kyrgyzstan as a destination for sustainable tourism. d) Facilitate the participation of Kyrgyz companies with sustainable products and production processes in foreign trade fairs with a sustainability focus.
3	Strengthen the skills of civil servants tasked with developing and implementing policies for shaping and creating markets for innovative sustainable products, services and production processes	a) Further mainstream sustainable development into the curricula of the Academy for Public Administration b) Create programmes for civil servants and policy makers to participate in international exchanges of experience with their peers on policies, laws, and regulations promoting innovation for sustainable development and their implementation. c) Create platforms for dialogue between Government implementing agencies and producers and consumers affected by policies and regulations aiming to facilitate the development and adoption of sustainable innovative products, services and production processes. d) Use this dialogue to create a feedback mechanism through which policies and regulations can be improved over time in light of experience.
4	Supporting the supply of innovative solutions to sustainability challenges in areas of national priority by promoting both dometic development and the adoption and adaptation	a) Define priority areas for research with potential applications in fields relevant for the national sustainable development strategy of Kyrgyzstan. b) Provide additional dedicated funding for research projects in these areas. c) Encourage the transfer of research results in these areas to industry and their translation into new sustainable products and processes by providing dedicated research funding to universities

	of innovative solutions from abroad.	and academic institutes conditional on co-financing from the private sector. d) Further encourage the participation of Kyrgyz researchers and research institutes in international research networks focused on solving sustainability problems. e) Provide funding for research and development aiming to modernize the traditional know-how in foods, forestry, personal care, textiles, housing. f) Mainstream national sustainable development priorities into foreign direct investment policies by systematically considering the impact of foreign direct investment projects on the sustainable development of the Kyrgyz Republic and facilitating the diffusion of foreign knowledge about new sustainable practices to domestic businesses and workers.
5	Improving policy consistency across different policy spheres with an impact on sustainable development so that poicies reinforce rather than counteract each other	a) Gradually remove consumer and producer subsidies for fossil fuels and water use and to move towards market prices which reflect the full cost of using these resources, including the negative effects their use may have on the environment and the long-term sustainable development of Kyrgyzstan. By artificially lowering the prices of these resources, these subsidies reduce the incentives for consumers and producers to adopt more sustainable alternatives. By extension, this reduces the incentives of potential innovators to invest in innovations that would provide these sustainable alternatives. b) Provide additional financial support to poor citizens to cushion the impact of price increases for fuel and utilities. c) Review existing subsidies for the introduction of sustainable technologies and products in step with the removal of the above subsidies for non-sustainable ones. As subsidies for non-sustainable products and practices are phased out, and thus counter-productive incentives are diminished, it may become possible to achieve sustainability goals at lower cost by reducing the subsidies for sustainable practices.

Chapter 1

RECENT ECONOMIC AND INNOVATION PERFORMANCE

Kyrgyzstan is an open economy with a strategic location…

Often seen as one of the most open economies in the world according to the Economist Intelligence Unit's Democracy index (2012), Kyrgyzstan has undergone one of the most effective, albeit incomplete, transition processes from a centrally planned to a market economy.

Equally promising is its location. While landlocked, this mountainous, scenic country lies at the centre of the One Belt One Road (Box 1.1) initiative while also being part of the Eurasian Economic Union (EAEU), making it a potential hub for regional trade, investment, and tourism. Kyrgyzstan is also rich in certain natural resources, such as gold and hydroelectric power. With a relatively well-educated work force, an open economy, language skills, and low wages, Kyrgyzstan has substantial potential. As a small but vibrant start-up scene and high-tech exports demonstrate, innovation, with concerted support from the country's network of research institutes, could play a substantial role in upgrading existing activities, diversifying into new ones, boosting service exports, and absorbing technologies and business models proven elsewhere.

Box 1.1 One Belt One Road (OBOR) initiative

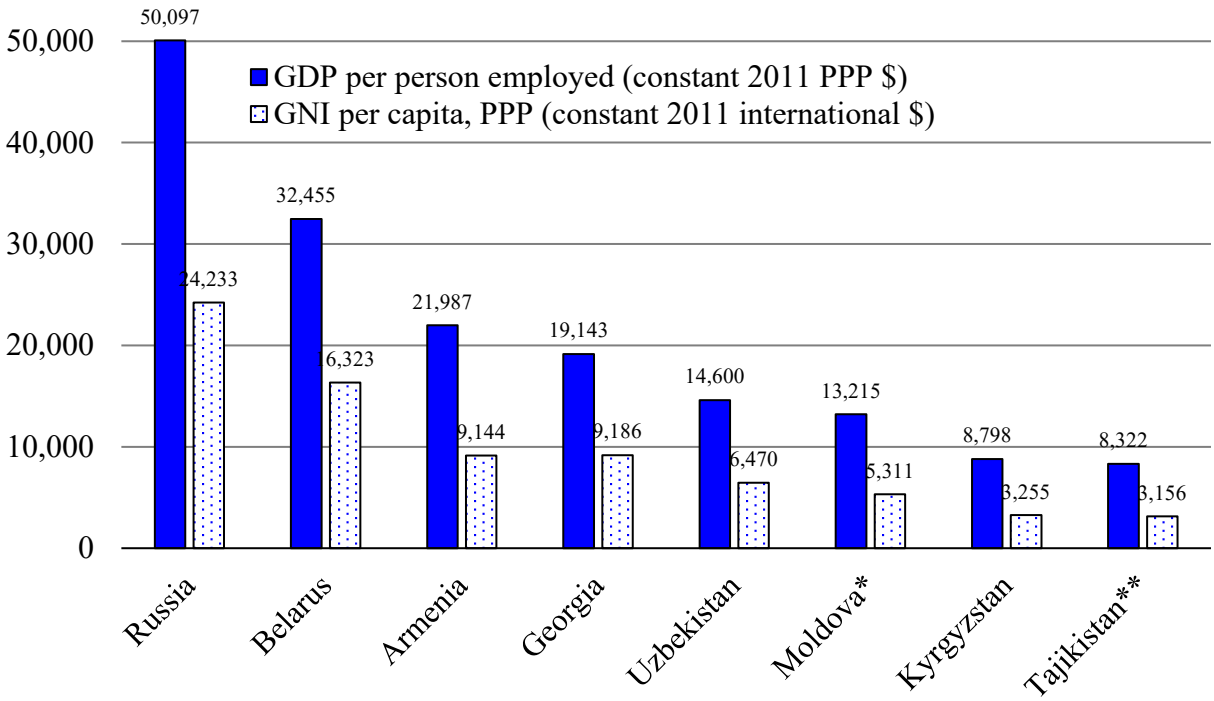
The Chinese OBOR initiative is one of the largest economic integration initiatives the world has ever seen. An attempt to improve China's links with the rest of the world along the old Silk Road, the initiative involves up to 65 countries with 40% of global GDP. The funding is immense: a new silk road fund already has $40 billion of capital, and the Asian Infrastructure Investment Bank has pledged $100 billion in lending, while China Development Bank will also become a partner.

Kyrgyzstan is excellently positioned as a potential transport hub under OBOR. But OBOR goes much further than infrastructure, promising trade and investment links. With wages rising fast in China, the country is looking to locate parts of its value chains in neighbouring countries – mainly Southeast Asia to date, but there is evidently strong potential for Central Asia as an alternative. Indeed, OBOR goes far beyond connectivity – policy harmonization, trade and investment promotion, technology transfer, and value-chain integration are all high up on the agenda. China is already heavily invested in Kyrgyz infrastructure, but is diversifying. For instance, the blossoming Kyrgyz start-up culture has recently attracted the interest of Chinese investors.

…but economic performance over the past decades has lagged far behind its potential partly due to macro risks.

Despite this potential, Kyrgyzstan remains a lower middle-income country and towards the lower end of its peer group. As Figure 1.1 shows, on a purchasing power parity (PPP) basis, Kyrgyzstan had a Gross National Income (GNI) per capita of $3,255 in 2017.

Figure 1.1 GNI per capita and GDP per person employed, 2017



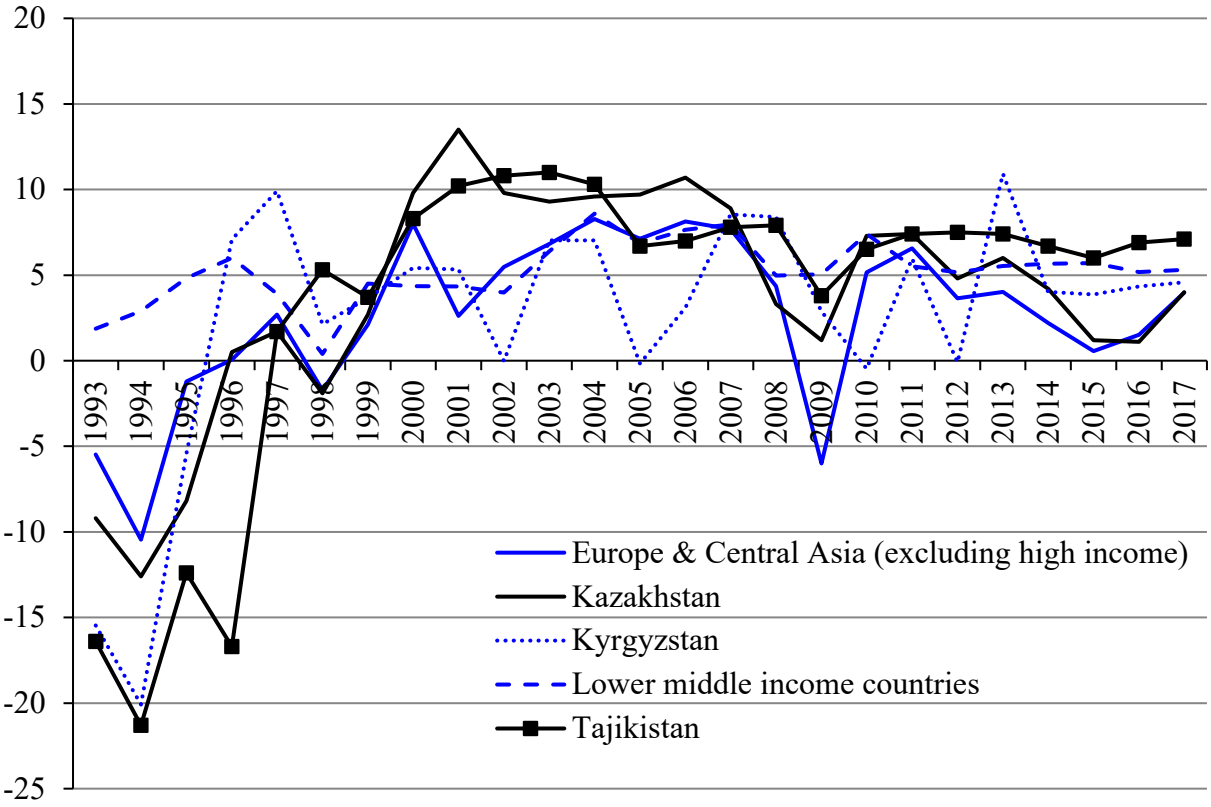
Source: World Development Indicators - World Bank Open Data.
* Latest GNI per capita data from 2016
** Latest GNI per capita data from 2013

In addition, growth has been haphazard (Figure 1.2). On the supply side, a swift expansion of the service sector, especially trade and telecommunications, compensated for dwindling manufacturing output. On the demand side, high government spending, reaching almost 40% of GDP, and remittances from migrant workers heading for neighbouring Kazakhstan or further afield funded a boom in consumer demand. In part due to the 2010 conflict, economic growth averaged 3.9% over the 2001-2012 period - one of lowest in the region, and from one of the lowest bases among CIS countries. This growth has not been able to provide employment for all; and rates of informal economic activity and hidden unemployment are high – around 20% of the economy in 2012 as per official sources, but considerably higher according to World Bank estimates and business surveys, such as the 2011 poll of private enterprises by the Center for International Private Enterprise.

Economic growth has accelerated over the 2013-2017 period, averaging 5.5 percent. However, the economy of Kyrgyzstan remain vulnerable to external shocks owing to its reliance on one gold mine, Kumtor, which accounts for about 10% of GDP, and on worker remittances, equivalent to about 30% of GDP in 2011–15. This instability may well continue, especially in

view of the country's excessive dependence not only on remittances and unsustainable fiscal expansion using a low tax base, but on gold exports – making it vulnerable to economic shocks in neighbouring countries as well as to fluctuations in the price of gold.

Figure 1.2 Annual percentage GDP growth 1993-2017 - Kyrgyzstan and peers



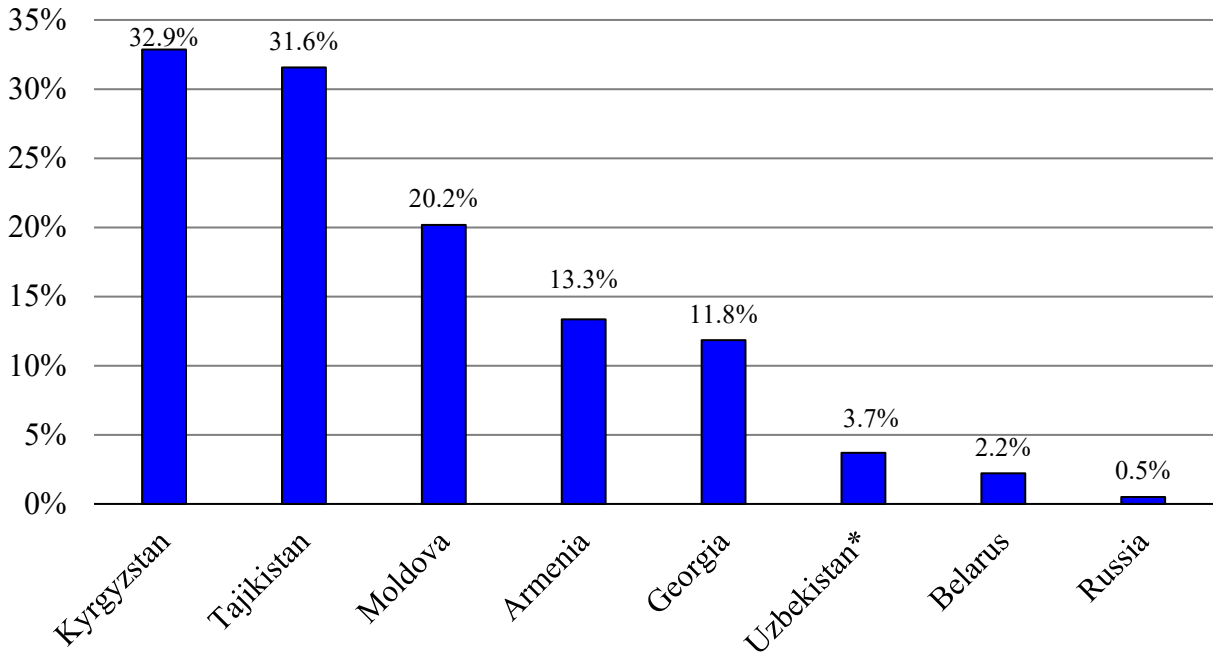
Source: World Development Indicators - World Bank Open Data.

Another, related source of macrorisks is the exchange rate. The Kyrgyz som appreciated substantially against the Kazakh tenge and the Russian rouble during the economic downturn in Russia. This real appreciation of the som against the currencies of its major commercial partners have quickly made several parts of the Kyrgyz export basket less competitive. This also acts as a substantial disincentive to invest in tradeable activities, and further encourages another source of instability: the dependence on domestic credit denominated in foreign currencies.

Remittances have been an important source of finance, but are volatile…

Another source of instability is the country'dependence on personal remittances, almost all from Russia and Kazakhstan, where 25% of the work force is active. At over 30% of GDP (Figure 1.3), it is the leading driver of consumption – which, in turn, mostly feeds into consumer spending and imports rather than savings and investments. This dependence is highly pro-cyclical, as recent fluctuations following the downturn in Russia and the rapid devaluation of the rouble have shown.

Figure 1.3 Remittances as a per cent of GDP, 2017



Source: World Development Indicators - World Bank Open Data
* Data relate to 2016

…and much more could be done to leverage the potential of the diaspora as a driver of development.

The term "diaspora" defines the citizens of one country settled temporarily or permanently abroad. The Kyrgyz Republic has an important part of its population living in other countries, in particular in the Former Soviet Union (FSU). They have played a key role in terms of remittances to support living standards during economic transition, but their role in boosting productive capacity has been more limited. While the Migration Service is the competent authority to address the main issues deriving from mass emigration, no Ministry for Diaspora has been established and Kyrgyzstan has yet to develop a structural migration policy.

As the wealth and strength of the Kyrgyz diaspora network grows, it will be important to leverage this resource beyond remittance flows. There are a range of possible models to follow, both in the former Soviet Union (e.g. Armenia and Moldova), as well as further afield (e.g. Israel), where policies go far beyond mere protection of the rights of citizens abroad, and include more proactive measures.

A recent IncoNet Central Asia study recommended, as part of a systematic evaluation of public research organizations and higher education institutes, that foreign experts and representatives of the Kyrgyz scientific diaspora should be involved in the different forms of evaluation.[1] The same report also recommended the participation of scientists from the Kyrgyz diaspora in comepetitive grant funding evaluations, as well as research on and creation of a database on the scientific diaspora. Such practices would help the country move towards international best

[1] IncoNet Central Asia S&T Policy Mix Peer Review of Kyrgyzstan, recommendation 3. https://www.zsi.at/object/publication/4327/attach/Peer_Review_R_I_Kyrgyzstan_v10_oct16_final.pdf

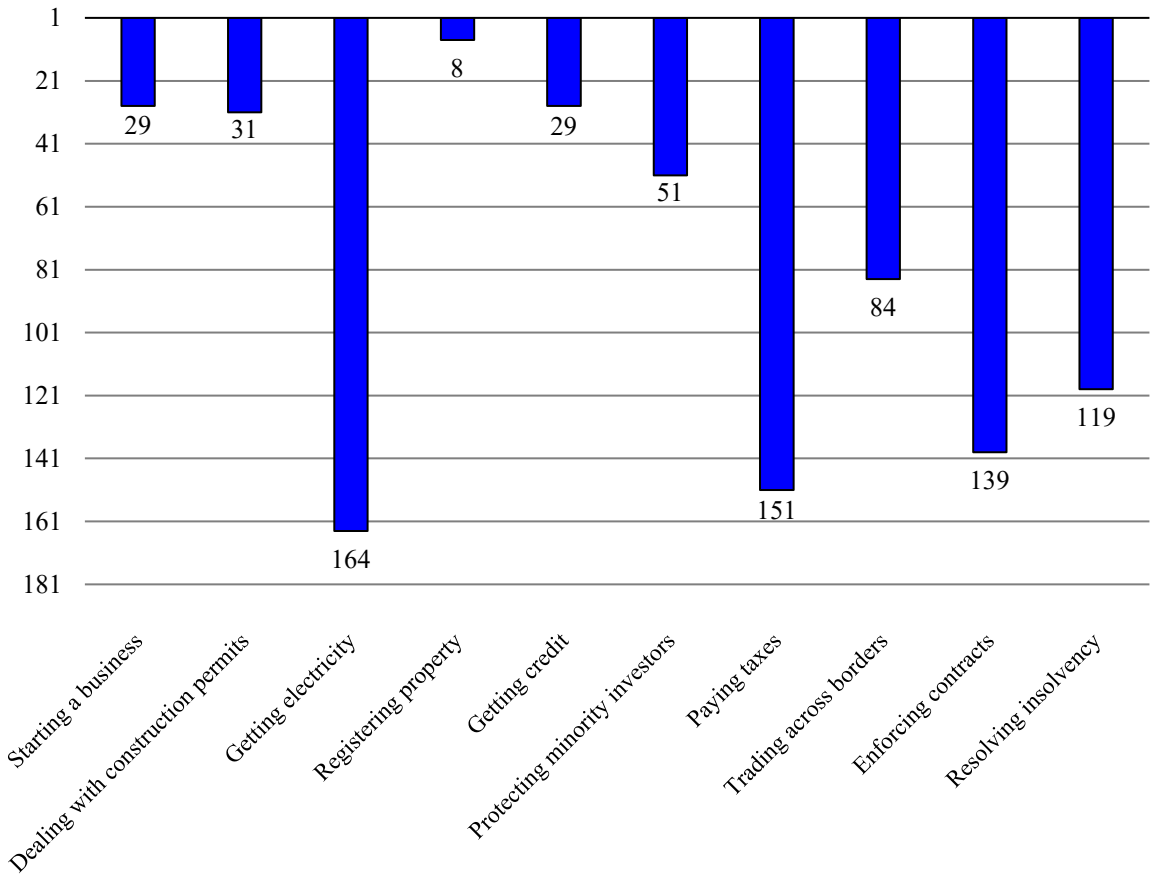
practice in research and scientific evaluation and expertise, while facilitating networking to establish all-important personal connections in the international research community.

Experiences in countries such as Armenia and Moldova have shown that both strengthening the diaspora identity and ties with the home country are important, and there can also be scope for using the national diaspora to reach out to other diaspora communities (in the case of Kyrgyzstan, possible diaspora around the world from other Central Asian or former Soviet Union countries). Much can be done to extend the opportunities for a diaspora contribution to national development, including policy reforms. The diaspora is likely still more important in innovative as opposed to traditional sectors, given the importance of intangibles and international knowledge flows for such sectors.

A range of micro risks face the private sector and foreign investors in innovative activities.

Compounding these macro risks, a range of micro risks hinder the private sector in general – and innovation in particular. Overall, on the regulatory side, the country has clocked up remarkable achievements in opening up the economy and improving the business environment. As the 2018 Doing Business index shows (Figure 1.4), recent reforms closely aligned to good practices have put the country near the top of the world on registering property, closely followed by starting a business, getting credit, and dealing with construction permits.

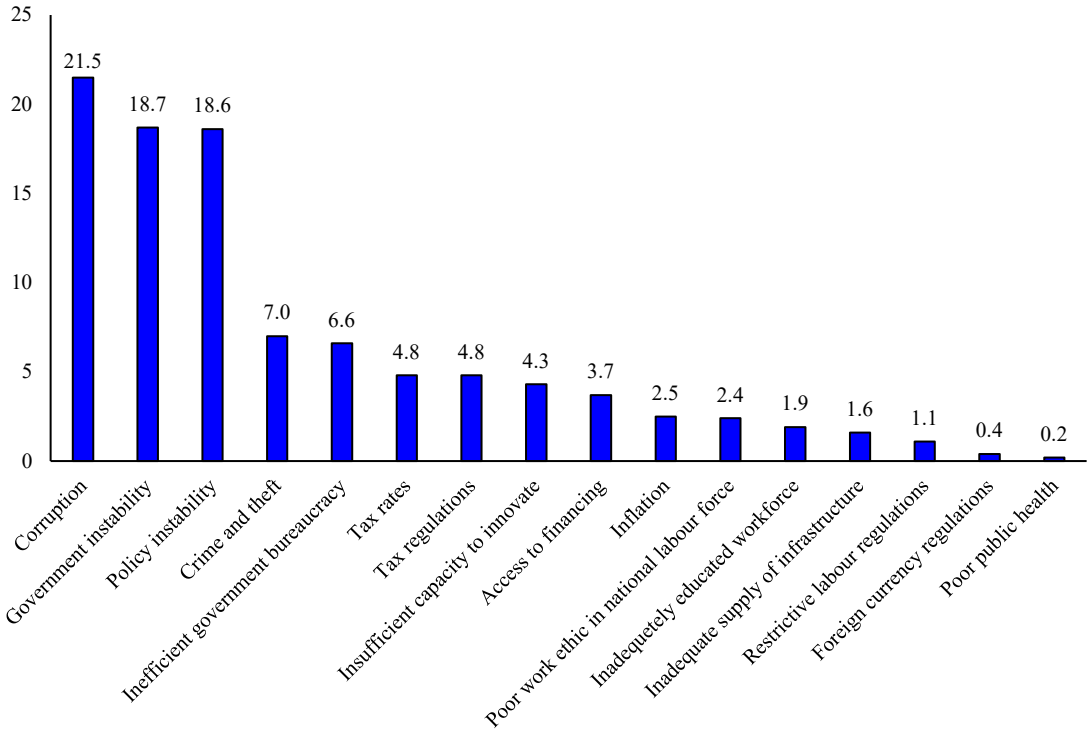
Figure 1.4 Kyrgyzstan's "Doing Business" ranking by topic, 2018



Source: World Bank Doing Business

Nonetheless, full transition to a market economy remains incomplete, with the most problematic factors for business being cited as corruption, government instability and policy instability (Figure 1.5).

Figure 1.5 Most problematic factors for "Doing Business" in Kyrgyzstan



Source: World Bank Doing Business

Rule of law ranks among the fundamental institutional pillars that makes a market economy work well – and, according to ADB's 2013 growth diagnostic, a binding constraint to economic development. Here, Kyrgyzstan has been, in contrast to its neighbours, on a downward trend, ranking merely in the 13th percentile (2016), down from 25th percentile in 2002 (World Governance Indicators) – while Kazakhstan improved from 13th to 35th in the same period. Innovative and export activities are often heavily reliant on a network of suppliers and service providers, making reliability of contract fulfilment paramount to their investment decisions – especially for Government contracts. There are also wide divergences between the letter of the law and enforcement; for instance, business surveys indicate that the labour code is often ignored in practice – with serious consequences both for working conditions and investor risk.

Corruption, especially bribery, is equally on a disconcerting upward slope. Ranking 37th in the world in 1996, it fell to 150th place among 177 countries in the 2013 edition of the Corruptions Perceptions Index, although rising to 136th in 2016. A 2011 EBRD survey found that over 60% of respondents reported personal experience with bribery or other kinds of corruption – far ahead of regional peers.

Access to finance, also a binding constraint according to ADB, is particularly important for innovative entrepreneurship. This is actually an area where recent reforms have been ostensibly successful. In the getting credit topic of the 2017 World Bank Doing Business Index,

Kyrgyzstan ranked 29th in the world – far ahead of Kazakhstan (77th) and Tajikistan (177). This is because of strong legal rights and accessible, reliable credit information.

But this is clearly not the whole picture. The financial market development pillar of the Global Competitiveness Index puts Kyrgyzstan in 96th place, pointing to weaknesses in equity markets and the ability of the financial sector to meet financing needs.

The problems lie elsewhere. While the Kyrgyz banking system is relatively stable following 20 years of reform and a period of crisis around 2010, they have little to draw from. Annual domestic savings remain below 10% of GDP (National Bank of Kyrgyzstan, NBK). Credit to GDP, at 20% in 2013, has risen from 6.3% in 2003 (NBK). But more than half of this goes into trading, and very little into investment. This is because of the conditions: real interest rates are very high, even for USD-denominated debt. Loan terms are short, rarely exceeding a year. And collateral requirements are stringent – the 2013 World Bank Enterprise Survey found that 89% of firms receiving credit had to put up collateral at an average value of 187% of the principal. This makes credit out of reach for new companies. At the same time, venture capital and other kinds of innovation-friendly equity is nascent at best.

With government spending of close to 40% of GDP and a low tax base, tax rates for companies that do pay tax are high and compliance requirements strict – while avoidance is widespread. The booming trading sector in particular remains competitive in part by avoiding tax and customs duties. Overall, companies have strong incentives to remain small and out of the eyes of the Government – or not to register at all.

A difficult transition has led to an economic structure that hampers Kyrgyzstan's potential for sustainable economic growth.

The transition has been difficult. The period 1992-1996 in particular witnessed a collapse in industry (36% to 17% value added as a share of GDP) and manufacturing (32% to 8% value added as a share of GDP), representing a tremendous loss of productive capacity during a period of economic dislocation (Figure 1.6). There has been some recovery, but manufacturing remains weak and struggles to maintain export competitiveness. The garment and textiles sector has risen to the fore over recent years, but margins are low and overreliance on the Russian market for exports has caused fluctuations due to a volatility in the Russian rouble exchange rate. Another issue is the low technological level: most industrial output comes from basic metals and minerals, with food processing and garments making up most of the rest. High-tech exports declined to just 0.6% in 2016.[2]

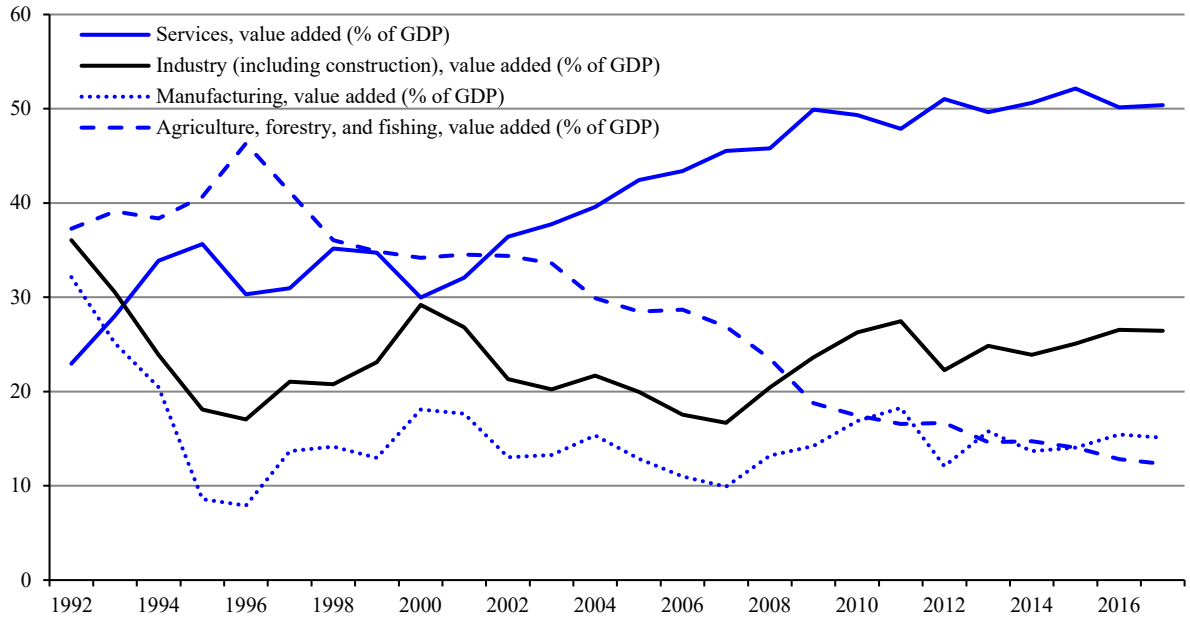
Most of the expansion in industry and manufacturing is driven by growth in basic metal outputs, based on heavy investments in gold mining – especially a single large mine, Kumtor, in Issyk Kulskaya oblast. Starting with discoveries in 1997, the sector reached 45% of exports in 2011. But gold mining is a capital intensive but employment poor sector with few potential spill-over effects on the private sector as a whole and with heavy reliance on fluctuating world market prices and unpredictable geological factors.

The share of agriculture in GDP fell from around 40% to 12% of GDP over the period 1992-2017 (Figure 1.6), offset by growth in the services sector, growing from 23% to around 50% of

[2] ITC Trade Competitiveness map.

GDP. This has been significantly driven by the trading sector, which has benefited both from booming consumer demand, financed in large parts by remittances and government transfers, and trades exploiting tariff differentials to profit from re-export – a window gradually closing after Kyrgyzstan entered the Eurasian Economic Union in 2015.

Figure 1.6 Sectoral composition of Kyrgyz economy, 1992-2017

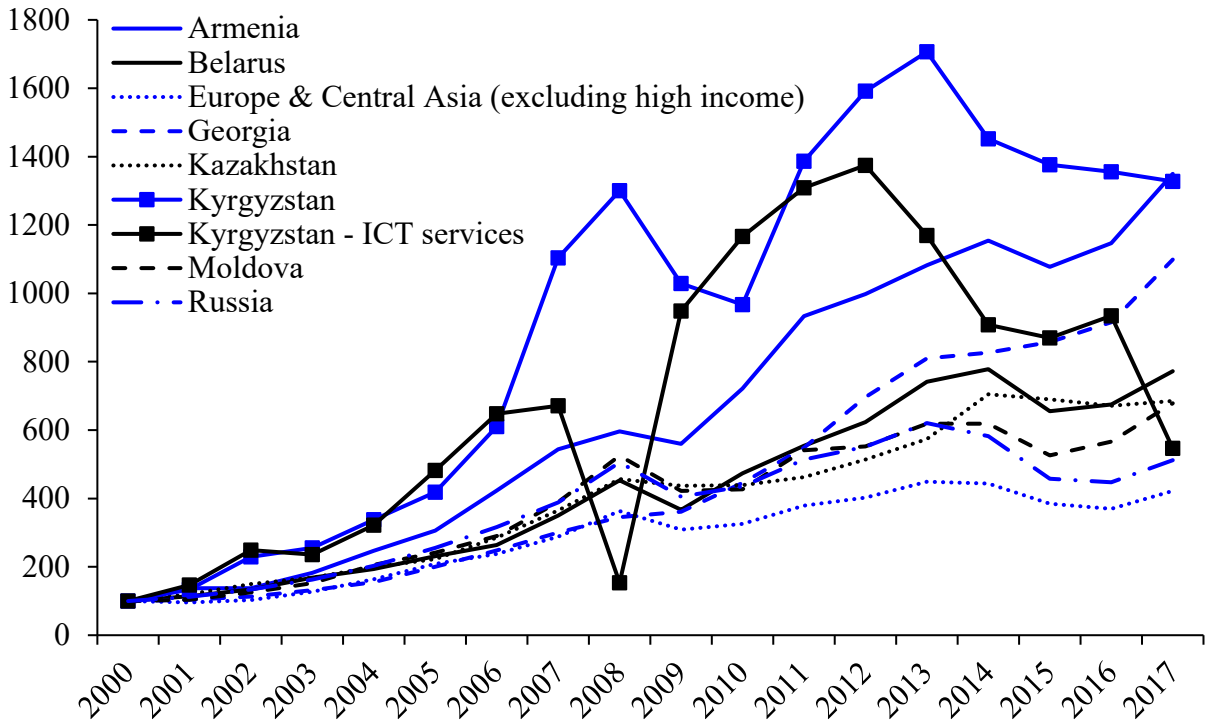


Source: World Development Indicators - World Bank Open Data

Growth in services exports has been a highlight of structural transformation …

The recent growth of services exports has been a highlight, with Kyrgyzstan performing at the top of its peer group (Figure 1.7). Over the period 2008-2013, the country saw very strong growth in ICT services exports in particular, albeit from a low base, driven by business process outsourcing, using low wages and local skills to cater to the needs of mostly Russian companies. A few years later, a slew of IT start-ups emerged, with bright graduates taking advantage of opportunities abroad and the low barriers to entry posed by falling prices for connectivity and processing. Supported by new initiatives such as a high-tech park in Bishkek, this boosted ICT services exports substantially, although performance has fallen back in recent years. This may have been partly driven by volatility in the Russian economy and rouble exchange rate, although export volumes for specific subsectors can always be expected to fluctuate from year to year, and the overall performance on services exports remains very strong as a whole over the period 2000-2017.

Figure 1.7 Services exports (2000 = 100)



Source: World Development Indicators - World Bank Open Data

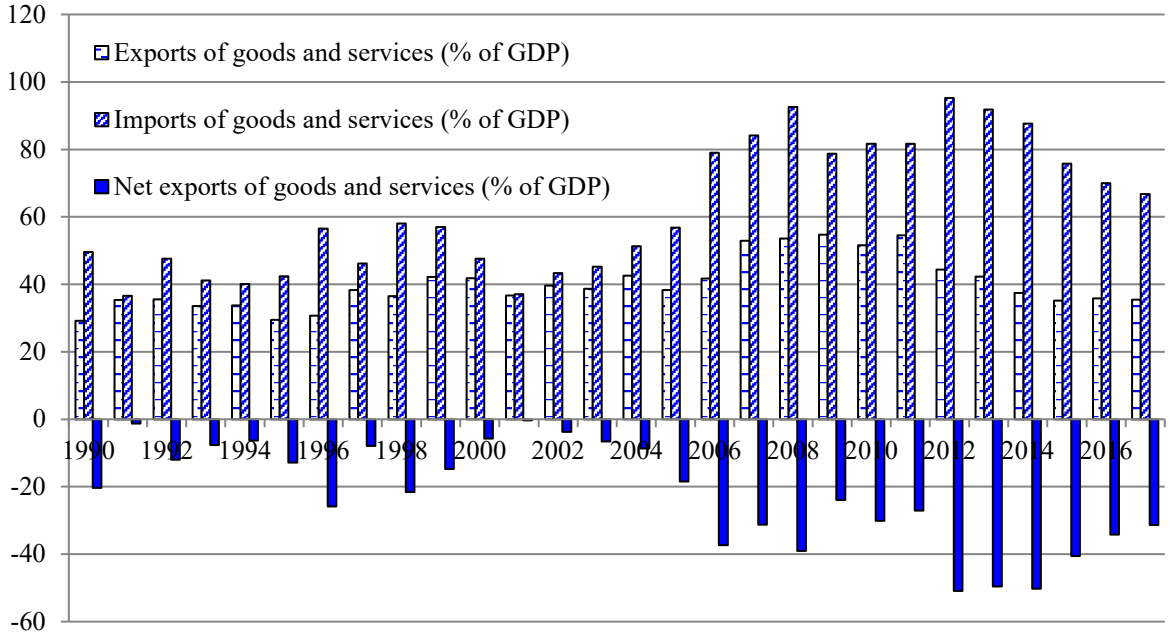
… although exports rely heavily on a few products and target countries.

With merchandise trade making up 83% of GDP, compared to 49% in Kazakhstan and 46% in Uzbekistan,[3] Kyrgyzstan is the most open economy in the region. Kyrgyzstan's accession to the EAEU in August 2015 changes the context for business internationalisation. While EAEU membership will give the country unfettered access to a large market, it might nevertheless have an adverse impact on investments in Kyrgyzstan. In particular, the higher tariffs at EAEU external borders, such as between Kyrgyzstan and China, might undermine Kyrgyzstan's foreign trade, especially in view of the important role of non-EAEU inputs (especially in the garment sector) and re-export activities from China, Turkey and other countries in Kyrgyzstan's foreign trade.

There is a long-running trade deficit in goods and services, largely funded by remittances and other capital inflows (Figure 1.8). It has narrowed in recent years as a share of GDP and represents in many cases domestic expenditure that supports improved living standards, but most likely will need to shrink further as the economy transitons to a higher level of development. Trade is concentrated in activities that are not always able to create the capacities needed for sustainable growth.

[3] World Bank Development Indicators, 2017.

Figure 1.8 Trade in goods and services, 1990-2017



Source: World Development Indicators - World Bank Open Data

Around half of products exported by Krygyzstan are unprocessed commodities, mainly gold – neither a source of valuable productive capacities nor employment. Gold production in particular is concentrated in a single mine with irregular output that strongly affect overall growth. Agricultural exports, such as dried fruit and vegetables to Turkey, forms a second leading category.

A major factor that drives this trend is the trading activity itself. Driven by differences in tariffs and preferential tax treatment, re-exports of consumer goods from China and other countries have played a major role in the economy, accounting for 13% of GDP in 2010.[4] These activities have been highly volatile, with volumes dropping by almost 50% in the wake of the global financial crisis and the devaluation of the Russian rouble and Kazahkstani tenge. Accession to the EAEU has presented both opportunities in the form of a larger market, and challenges in terms of external tariffs which are now, on average, higher (Box 1.2).

Only a small part of the export basket is made up of manufactured goods made in Kyrgyzstan, although EAEU accession has strongly benefited the nascent garment and textile sector due to access to what is effectively a new, much enlarged "internal" market. Textile products have become Kyrgyzstan's second largest export after gold. However, the sector is highly dependent on Russia, which is the destination of more than 95% of Kyrgyzstan's garment exports – resulting in major fluctuations in volume as the Russian currency depreciated sharply in 2014-2015.

Product space visualisations[5] suggests, with the exception of gold production, relatively few areas of strong revealed comparative advantage, often located in sparse areas of the product

[4] http://www.ucentralasia.org/Content/Downloads/UCA-IPPA-WP-9-Reexport-Eng.pdf
[5] See for example atlas.mit.edu

space and indicating that the production capacities concerned do not easily lend themselves to innovative diversification into other, new economic activities.

Box 1.2 Eurasian Economic Union

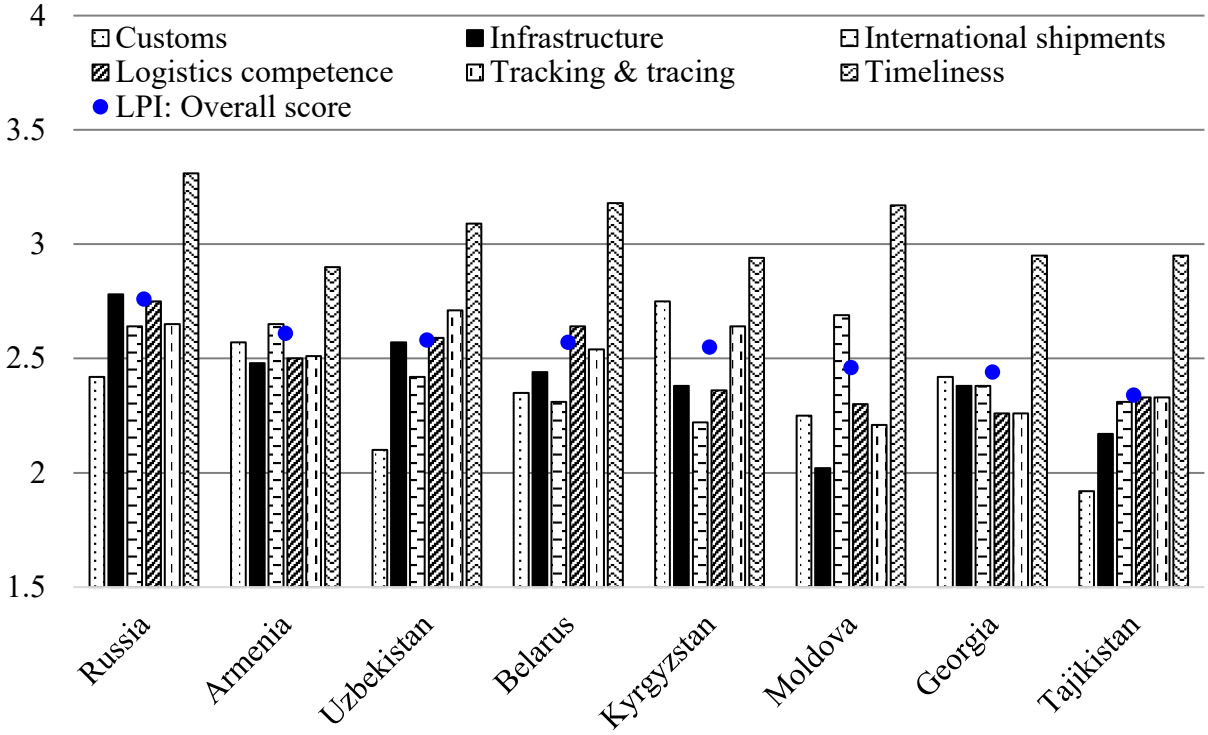
Kyrgyzstan formally acceded to the Eurasian Economic Union on 12 August 2015, joining Belarus, Kazakhstan, Russia, and Armenia to ensure free movement of goods, labour, and capital and coordination of economic policy. For a small economy like Kyrgyzstan, this immediate access to a large and growing market opens up a wide range of opportunities – not least for migrant workers, whose status is often vulnerable.

In the short term, the country has had to adapt its external tariffs to that of the union – causing average tariff rate to double from 5% before to 10.5% after accession, according to the WTO. This has increased consumer prices, and reduced incentives that underpinned the preceding boom in re-export activity. China, whose role has grown tremendously in the past decade – as exporter and investor – does not have a formal trade and investment agreement with Kyrgyzstan that could provide the certainty needed for further co-operation under OBOR.

However, much import-export activity was relatively low profit margin, with issues surrounding the long-run sustainability of the business model. Continued growth in the garment sector suggests that, at least for this sector, such challenges have been balanced by the opportunities of increased market access to other EAEU countries.

In addition to landlockedness, other factors combine to hamper exports. Given its low unit value and distance from high-income markets, Kyrgyz exports are quite sensitive to transport costs. In 2014, costs to import (US$ per container) were $600 and to export $4,760 – less than for Tajikistan, but 2-3 times more expensive than costs of trade for Armenia, Georgia or Moldova. In terms of performance relative to its peers, the World Bank Logistics Performance Index shows an average overall performance, with areas of relative strength including customs and tracking and tracing, and areas for improvement including international shipments, logistics competence and logistics infrastructure (Figure 1.9).

Figure 1.9 Logistics performance index, 2018



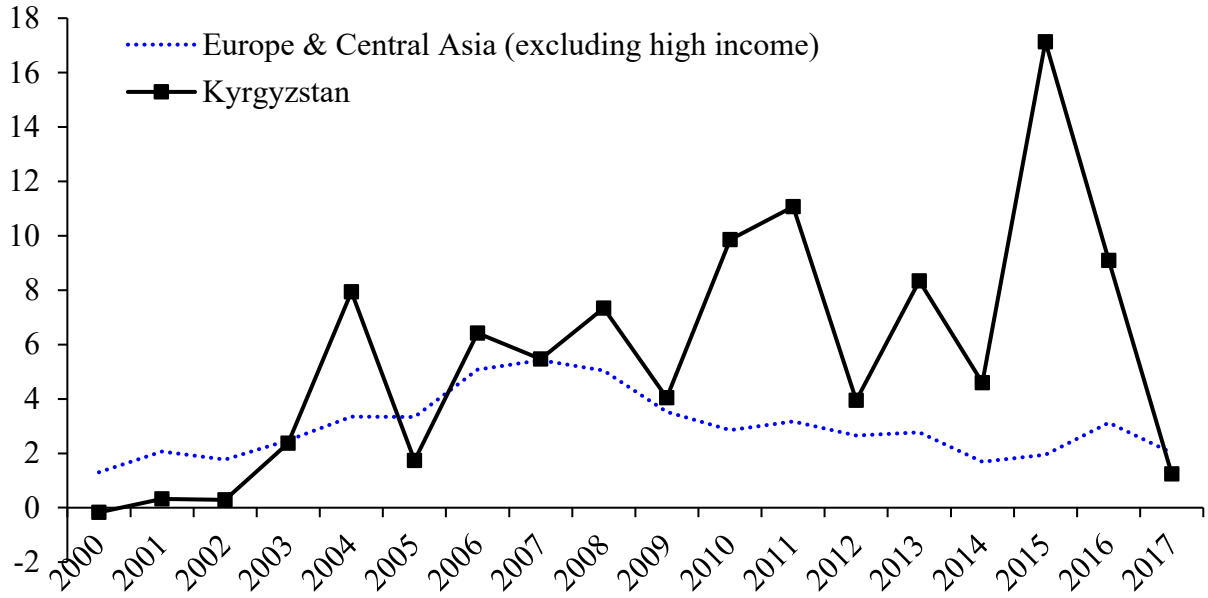
Source: World Bank International Logistics Performance Index; 1=low to 5=high

Investment is volatile and centred on mining…

Kyrgyzstan has made concerted efforts since independence to welcome investment and set up market-based institutions. With an open economy, low labour costs, and preferential access to the EAEU market, there is significant potential to attract investment. This is especially the case for infrastructure, agriculture, tourism, and light manufacturing

Following an economic boom at the turn of the century, the country currently invests between 20%-25% of GDP. 2000-2015 also saw strong increases in FDI inflows as a share of GDP (Figure 1.10), which were consistently above the average for the Europe and Central Asia (excluding high income) region. However, FDI net inflows have been highly volatile, and fell steeply from 2015-2017. Also, given low savings rate, Kyrgyz investment is highly dependent on external factors.

Figure 1.10 Net FDI inflows as a share of GDP, per cent



Source: World Development Indicators - World Bank Open Data

Major investors in recent years have been from Canada and China, and to a lesser extent the United Kingdom, Russa and Kazakhstan. The overwhelming majority has flowed into mining, in particular the Kumtor gold mine, although a growing share has benefited other sectors of the economy. Investment and export promotion efforts have already benefitted the garment sector, although the sector's opportunities could be re-assessed in the context of Kyrgyzstan's 2015 membership of the Eurasian Economic Union.

Another issue is that FDI flows have not targeted the kinds of activities that build productive capabilities for diversification and innovation. For diversification, Kyrgyzstan needs sectors that have the potential to transfer technology, raise value added and promote innovation through linkages of different kinds – such as those central in the product space. For Kyrgyzstan, this could include garments, tourism, agro-industries, but also opportunities to build on existing, marginal sectors such as construction materials and heavy machinery. As for the private sector, however, most investment is incremental and financed by reinvested earnings, highlighting problems with access to finance.

This could be in part due to Government policy. While the Government clearly acknowledges the role of domestic and foreign investors for sustainable development in general, and as a source for technology and management skills in particular, there are no concerted policies targeting such investment.

That Kyrgyzstan has been struggling to translate foreign investments into economy-wide improvements in technology and skills is clear. Total factor productivity growth, an indicator of efficiency gains due to technology and skills upgrading, was negative at an annual average rate of -0.54% over 2006-2012[6]. This is in stark contrast to the rest of Central Asia, where Tajikistan's TFP grew by an annual 4.07% and Uzbekistan by 5.87%. This is in part because

[6] Conference Board Total Productivity Database.

of negative sectoral reallocation – labour freed up by the declining manufacturing sector resorted to lower productivity employment in agriculture or in the informal services sector.

…while fiscal resources and institutional capacities remain limited…

Sustainability of public funding is a source of macroeconomic risk for the private sector. In an effort to sustain aggregate demand in the wake of the 2010 crisis and, soon after, a sharp reduction in demand from Russia due to currency devaluation, the Government has engaged in expansionary fiscal policies.

Public spending levels are very high for a lower middle-income country. But even more so for Kyrgyzstan, with Government revenue amounting to only around 25% of GDP and creating a large deficit financed by lending from abroad and depleting reserves. Combined with a small tax base, significant informality, and inefficient revenue administration, this has led to a high tax burden for the formal private sector – a strong disincentive to innovation and export-intensive economic activity and investment.

This will make serious reform and fiscal consolidation inevitable over the next decade. This is not only likely to adversely affect aggregate demand, but will also further slow down essential investment into infrastructure, energy, and education.

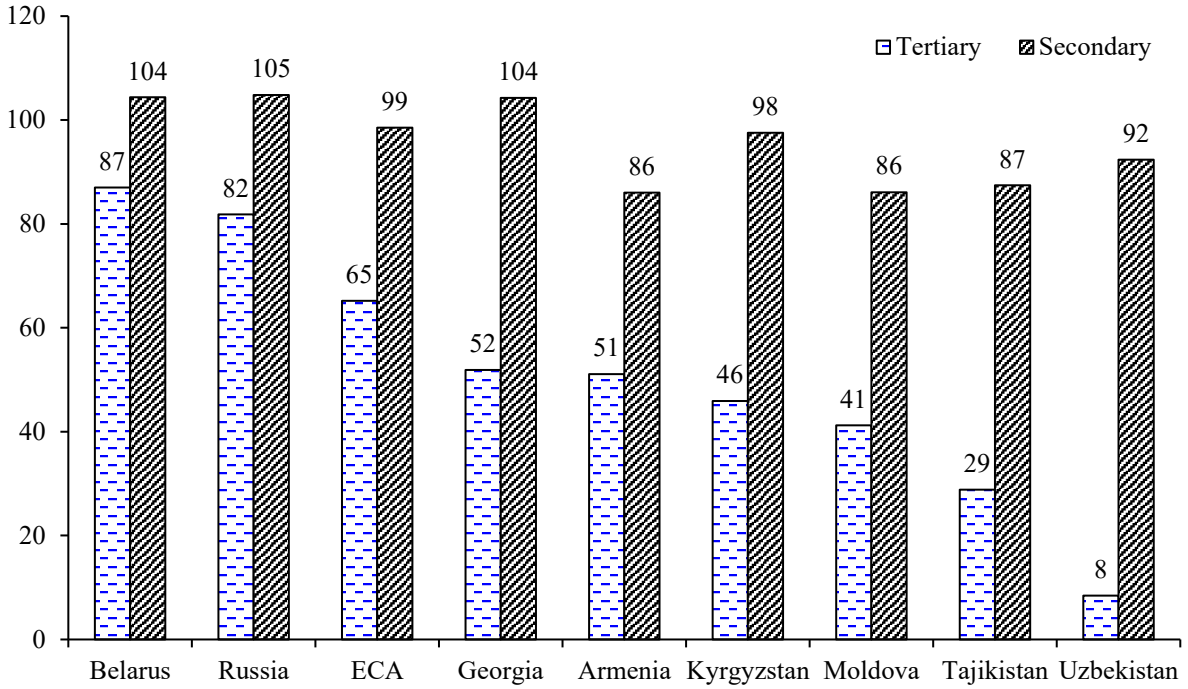
…and lack of workforce skills hinders productivity.

Low productivity figures have a simple explanation: too much employment is concentrated in lower value added economic activities. The decline of manufacturing exacerbated the situation, driving workers to often informal work in agriculture or domestic services such as petty trade. With much of the work force in the low productivity agricultural sector, not even capital intensive investments in mining and utilities were able to prevent negative productivity growth over the past decade.

A lack of access to skilled labour consistently ranks among the top constraints in business surveys. In the 2014 World Bank Enterprise Survey, 75% of respondents cited access to appropriate skills as a major problem. Outflows of both skilled and unskilled labour in the form of migrant workers have made this issue even more pressing. This stymies innovative activities in particular, as qualified labour is needed for companies to move to new or higher value-added stages of production.

At first glance, the situation looks more promising. Inheriting an extensive system of education from the Soviet Union, around 17% of the population has higher education – well above the average for lower middle-income countries. Among the younger generation, that proportion is in fact higher – and even slightly above the CIS average, though substantially behind Belarus and Russia (Figure 1.11).

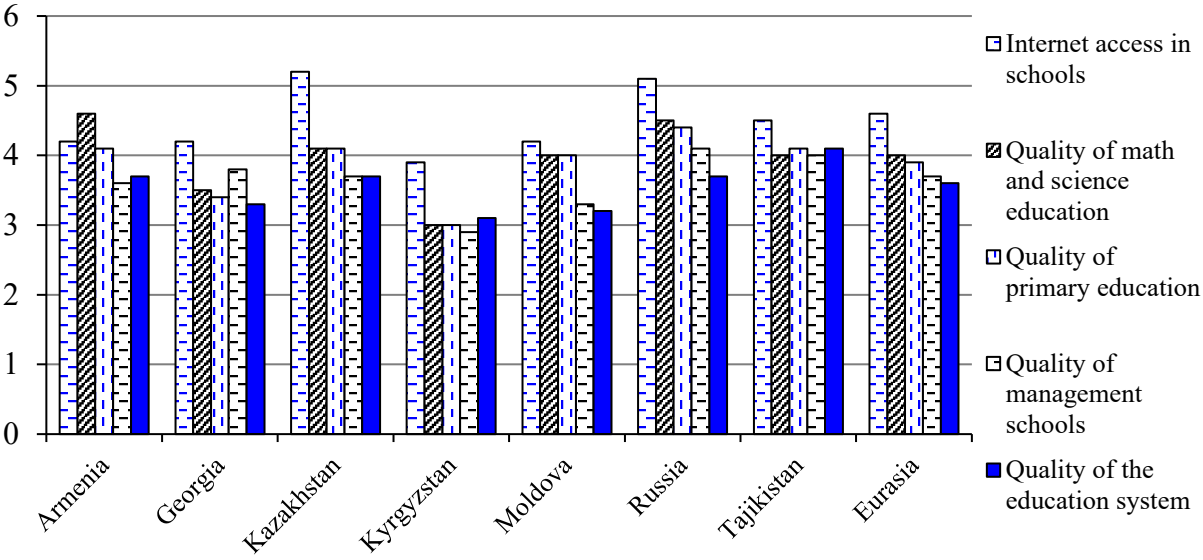
Figure 1.11 Gross enrollment rates, 2017



Source: World Development Indicators - World Bank Open Data
Note: ECA = Europe & Central Asia (excluding high income)
Note: Data for Kyrgyzstan from 2015; Belarus secondary enrollment data from 2015; Tajikistan secondary enrollment data from 2013.

The issue appears to lie in educational quality (Figure 1.12). While Kyrgyzstan has seen a boom in the number of private universities, quality across the sector has not been tightly controlled. According to the Executive Opinion Survey, upon which the Global Competitiveness Report is based, educational quality in Kyrgyzstan trails behind that of other CIS countries.

Figure 1.12 Educational quality, 2016



Source: World Economic Forum Global Competitiveness Index
Note: Metrics on a scale of 1-7 (best)

Perhaps even more pressing is insufficient vocational and technical education, which reaches only 4.5% of the population. Training institutes operate in relative isolation, with only a few partnership agreements with the private sector and little workplace training.

The effects of the skills gap can be seen in official unemployment figures. While in 2012 the overall unemployment rate was 8.4%, it was only 5.5% for people with tertiary education, according to the National Statistics Committee. Another indication are average wages, which for people with tertiary education were 2.4 times higher than for people with only primary education – a larger differential than in Armenia (1.41) or Russia (1.87).

Overall levels of expenditure do not appear to be the key factor. Indeed, it is extremely positive that government expenditures on education have risen from 3.5% (2000) to 5.5% (2015) of GDP, in addition to substantial private expenditure on tertiary education. Expenditure on education has at times amounted to 20% of total public expenditure, placing Kyrgyzstan very favourably in comparison with peer economies. Similarly, with a student-teacher ratio of 15:1, the country compares well.

However, there are significant urban – rural disparities. Moreover, teacher training is poor, quality control patchy, and teacher salaries low – 60% of the average civil service salary.[7] Officials at local or regional level have limited accountability, and the curriculum is in dire need of modernization. There has been consistent underinvestment in vocational and continuing education – an urgent need, as about half of the young population needs re-training.

A related issue is labour market efficiency. While the country has few restrictions on wage setting and job security, the country ranks 144th in the world on its perceived capacity to attract and retain talent.[8]

Progress has been made on female education, but the labour market record is less strong

Gender equality has been a key policy challenge for most countries in the region during the post-Soviet period, which saw significant institutional and social upheaval. Such upheavals typically affect more vulnerable groups, including women and girls. Gender bias, poverty and environmental risks have all been factors driving vulnerability. Other issues, particularly during the early days of economic transition, have included unfair distribution and access to resources, reduced employment opportunities for women, closure of childcare and social support institutions, and poor public medical services. Women were disproportionately impacted by poverty, and more likely to be excluded from decision making.

Nonetheless, there has been important progress in recent years, beginning with the ratification of the United Nations Convention on the Elimination of all Forms of Discrimination against Women (CEDAW) in 1997. CEDAW is a voluntary framework and requires States Parties to remove discriminatory legislation and to support women's greater access to decision making. In 2007, a 30 percent gender quota in leadership and decision-making positions was introduced. Female education is an area of strength. More women than men graduate from higher education institutions (HEIs), although a higher proportion of men than women possess doctoral degrees.

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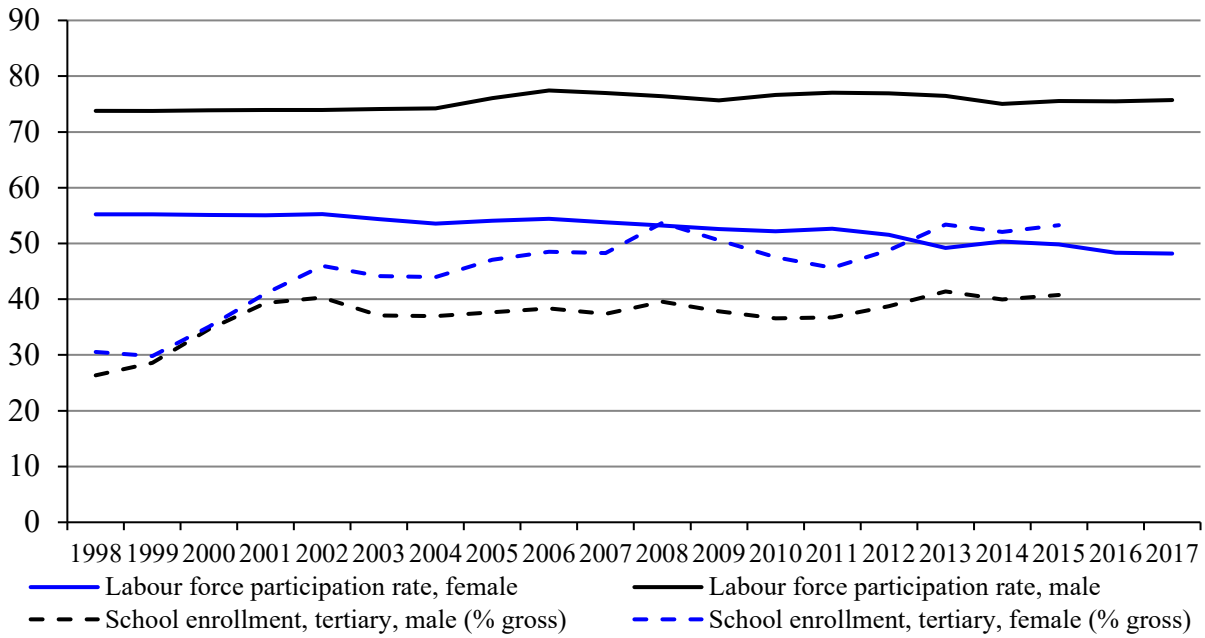
7 https://openknowledge.worldbank.org/bitstream/handle/10986/10100/622570BRI0Educ0Box0361475B00PUBLIC0.pdf?sequence=1&isAllowed=y

8 World Economic Forum Global Competitiveness Report, 2014, indicators 7.08-7.09.

Nonetheless, the latest available data indicated a higher percentage of women than men aged 25 years and above possessed a Master's degree, and tertiary enrollment rates are also higher for women than for men.

However, when we turn to the labour market, there is evidence of more significant gender bias (Figure 1.13). Women are concentrated in lower and poorly paid positions, including the traditional sectors of health, education and social services, as well as in the informal economy, with its risks and lack of social protection. In contrast to strong and improving educational attainment of women and girls, we see a trend of increasing underperformance as measured by the labour force participation rate, suggesting challenges for highly educated women to put their knowledge and skills into commercial practice. As noted in Chapter 6, a recent negative trend on SDG 5 (gender equality and women's empowerment) was due mainly to declining participation rates of women in the labour market and in parliament. Overall, despite a robust regulatory framework and a positive performance relative to a number of peer countries, more work remains to be done in terms of practical implementation, including support to civil society as an important driver of progress towards gender equality in the economic sphere.

Figure 1.13 Tertiary school enrolment and labour force participation by gender



Note: Labour force participation rates based on ILO modelled estimates for ages fifteen and above.

The national innovation potential is tangible but in urgent need of strengthening

The private sector is the main driver of the national economy, generating about 75% of GDP in 2004 and 84% of employment. It comprises mainly small entities: peasant farmers, individual entrepreneurs, and small and medium-sized enterprises, which accounted for 99.7% of registered businesses in 2011. Expert sophistication is low, and absorption of foreign technology and management practices – where by far most of the potential for growth lies – is also far below potential.

This is a leading reason why the Global Competitiveness Report, based in large parts on business perceptions as expressed in the annual, global Executive Opinion Survey, paints a picture of a country that lags far behind in its capacity for innovation. While the country performs well on health, higher education, goods market access, and macroeconomic stability, on almost all indicators of the innovation pillar, the country ranks much less well.

The same goes for technological readiness. Few technologies are available, companies are poorly able to absorb them, and FDI has brought few opportunities for technology transfer. An underlying reason is low levels of business sophistication, including cluster development and production process sophistication.

Kyrgyzstan has improved its ranking considerably in the Global Innovation Index, reaching a position of 94th in the 2018 edition. Areas for further development included creative outputs, institutions (in particular the political and regulatory environment), infrastructure (in particular logistics performance, energy intensity of GDP), and research and development.[9] Low levels of expenditure on research and development (chapter 3), are a key challenge.

[9] Global Innovation Index 2018: Energizing the World with Innovation, Cornell, INSEAD and WIPO.

Chapter 2

INNOVATION GOVERNANCE: FRAMEWORK CONDITIONS, POLICIES AND INSTRUMENTS

Chapter 2 presents the methodological approach that is followed in the Innovation for Sustainable Development Review of Kyrgyzstan, which is based on the National Innovation System (NIS) concept. The assessment of Kyrgyzstan's NIS, its structure and functioning is undertaken on the basis of the notion of "innovation for development", in the context of Kyrgyzstan being a lower-middle-income economy. The chapter proposes a number of conclusions and recommendations to complete the process of building Kyrgyzstan's NIS, as well as to improve framework conditions, NIS governance and performance.

2.1 Innovation in the context of Kyrgyzstan

The methodological approach in this Review is based on the National Innovation System (NIS) concept that innovation takes place in a system with interdependencies that influence the generation and diffusion of innovation. One definition of the NIS is: "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies". [10] This systemic approach helps to identify specific aspects (strengths, weaknesses, driving forces, etc.) of the innovation process and possible policy measures to help improve innovative performance.

Innovation is a broad concept, but is always associated with the successful commercial application of knowledge. The Organisation for Economic Co-operation and Development (OECD) defines four main types of innovation: product innovation; process innovation; marketing innovation and organizational innovation.[11] A product in one market can be an innovation when introduced into a market in which it was not present before. Importing a new to the market technology from abroad or introducing a new organizational model in a firm that imitates existing managerial models in established firms are also considered as innovation.

In transition economies such as Kyrgyzstan, still catching up in terms of economic and technological development, R&D-based technological innovation may not yet play a leading role. Nonetheless, vibrant innovative activities may still be present, based on imitation, adaptation and products, services and technologies that are new to the country. Local specificities that affect the nature of innovation activities include that:

- Kyrgyzstan is classified as a "lower middle-income country"[12], and is among the lowest income economies in Central Asia;
- Kyrgyzstan is a land-locked country, remote from major international markets;

[10] Chris Freeman (1987), Technology Policy and Economic Performance - Lessons from Japan, London: Pinter Publishers.
[11] OECD, Guidelines for Collecting and Innovation Data (Oslo Manual), 3rd edition. Paris: Organisation for Economic Co-operation and Development, 2005.
[12] For the year 2017, the World Bank defines as lower middle-income economies those with a gross national income per capita calculated using the World Bank Atlas method between $1,026 and $4,035 in 2015.

- Exports are dominated by primary commodities and low value-added products;
- 66.3% of the population live in rural areas (2015 data);
- Labour migration (including seasonal) is very high, accounting for a sizable share of the working age population;[13]
- Remittances play an important role as a source of income to the local population and as balance of payments support.

Innovation in a transition economy such as Kyrgyzstan is characterised by some specific features (Box 2.1) that serve as guiding principles in this Review.

Box 2.1 Innovation for development

Analysis of innovation processes in low and middle-income economies has given rise to the notion of "innovation for development", meaning innovation-based initiatives that also address development issues.[14] This results in specific challenges, including:

- An unsupportive economic and institutional environment and deficient infrastructure;
- Small domestic markets lacking in economies of scale;
- A business sector dominated by low-tech and often informal SMEs and microenterprises;
- Underdeveloped and fragmented innovation systems (with missing components and poor linkages);
- Unfavourable conditions for technological innovation;
- Acute financing constraints for potential innovators with limited ability to bear risk;
- Short-term planning horizons that suppress the motivation of entrepreneurs to start longer-term innovative projects.

Specific opportunities for innovators in low and middle income countries include:

- The distance from the technology frontier creates opportunities for catch-up and productivity growth through technology transfer;
- Imitation and adaptation face much lower barriers than frontier innovation but require local learning capacity for knowledge diffusion and absorption;
- Grassroots innovation[15] has great potential to support economic development in low-income countries by addressing local needs;

[13] By some estimates, around 1 million Kyrgyz people work abroad of which 800 ths. in the Russian Federation.
[14] See: Jean-Eric Aubert, Promoting Innovation in Developing Countries: A Conceptual Framework, World Bank Policy Research Working Paper 3554, April 2005 (https://openknowledge.worldbank.org/bitstream/handle/10986/8965/wps3554.pdf?sequence=1); Yoslan Nur, Rethinking the Innovation Approach in Developing Countries, WTR (World Technopolis Association) 2012; Manuel Trajtenberg, Innovation Policy for Development: An Overview, presented at the 2nd annual meeting of the Latin America/Caribbean and Asia/Pacific Economics and Business Association (LAEBA) in Buenos Aires, Argentina, 28-29 November 2005 (http://www.tau.ac.il/~manuel/pdfs/Innovation%20Policy%20for%20development.pdf).
[15] Grassroots innovation usually refers to bottom-up initiatives of local stakeholders that seek novel solutions to (mostly local) social challenges or development issues.

- The agricultural sector offers considerably opportunities for innovation for development, especially based on the introduction of new technologies;
- There is considerable scope for low cost managerial and organisational innovations.[16]

Innovation based on adaptation and imitation (mainly through technological imports) can address some of the challenges and risks faced by innovators in low-income countries. In particular, the risk of market acceptance, a key risk for globally new products and services, is much lower when an innovation has been proven abroad, while time horizons are much shorter due to "skipping" early, post-invention phases such as proof of concept, scaling up, etc. Financing requirements for R&D are lower. There is no need for early stage innovation financing (such as business angel or venture finance) and imported technology may be used as collateral. Finally, such innovations are also often undertaken by established firms with a track record of revenues, expenditures and credit.

There are important policy implications of "innovation for development" and a broad understanding of innovation as including novelties in the local context of low-income countries:

- A multitude of positive socio-economic outcomes: jobs and income growth, skills development and economic diversification;
- A need to target specific innovation capabilities: imitation and adaptation should be central to the policy focus;
- Prioritization of technology diffusion and adaptation and the required local capabilities, in particular learning;
- Policy instrument can include metrology, standards and quality control, extension services, information and training programmes, demonstration and pilot projects;[17]
- A narrow economic specialization can be turned into an opportunity, identifying natural starting points for innovative ventures in already established economic sectors;
- Policy should support the most promising and successful innovation practices (such as grassroots innovation), including by promoting demand for local innovation;
- Innovation for development tends to be bottom up; the rationale is to establish an enabling environment and incentives for local innovative entrepreneurs;
- Resource constraints in low-income countries dictate a gradualist approach, tailored to local context.

An effective NIS depends on several key subsystems, including the (national and international) market for innovative products and services. The (national and international) business sector is another key subsystem, both as a supplier of innovative products and as an important driver of innovation demand. A third key subsystem is that of knowledge generation, including academic and R&D institutions. The subsystem of innovation intermediaries providing various innovation support services helps different stages of the market uptake of innovative ideas. Finally, there is the business environment and framework conditions that shape the incentives and motivation of all innovation stakeholders. The network of linkages is a precondition for

[16] Caroline Paunov, Innovation and Inclusive Development: A Discussion of the Main Policy Issues, OECD Science, Technology and Industry Working Papers, 2013/01, OECD Publishing (http://dx.doi.org/10.1787/5k4dd1rvsnjj-en)
[17] Jean-Eric Aubert, op.cit.

collaborative interaction between innovation stakeholders and is also an important building block of the NIS.

The NIS of small, open economies such as Kyrgyzstan have certain specificities. A limited local market calls for a high degree of integration into the global economy, and full-fledged participation in the international division of labour. Well-functioning bidirectional linkages to large international markets are a precondition for local firms to grow, as well as for the inflow of modern technologies and ideas, the connection of local innovation stakeholders to international partners and the establishment of stable partnership relations within global value chains. The existence or absence of such linkages can be partly attributed to geopolitical factors and other national specificities. But they are also to a large degree shaped by – and the result of – national policies to develop sustainable international linkages.

This Review seeks to identify those missing or weak elements in the Kyrgyz NIS that have or may have a critical role to play in the emergence of vibrant innovation-for-development processes. Given the generally underdeveloped state of the innovation system, the range of possible policy recommendations is very wide, while administrative capacity and available resources are limited. This Review therefore focuses on certain core measures that are likely to have the most significant and immediate effects, as well as on measures that are less demanding in terms of financial resource.

2.2 Innovation policies and institutions in Kyrgyzstan

Legislative and institutional reforms

The years following Kyrgyzstan's independence have been dynamic and often turbulent. As was also the case in all post-Soviet countries, the breakdown of pre-existing economic and trade links left most manufacturing firms redundant and left a shattered economy. State building and crisis management were the tasks of foremost priority.

Some of the first legislative acts governing entrepreneurship, science and innovation (the Law on Science and Science and Technology (S&T) Policy, Law on Innovative Activities and Law on the Protection of Entrepreneurs) were adopted in the late 1990s during periods free of political turmoil (Table 2.1). In the early 2000s, they were followed by the Law on the National Academy of Sciences and the Law on Education, while the promotion of entrepreneurship was strengthened through the Law on State Support to Small Entrepreneurship.

Table 2.1 Recent legislative, programmatic and regulatory innovation policy documents (chronological order)

Policy document	Implementing agency
Law of the Kyrgyz Republic on Science and State Science and Technology Policy, 15 April 1994, No. 1485-XII (revised 1999, 2008 and 2012)	Government of Kyrgyz Republic
Law of the Kyrgyz Republic on Innovative Activity, 26 November 1999, No. 128.	Government of Kyrgyz Republic
Law of the Kyrgyz Republic on the Protection of Entrepreneurs' , 1 February 2001, No. 15 (revised 2008 and 2015)	Government of Kyrgyz Republic
Concept for the Development of Support of Small and Medium Entrepreneurship in 2001-2005. Approved by Government Degree No. 424 of 11 August 2001.	Government of Kyrgyz Republic
Government Decree No. 466 of 20 August 2001 "On the financing of scientific, R&D and innovative activities from the Republican budget" (revised by Government Decree No. 479 of 23 August 2011).	Ministry of Finance
Presidential Decree No. 26 of 19 January 2002 "On measures for further development of industry and innovative activity in the Kyrgyz Republic" (revised August 2002 and April 2003)	Government of Kyrgyz Republic
Government Decree No. 259 of 29 April 2002 "On the Concept for the Development of Education in the Kyrgyz Republic"	Ministry of Education and Science
Law of the Kyrgyz Republic on the National Academy of Sciences of the Kyrgyz Republic, 7 August 2002, No. 59	National Academy of Sciences
Law of the Kyrgyz Republic on Education, 30 April 2003, No. 92 (revised 2006, 2009, 2013, 2015 and 2017)	Ministry of Education and Science
Government Decree No. 28 of 27 January 2003 "On the State Innovation Fund of the Kyrgyz Republic" (revised June 2003).	State Centre for Innovative Technologies (now non-existent); Kyrgyzpatent
Law of the Kyrgyz Republic on State Support to Small Entrepreneurship, 26 May 2007, No. 733 (revised and updated 2008, 2009 and 2015)	Government of Kyrgyz Republic
Law of the Kyrgyz Republic on the High-Technology Park of the Kyrgyz Republic, 8 July 2011, No. 84	Government of Kyrgyz Republic
State Programme for the Development of Intellectual Property and Innovation in the Kyrgyz Republic in 2012-2016. Approved by Government Degree No. 593 of 23 September 2011.	Kyrgyzpatent
Government Decree No. 131 of 20 February 2012 "On the State Service of Intellectual Property and Innovation under the Government of the Kyrgyz Republic (Kyrgyzpatent)" (revised by Government Decrees No. 163 of 1 April 2013 and No. 168 of 30 March 2015).	Kyrgyzpatent
Government Decree No. 201 of 23 March 2012 "On the strategic directions for the development of the education system in the Kyrgyz Republic" (including "Strategy for the Development of Education in the Kyrgyz Republic in 2012-2020") (revised by Government Decree No. 395 of 1 July 2013)	Government of Kyrgyz Republic; Ministry of Education and Science

Government Decree No. 790 of 22 November 2012 "On measures for the development of innovative activity in the Kyrgyz Republic".	Government of Kyrgyz Republic
State Programme for the Development of Intellectual Property and Innovation in the Kyrgyz Republic in 2012-2016 (revised 2013). Approved by Government Degree No. 623 of 11 November 2013.	Kyrgyzpatent
Concept for the Reform of the Science System in the Kyrgyz Republic. Approved by Government Decree No. 221 of 16 April 2015.	Government of Kyrgyz Republic; Ministry of Education and Science
Concept for the Scientific and Innovative Development of the Kyrgyz Republic until 2022. Approved by Government Decree No. 79 of 8 February 2017.	Government of Kyrgyz Republic; Kyrgyzpatent

Source: Author's compilation

This basic legislation set the stage for elaborating some key programmatic documents and the accompanying regulation detailing the directions of public policy on scientific and technological development such as the government decree on the Strategic directions for the development of the education system (2011); the State programme for the development of intellectual property and innovation (2013); the Concept on reform of the science system (2015) and, more recently, the Concept on scientific and innovative development (2017).

Already the Law on Innovative Activity, adopted in 1999, laid a solid foundation for entrepreneurial activities resulting in new products and services on the Kyrgyz market. This law introduced in legal form the key concepts related to the innovation process and was based on the most up-to-date conceptual framework at the time. It defined the key national objectives and principles of conduct of innovation policy. Responsibility for innovation policy design and implementation was assigned to the Government - another sign of the priority associated with this role. In particular, the government was tasked with the responsibilities for establishing the national innovation system, developing the state programmes for innovative development, preparing drafts of future laws and regulations as well as for the operational management of the related implementation tasks.

The Law on Innovative Activity was a first attempt at institutional build-up of the NIS and the systematic development of innovation infrastructure. It contained a proposition for the establishment of a National Innovation Council as the highest public authority tasked with the management and coordination of innovation activity in the country. The Law envisaged establishment of innovation departments at all relevant lower levels of public administration and establishment of a National Innovation Fund as one of the instruments for public funding of innovation. However, none of these provisions was implemented as planned, largely due to political turmoil in the years that followed.

The next practical steps in this area were taken in 2001-2002 (see Table 2.1). In 2001, the Government adopted a decree on the financing of scientific, R&D and innovative activities. This decree defined the funding sources and allocation mechanisms of public funds to scientific and R&D programmes and innovation projects. This decree was only partially implemented with regard to the funding of scientific and R&D programmes.

The Presidential Decree on measures for further development of industry and innovative activity (2002) introduced a new policy direction by linking innovation to industrial development, calling for establishment of a Council for the Development of Industry and Innovative Activity under the President as well as preparations to establish a National Innovation Fund. Accordingly, in 2013, the Government adopted a decree to set up this Fund and its managing body, the State Centre for Innovative Technologies.

Again, implementation did not follow prescribed directions. In particular, a National Innovation Fund was never set up as a funding agency of R&D and innovation projects. While the State Centre for Innovative Technologies came into existence, it never acted as a funding body but mostly engaged in policy related research. This centre was later closed down as part of a reorganization of Kyrgyz research organizations.

In 2012, functional responsibility for implementation of innovation policy was assigned, by Government decree, to the State Service of Intellectual Property of Kyrgyzstan, which was renamed the "State Service of Intellectual Property and Innovation" (Kyrgyzpatent). Kyrgyzpatent is now the lead agency tasked with the preparation of draft legislation and regulation governing innovation activity.

A new wave of reform in education, science and R&D activity followed with a series of legislative and programmatic measures (Table 2.1). Government decree No. 790 of 22 November 2012 "On measures for the development of innovative activity in the Kyrgyz Republic" revisited provisions of the Law on Innovative Activity of 1999 and established a State Council on Innovation under the Government of the Kyrgyz Republic headed by the First Vice Prime Minister and including key ministers and heads of public agencies. The decree prescribed that Council serve as the highest public authority recommending legislative and regulatory policy initiatives and measures for the support and promotion of innovative activity.

The Government adopts on a recurrent basis priority areas of scientific research that serve as the basis for funding of state S&T programmes and projects. For 2017-2020 these include:

- Efficient use of natural resources;
- Food security;
- Information technologies (IT);
- Health and quality of human life;
- New energy technologies;
- Tourism and transport; and
- Social sciences and humanities.

The Concept for scientific and innovative development to 2022 (hereon referred to as "CSID 2022"), adopted by Government decree in February 2017, is a key programmatic document that will have a lasting impact on development of the NIS. It is based on the National Strategy for Sustainable Development 2013-2017 while also offering an up-to-date vision for the future development of science and innovation based on the most recent methodological developments. CSID 2022 defines precise terminology such as National Innovation System, public innovation policy, innovation infrastructure, innovation activity, commercialization, etc., adapted to the national context.

Given the current level of economic development, CSID 2022 realistically identifies the most urgent priority of the NIS as the transfer and adaptation of modern technologies from international to local markets. Policy objectives include the integration of education, science and business as part of an NIS focused on technological transfer. Policy should aim to develop the necessary infrastructure and an enabling business environment. Innovation policy should also be selective in supporting technological transfer in those sectors and production facilities identified as priorities of national economic development. This understanding of innovation policy given the wider level of economic development is fully aligned with the "innovation for development" concept - evidence that national policymakers have set realistic and pragmatic innovation policy objectives.

CSID 2022 states that the manufacturing modernization should be regarded as the foundation of national innovative development and rely in the first instance on technological transfer from abroad rather than on indigenous development of new technology. Policy should thus focus on: support to the import of new technological equipment; facilitating inward FDI; promotion of international S&T cooperation and exchange; development of and support to technology transfer centres as well as economic zones and clusters focused on technology transfer.

CSID 2022 formulates the main objectives and tasks for NIS development. Key targets include: enhancing the science system deepening the collaboration between academia and business and developing the NIS infrastructure. CSID 2022 also outlines the mechanisms and instruments for pursuing these long-term objectives, including to: support innovative companies, especially in their early stages; establish innovation support institutions (e.g. business incubators and technology transfer centres); and set up enabling regulations and framework conditions. The document recognizes that such new innovation policy mechanisms and instruments need to be adequately financed. It calls for a gradual increase in the budgetary funding of R&D and innovation and mobilization of additional funding from the business sector by offering attractive opportunities for co-financing of R&D and innovation projects.

Current state of the national innovation system

The NIS is at an early development stage with many building blocks of typical, mature innovation systems missing or in an embryonic form.

The knowledge generation subsystem is represented by a fairly comprehensive higher education system and a set of R&D institutions, both largely a legacy of the Soviet past. Tertiary education is represented by 52 universities with an aggregate enrolment of some 230 thousand students. After independence, the private sector entered the tertiary education market quite aggressively and now accounts for 21 higher education institutions. 30 universities (21 state-owned and 9 private) are concentrated in Bishkek. Rapid growth in the number of higher education institutions was not always matched by adequate teaching quality. A systematic assessment of tertiary education in 2009-2010 resulted in the closure of 14 universities and withdrawal of teaching licences for several dozen university teaching programmes. In 2010, Kyrgyzstan started the gradual introduction of a two-level system of tertiary education (bachelors and master degrees) in line with the Bologna Process of standardization of tertiary and higher education qualifications.

Following independence, the National Academy of Sciences (NAS) was reorganized as an independent, national body in 1993 and its statute set up by the Law on the NAS (2002),

identifying NAS as the highest scientific body undertaking fundamental and applied research. This law also identifies NAS as the public body responsible for development and implementation of the national S&T policy, including state programmes for fundamental and applied research. The law also envisages fully autonomous funding of NAS through a separate line in the state budget. The NAS allocates these financial resources among NAS institutes and S&T programmes according to adopted national priorities and funding rules.

NAS includes 24 institutes in various areas of fundamental and applied research. Their main source of funding is that allocated within the NAS; applied institutes also undertake contractual research for local businesses which generates supplementary funding. Overall, NAS institutes, including those that sell their own R&D services, are grossly underfunded, preventing investment to upgrade equipment and facilities. As at end 2016, NAS staff totalled 1,986 persons, of which 1,014 researchers (589 of whom holding postgraduate degrees). During 2016, NAS scientists worked on 48 national projects with a total funding from the state budget amounting to KGS 310.5 million. In addition, NAS took part in 43 international projects raising USD 0.756 million and in projects funded by grants from the Ministry of Education and Science (MES) raising KGS 0.61 million. Supplementary contractual funding raised by NAS in 2016 amounted to KGS 11.67 million. Budgetary financing accounted for around 77% of NAS total revenue in 2016, with 23% from international grants and contractual funding.[18]

There is also a subset of non-NAS research institutes: 38 research centres at higher education institutions, 9 sectoral R&D institutes under various line ministries and 16 medical research centres.

The local market for R&D and innovative products is very shallow. Local manufacturing, considered by public policy as a key driver of innovation through modernization, is tiny and fragile. Contractual R&D projects largely concern partial modernization or renovation works, as well as maintenance or repair works on outdated technologies utilized by local businesses. These could, in principle, be undertaken by the industry's own R&D departments, but the latter are practically non-existent in Kyrgyzstan. Industrial reconstruction and expansion, for example in food processing, textiles, energy and other sectors, is almost exclusively through the import of new technological equipment. Overall, the level of in-house innovation activity in the Kyrgyz business sector is rather low.

Innovative entrepreneurship and grassroots innovation initiatives do exist in Kyrgyzstan and could become key drivers of innovative activity, particularly in traditional industries like agriculture and food processing but also high-tech branches like the ICT sector. Microcredit is relatively well developed and could be drawn on to support innovative entrepreneurship. However, such a shift would require targeted policy support, which is missing at present.

Innovation intermediaries are largely absent from the NIS. There are very few functioning innovation support institutions such as incubators, technoparks and technology transfer centres.

[18] According to data in the articles "About the activities of NAS In the last 5 years" by NAS President Erkebaev and "Main outcomes of the organizational and scientific activity of NAS" by NAS Chief Scientific Secretary Arabaev, published in: National Academy of Sciences of the Kyrgyz Republic, Concise Annual Report 2016, Bishkek, 2017.

Early-stage financing institutions, such as business angels and venture capital firms, are either non-existent or play a marginal role.[19]

The establishment of an efficient NIS in small open economies depends crucially on international economic integration - in particular, successful plugging of local businesses into global value chains. Kyrgyzstan's geographic location presents major physical obstacles for such processes, despite repeated policy efforts. Thus, Kyrgyzstan was the first post-Soviet state to join the WTO in 1998 and opened its markets almost completely. However, rapid trade liberalization was not sufficient to spur the desired influx of FDI; instead cheap imports from China strengthened competitive pressures in the local market, pushing many already frail domestic producers into bankruptcy.

Kyrgyzstan subsequently strengthened its economic ties with Russia and Kazakhstan and took part in some economic cooperation initiatives among post-Soviet states. Kyrgyzstan joined the EAEU in 2015, and now benefits from privileged access to a large market and strengthened economic relations with Russia. Institutions tasked with strengthening integration within the EAEU like the Eurasian Development Bank do support projects of trans-border EAEU economic integration but, so far, macroeconomic effects are insignificant. Such projects are mostly related to infrastructure development, with only a few focused on industrial modernization. To date, there is limited evidence that the EAEU has contributed to the strengthening of the international linkages to support an efficient NIS.

Kyrgyzstan also takes part in innovation cooperation mechanisms with CIS countries, including the Interstate Programme on Innovation Cooperation of CIS countries to 2020. This programme supports areas of cooperation such as: innovation projects and matchmaking; research projects and coordination of research programmes; skill development for R&D and innovation support staff; innovation infrastructure; coordination of R&D policy and harmonization of regulations. Practical impact has been limited due to the lack of centralized funding earmarked to support programme activities, with the programme relying on national funding already allocated for similar purposes which, in the case of Kyrgyzstan, is very limited.

The financial system is underdeveloped and typical of a lower-middle income economy, being dominated by the commercial banking sector. In 2016, 25 commercial banks were operating in Kyrgyzstan and accounted for 91% of total assets in the financial sector. Foreign participation is significant: in 2016, foreign entities held ownership stakes in 18 commercial banks; 12 out of these were majority foreign owned. The Kyrgyz financial sector includes 17 insurance companies, 9 investment funds and two pension funds and a fairly well-developed system of microcredit institutions (168 microfinance organizations and 119 credit unions in 2016). In turn, the subsector of non-bank financial institutions is fairly concentrated: in 2016, the three largest institutions accounted for more than 40% of total assets.[20] Dollarization is very high, with more than half of bank deposits denominated in foreign currency in April 2016.[21]

[19] Highland Capital Bishkek (www.highland.kg) is one of a very few private local firms that define themselves as venture funds. It is part of a regional vehicle operating in Kyrgyzstan, Tajikistan and Kazakhstan that provides mezzanine debt and private equity finance to medium-sized enterprises. However, since its inception in 2014 it has closed just a handful of deals in Kyrgyzstan.

[20] Financial Sector Stability Report of the Kyrgyz Republic, National Bank of the Kyrgyz Republic. First half of 2016 (http://www.nbkr.kg/ index1.jsp?item=2305&lang=ENG).

[21] National Bank of the Kyrgyz Republic. Monetary survey (http://www.nbkr.kg/index1.jsp?item=127& lang=ENG).

International donors and development support institutions are present in Kyrgyzstan, with the Eurasian Development Bank being particularly active. International financial institutions such as the Word Bank Group, ADB and EBRD have long records of development assistance to the country. The EU is also engaged in development assistance through its Investment Facility for Central Asia and the Central Asia Invest programme.

The Russian-Kyrgyz Development Fund is an important recent initiative that supports a wide range of public and private development ventures, including modernization and innovative projects (Box 2.2).

Box 2.2 The Russian-Kyrgyz Development Fund

The Russian-Kyrgyz Development Fund (RKDF - http://www.rkdf.org/) was established in accordance with a 2014 intergovernmental agreement between Russia and Kyrgyzstan. RKDF supports economic cooperation between the two countries, modernization and development of the Kyrgyz economy, as well as Eurasian economic integration. RKDF defines its main areas of activity as:

- Debt financing of bankable projects in priority areas of the Kyrgyz economy, including projects with Russian participation;
- Equity financing of business entities operating in Kyrgyzstan;
- Facilitating privileged access of Kyrgyz business entities to medium- and long-term finance;
- Support to Kyrgyz financial sector development, including new financial services;
- Modernization of corporate management.

RKDF was established with statutory capital of USD 500 million in low interest credit granted by the Russian government. RKDF is governed by a five-member Board consisting of three members appointed by the Russian government and two members appointed by the Kyrgyz government. RKDF's mission largely matches Kyrgyz Government policy goals for innovative development through industrial modernization. The Fund can be regarded as a key innovation support and financing institution aligned with national policy. RKDF provides credit to borrowers at rates considerably better than prevailing market rates in Kyrgyzstan, acting as a genuine development financing institution. RKDF operates both directly (mostly for large project financing) and through a network of partner banks (mostly for SME support).

As at April 2017, RKDF had approved - directly or through partner banks - funding to 690 projects in Kyrgyzstan totalling USD 221.6 million. These included 27 directly funded large projects totalling USD 120.5 million and 663 projects initiated by SMEs and funded by partner banks, totalling USD 101.1 million. Key sectors included: the agri-business sector (about one third of all projects), transport and logistics, wood processing, plastics, metals and other materials, and infrastructure projects.

Planned reform of S&T management

At the time of this Review, the authorities were considering radical reforms to science and innovation, following the Concept for reform of the science system (2015). The envisaged

reform of S&T management is due to be harmonized with the earlier adopted Strategy for the development of education 2012-2020, which highlights the importance of education and human capital development for future competitiveness and social welfare. This strategy defines priorities for reforming tertiary education in Kyrgyzstan to align it with international best practice, including strengthening scientific research at higher education institutions.

The Concept for reform of the science system (hereafter "Concept for Reform") was put out to public consultation with all key stakeholders, including ministries and other public bodies responsible for education, R&D and innovation, the NAS, universities and R&D institutions. The expected outcome of these public debates is the development of new legislation governing science and innovation and, in particular, a new law on science and public science and technology policy and a new law on NAS. Furthermore, this new legislation would be the basis for developing by the Kyrgyz government of new approaches of shaping the national S&T programmes and screening the S&T projects as well as new mechanisms of funding R&D and innovation in Kyrgyzstan.

The Concept for Reform targets efficient management of R&D institutions in line with development priorities. It proposes further consolidation of financial and human capital resources, competitive R&D funding mechanisms, improved evaluation and screening of R&D proposals, and new public funding instruments for R&D and innovation projects. The Concept also envisages establishment of a Council on Science and Innovation under the Prime Minister to replace the existing State Council on Innovation under the Government. Responsibility for science policy are to be fully assigned to the existing Department of Science under the MES. The Concept for Reform envisages further extension of this Department's responsibilities, in particular, administration and management of a single Science Fund as sole holder and administrator of public funds earmarked for R&D.

The Concept for Reform envisages three types of S&T funding:

- Basic funding, for a transitional period of up to 2 years for research institutes that may be separated from the NAS and integrated with universities to support salaries and maintenance costs.
- Targeted funding, allocated by the Council on Science and Innovation to priority S&T programmes and projects.
- Grant funding to projects aligned with national S&T priorities through the single Science Fund on the basis of competitive bids.

Certain reform proposals put forward for public consultation are somewhat controversial and provoked heated debate. These include:

- Gradual reorganization of academic and research institutions by integrating some R&D institutes (mostly NAS institutes) into universities matching their profile, while reorganizing and streamlining the remaining NAS institutes. The aim is to boost the R&D capacity of higher education institutions, while raising the quality of tertiary education by involving experienced researchers in teaching. There is resistance from both sides due to the risks of such reform and, for successful implementation, the authorities should proceed very gradually and mainly on the basis of voluntary moves with adequate incentives.

- A single Science Fund under the MES, targeting more efficient allocation of public R&D funding. This would reduce the financial autonomy of the NAS, currently funded under a separate line in the state budget and independent in the internal funding allocation between NAS institutes.
- Similarly, assigning all functional responsibilities for the design and implementation of public science policy to the Department on Science under the MES would remove all such functions from the NAS, which currently acts as a high-level public authority responsible for shaping national science policy.

2.3 Framework conditions

Kyrgyzstan is an open economy with a relatively liberal trade regime. The transition from a planned to market economy was uneven, with "stop-go" reforms, but with persistent policy efforts to establish a conducive business environment and attract FDI. Kyrgyzstan ranked 75th out of 190 countries in the World Bank Doing Business Report 2017, compared to Kazakhstan at 35th and Tajikistan at 128th.

The business environment is generally investor friendly.[22] Market entry, including by foreign businesses, has been eased by business facilitation reforms. The most common type of business entities are private entrepreneurs followed by limited liability companies. The tax regime is competitive, especially for foreign companies, including a profit tax at a low, 10% standard rate and various allowable deductions. The standard value added tax (VAT) rate is relatively low at 12%, and most SMEs are VAT exempt, falling below a low revenue threshold. Businesses are subject to a sales tax on goods, works, and services at rates of 1.5%, 2.5% or 3.5% depending on transaction type and whether VAT is applicable. The sales tax is a rudimentary instrument which is due to be phased out and integrated into the VAT.

Aside from general tax provisions, special tax regimes apply to activities under a special patent tax regime for individual entrepreneurs not registered for VAT purposes only, some types of businesses (in particular, SMEs), or "zones" such as the Free Economic Zones (FEZ) and high-tech parks. Most special regimes grant certain privileges to eligible businesses and serve to attract investors or entrepreneurs.

FEZs enjoy special legal regimes offering resident businesses tax benefits and other privileges. The special Law on FEZ (2014) exempts entities operating in such zones from custom duties and a number of taxes and non-tariff measures when operating within these FEZs and/or performing export operations. When processing within an FEZ exceeds a certain threshold, products can also be sold to the domestic market under the same conditions. FEZs charge residents a certain percentage of their turnover to cover administrative and other costs. There are currently five FEZs in Kyrgyzstan.

High-tech parks also enjoy an advantageous tax regime: according to the special Law (table 2.1), residents are exempt from revenue tax, sales tax and VAT, and benefit from a special 5% income tax for employees. So far, there is only one High-Tech Park in Kyrgyzstan which specializes in IT services.

[22] For details see UNCTAD, Investment Policy Review Kyrgyzstan. New York and Geneva 2016 and WTO, Trade Policy Review Kyrgyz Republic, 2013,

There are special tax incentives for R&D and innovation activities undertaken by both local and foreign firms, in particular a 100% tax allowance for R&D expenditures. Kyrgyz standards and technical regulations are in transition from the Soviet state standard system (GOST) to international standards. Since EAEU accession, this process is aligned with the process of harmonizing standards within the Union. Competition policy is also being aligned and harmonized with other EAEU members. Competition policy is administered in accordance with the Law on Competition (as amended in 2016), with oversight by the State Agency of Antimonopoly Regulation.

Despite declared policy ambition to support the exports of local businesses there is no public export promotion body which is an area that calls for further practical steps. Public procurement is under the functional responsibility of a dedicated department of the Ministry of Finance. In 2014-2017 the Ministry undertook a comprehensive reform of the whole system of public procurement, targeting transparency, efficiency and fair competition among bidders.

IPRs are protected by legislative and regulatory measures, with Kyrgyzstan a signatory to various international treaties. Oversight of IPR laws and regulations is entrusted to Kyrgyzpatent, which also certifies IPRs and deals with infringements. IPR enforcement remains problematic due to inefficient judicial processes that result in lengthy appeals processes and problematic recovery of penalties. IPR infringement, including production and trade of counterfeit goods, remains a problem for both the authorities and general public.

Despite significant policy efforts to improve the business environment, investment activity has not reached levels desired by the authorities while the FDI inflows remain modest and mainly concentrated in mining (the largest being the Kumtor gold mine).

The SME sector is relatively well developed in Kyrgyzstan. The authorities have adopted several programmatic policy documents aiming to promote SME development and containing special incentives for small businesses (Table 2.1). According to National Statistical Committee data, there were some 14 thousand active SMEs in Kyrgyzstan in 2015, of which 13.2 thousand were classified as small and 0.8 thousand as medium-sized. 25% of SMEs operated in retail trade; 16% in manufacturing; and 11.4% in business services. In addition to that there were 366.7 thousand registered individual entrepreneurs. SMEs and individual entrepreneurs comprised 40.8% of GDP in 2016.

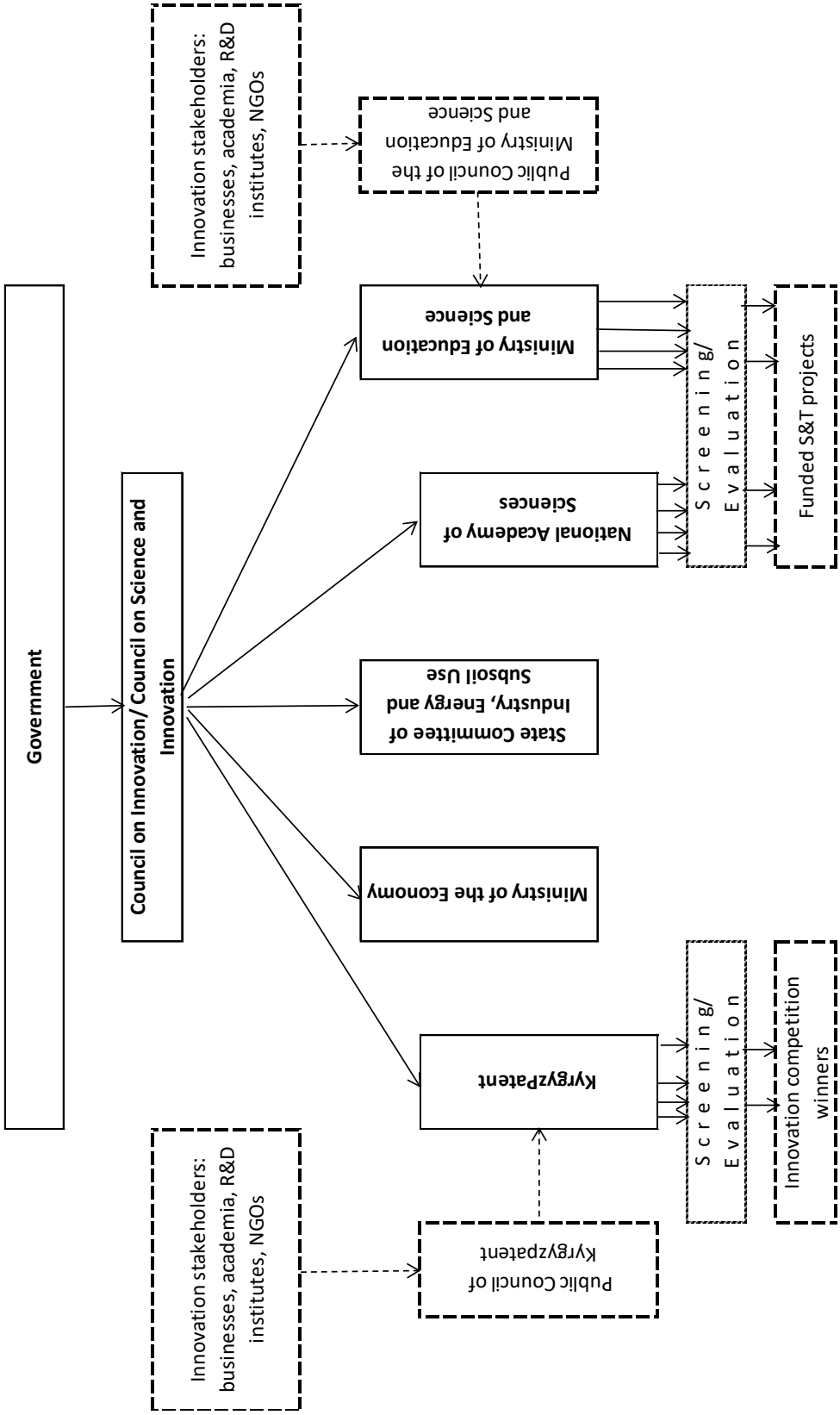
2.4 Innovation governance

Innovation governance has both a formal component related to existing legislation, regulations and other policy decisions and an informal or behavioural component, related to the incentives and motivation of NIS stakeholders, including public, private and non-governmental actors. One specific public sector function is the coordination of policy design and implementation – a need arising from the horizontal nature of innovation policy, which affects many actors at a similar level of governance.

Coherent policy design and coordination requires an agreed long-term national vision of the directions of economic and technological development and the related national priorities. The effectiveness of policy coordination also depends on the design of overarching elements of innovation policymaking, and on the existence of efficient NIS linkages.

Drawing on these general considerations, Figure 2.1 presents the main components of the innovation governance system in Kyrgyzstan.

Figure 2.1 Innovation governance in Kyrgyzstan



Source: Author's compilation

At the top are high-level Councils which, in recent time periods, have been variously under the President, Prime Minister, or Government of Kyrgyzstan. Currently, the highest coordinating body is the Council on Innovation under the Government of the Kyrgyz Republic, established in 2012 by Government Decree and headed by a First Deputy Prime Minster. The Concept for the Reform of the Science System envisages reorganization of this body and its transformation into a Council on Science and Innovation headed by the Prime Minister.

In addition, Kyrgyzstan's national governance system includes Public councils in several areas of public governance where stakeholders, including business, academia and Non-Governmental Organizations (NGOs), can advise the Government on stakeholder policy perceptions and lobby for their interests. For science and innovation there exist the Public Council of the MES and the Public Council of Kyrgyzpatent. Public councils are fully independent from Government; they are self-organized bodies with compositions based on nominations from their stakeholder communities. However, councils have only advisory functions and do not take part in public decision-making processes.

At the executive level, responsibility for design and implementation of S&T and innovation policies is currently split between several public bodies.

Kyrgyzpatent is the main public body with functional responsibilities for innovation policy and innovative development, along with IPR protection. In particular, Kyrgyzpatent coordinates preparation of the relevant policy documents, e.g. the State Programme for the Development of Intellectual Property and Innovation 2012-2016 and Concept for the Scientific and Innovative Development to 2022. Responsibilities also include preparing draft legislative and regulatory documents to grant and protect IPRs.

The strategic documents for innovative development envisaged that Kyrgyzpatent become one of the centres of public support of innovative projects. Accordingly, in 2016 Kyrgyzpatent launched its first open call for innovative projects to be supported by public grants. 44 applications were received which were then reviewed by a commission that selected four innovative projects for funding. Based on this experience, similar open calls are planned for the future on a regular basis.

The MES is another public body with important functional responsibilities for S&T, in particular, the design and implementation of state science policy and programmes. This includes drafting policy concepts, identifying national priorities for S&T, drafting state S&T programmes, coordinating international S&T cooperation, oversight of academic skill building. MES is also the public authority that allocates funding for implementation of state S&T programmes and projects.

At the time of writing, public funding for S&T activities is allocated through two channels: the MES and NAS. NAS receives annually a lump sum as a separate line in the state budget. This is then allocated through internal selection and decision-making process. MES allocates funding to the remaining part of the Kyrgyz S&T system. To better perform these functions, the National Science Foundation under the MES was established by a Government Decree in 2015. The Foundation organizes an evaluation and screening process and allocates funding to programmes and projects in accordance with the state S&T priorities and the quality of the project proposals. The Concept for the Scientific and Innovative Development to 2022 plans to

increase MES responsibility in the area of S&T funding. It has been proposed that all budgetary S&T funding be concentrated in a single Science Fund under the MES.

The NAS has a dual role in the NIS, acting as the main R&D hub in Kyrgyzstan, while also tasked with some responsibilities in S&T policy making including the development and realization of state S&T programmes. There is an ongoing public debate on this role of NAS; the Concept for the Reform of the Science System has proposed that the NAS focuses on S&T programme implementation, with reduced policy-making functions.

After successive reforms, the Ministry of Economy is tasked with coordinating the implementation of government programmes in the areas of sustainable development, trade policy, business regulation and policies in support of SMEs and entrepreneurship. Innovation policy is outside of scope; however, being in charge of business regulations in general, it has a say in the design and implementation of regulations associated with innovation activities. The Ministry of the Economy also seeks to support innovative development by attracting investment, including new technologies.

The State Committee of Industry, Energy and Subsoil Use is responsible for industrial and energy policy, as well as resource use. Statutory functions for industrial policy include export promotion, support and protection of new industries, cluster development and promoting innovation. However, these goals remain largely declared policy intentions as the Committee is not endowed with the necessary policy instruments, in particular those associated with technological development and innovation.

The State Committee on Information and Communication Technologies is mandated to coordinate national ICT policy and international cooperation in this area, and leads policy efforts on e-government.

There are also non-governmental structures engaged in innovation governance. The Development Partners Coordination Council is an informal association of international and national donor organizations that facilitates networking and donor aid coordination while seeking to align aid with national policy priorities through dialogue with Government.

The Chamber of Commerce and Industry of the Kyrgyz Republic provides a platform for policy dialogue and coordination between business and Government. Its mission is to improve the framework conditions and environment for doing business. It also helps its members develop their businesses in the country and access international markets.

The Union of Manufacturers and Entrepreneurs of Kyrgyzstan is an umbrella organization for more than 20 business associations from various sectors. It seeks to attract business partners or investors for the development of Kyrgyz industry and private sector. The Association of Guarantee Funds[23] promotes entrepreneurship and SME development by easing access to finance. Guarantee funds were established with support from the USAID Local Development Program following the 2013 Law on Guarantee Funds. At present, there are 6 guarantee funds operating in Kyrgyzstan. The Association of Microfinance Institutions includes 22 microfinance institutions (MFIs), established in 2005 to promote microfinance development in

[23] A guarantee fund assists entrepreneurs lacking collateral in obtaining bank loans or arranging lease contracts by providing guarantees which act as a substitute for the collateral.

Kyrgyzstan and support its members in their dialogue with Government and international donors. It also organizes capacity building and technical for its members.

2.5 Assessment and conclusions

The assessment of Kyrgyzstan's capacity and potential to pursue innovation for development policies needs to address two main aspects: 1) local specificities; and 2) state of the national innovation system.

Considerable local policy challenges relate to the country's development level and geographic isolation. A small domestic market provides the rationale for an export-led development strategy with incentives for inward FDI, and is reflected in strategic policy documents. There have been successes in certain export-oriented sectors with historic traditions, such as textiles. Accession to the Eurasian Economic Union and privileged access to its large internal market creates even more favourable conditions for such policies. The overall orientation of Kyrgyz public policy towards industrial modernization through the import of new technology and FDI-driven technological reconstruction and upgrading is a pragmatic and realistic one.

A small and isolated market remain a pressing constraint in certain sectors, e.g. those involving modern mass production, but need not be an impediment in others, e.g. agriculture and related processing industries, as well as services. The optimal policy mix may require pursuit of selective sectoral development policies reflecting local specificities and potential. One specific policy approach would be targeted support to virtuous cycles involving the introduction of products new to the local market or substituting imports. Such cycles would engage suppliers and consumers in positive feedback loops where supply breeds new demand and *vice versa*.

One key success factor of innovation-for-development policies is local ownership. Experience shows that bottom-up initiatives generated by locals – who know best the local context and needs, potential market niches and opportunities – are most successful. Policy should support local communities to identify and prioritize their own needs, propose and implement initiatives.

Another contextual challenge and opportunity is the large number of migrant workers. While their absence deprives the local economy of a major resource; on the other hand, working abroad helps them acquire new skills and connections that could later by applied domestically. They are also a source of remittances, providing significant balance-of-payment support at the macroeconomic level, and to family members in Kyrgyzstan. The migrant cohort thus should also be a specific target of innovation policy.

Despite notable progress in its institutional build-up, the NIS is at a very early stage of development. Kyrgyzstan has strong democratic traditions that contribute to the transparency of policy making and implementation, and has made considerable efforts to create an effective public administration. S&T and innovation policy are assigned a high priority and the authorities have advanced significantly in defining the legislative and regulatory framework. However, there is a need for significant further reform to establish a well-functioning NIS. A number of essential NIS building blocks are either missing or just coming into existence. A well-functioning NIS implies strong linkages between innovation stakeholders, which is also missing, while both the supply and demand for innovation are still rather weak.

Vibrant innovation activity requires a dynamic supply of entrepreneur-led initiatives to create a pipeline of innovation projects. Such activity involves collaboration between many stakeholders that can only take place in a conducive environment. Kyrgyzstan's innovation and entrepreneurial scene are still far from such performance due to the absence of important NIS building blocks and connectivity, exacerbated by a lack of incentives and supporting policy instruments for innovation, and low demand for innovation.

As regards the policy framework, Kyrgyzstan has made significant progress with the adoption of a range of legislative and programmatic documents (Table 2.1). However, there is significant scope for improvement at the operational level of the specific innovation policy instruments. Sources of seed- and early stage financing are practically non-existent or at an experimental stage of introduction. Experience from mature innovation ecosystems shows that, without such support, very few innovative entrepreneurial ventures can cross the "valley of death".

Despite a commendable microfinance institution (MFI) tradition, MFIs cannot substitute for proper early stage innovation financing agencies. The key specific feature of early stage innovation financing institutions – which distinguishes them from MFIs – is that the former extend non-debt finance to entrepreneurs in various forms (grants, equity finance, future options, etc.) whereas the latter only operate with credit. If Kyrgyzstan succeeds in developing a system of seed- and early stage financing, its operations could be coordinated with those of the MFIs to generate synergistic benefits.

Policy instruments to support technological innovation are very limited in scale and scope. Budgetary funding is earmarked for only R&D projects, with no policy instruments to support other stages of the innovation process (from idea to market). Private sources of finance for risky innovation projects are either unavailable or exist only in an experimental form. Additionally, the Kyrgyz business sector is practically outside the scope of S&T and innovation policy instruments. There are no instruments specifically incentivising the business sector to pursue the declared policy objectives of industrial and technological modernization. Policy mechanisms stimulating collaboration between R&D institutions and enterprises are also absent. Connectivity and linkages within the NIS are generally rather weak, and this partly reflects the fact that these specific NIS ingredients have neglected by policymakers.

Research funding is undergoing major reform that envisages transition from (direct or indirect) institutional funding to project-based funding, and concentration of S&T funding under the MES. This is seen in conjunction with an R&D system restructuring, including NAS operations. Such fundamental reform carries certain risks that need to be carefully studied and addressed to mitigate any possible negative effect. Such risks come from the speed and scale of reorganization, with difficulty anticipating all possible consequences in advance.

Policymakers should focus on new funding instruments covering not only the research phase but also the later phases of the innovation cycle, namely the transformation of research results into marketable products and services. Such through-cycle, project funding would strengthen the NIS by supporting linkages and collaboration among stakeholders. Funding could be conditional on the establishment of such collaborative linkages, e.g. between research institutions and industry, or cross-border industry-science linkages. Given public funding constraints, each step should be carefully planned to mobilize, through appropriate incentives, participation by private sector, development institutions, international donors and the diaspora. The Russian-Kyrgyz Development Fund (RKDF), along with other international donors, is a

promising potential partner for such joint ventures. It performs an important role in supporting economic modernization, which could be broadened to supporting innovation projects in partnership with national authorities. The potential is even greater if one considers cross-border projects with partners from other EAEU countries.

A weak element of the NIS is the infrastructure of support institutions and intermediaries for market uptake of innovative ideas, which are indispensable for bringing innovative projects to market but are either absent or at a very early development stage. Such infrastructure will require long-term, sustained policy support. At present, policymakers could focus on support institutions responding to existing demands for immediate impact. Entrepreneurship and business support institutions have significant growth potential, and policy efforts could attract international donor support. Such efforts could build on the positive experience in developing MFIs in Kyrgyzstan. An efficient way to use limited financial resources could be to support a greater number of would-be entrepreneurs rather than a few large-scale projects. MFIs could support innovative entrepreneurship through joint initiatives with the Government and enterprises. In particular, MFIs could support innovative entrepreneurship through microfinance-based support schemes with public sector risk sharing.

Microfinance on preferential terms would be well-suited to support entrepreneurs in agriculture and food processing, as well as university start-ups and spin-offs. It could specifically target young people to develop an entrepreneurship culture, which also requires greater support in higher education institutions by strengthening technology transfer offices. One of the key functions of such offices should be the support of in-house entrepreneurship, starting with university start-ups and spin-offs. Wide-ranging entrepreneurship support could create new engines of economic growth and the above mentioned self-sustaining virtuous cycles, as well as autonomous deepening of the local market.

Innovation governance is fragmented with various public institutions are tasked with responsibilities concerning innovation management, and governance lacks strategic policy leadership and implementation. While certain such responsibilities were entrusted to Kyrgyzpatent by Government decree in 2012, these did not come with the necessary authority over other bodies to perform this important role. There is a mismatch between the prescribed innovation policy responsibilities and the (lacking) instruments at the disposal of Kyrgyzpatent. More generally, innovation governance bodies are assigned limited autonomy in policy implementation, with few decentralized funding instruments under their control, with the exception of the S&T funding operated by MES and NAS. In principle, a superior body such as the Council on Science and Innovation could provide leadership and coordinate policy design and implementation. However, this Council has been frequently reorganized and has not performed such a function. This lack of leadership presents an important gap in innovation governance that also hinders cooperation between the public sector and non-governmental institutions.

2.6 Recommendations

Recommendation 2.1

Develop an Action Plan to strengthen the innovation infrastructure and innovation support institutions:

- Carry out a needs assessment of innovation intermediaries and support institutions and develop a programme for setting up the necessary institutions; seek to engage donor support to accelerate this process;
- Design programmes of technical assistance (including to facilitate access to finance) to innovative entrepreneurs, SMEs and grassroots innovation initiatives implemented by public innovation intermediaries and support institutions;
- Consider establishing an experimental technology transfer centre, possibly jointly between a number of higher education/research institutions, as a public-private partnership with industry participation to facilitate technological upgrading projects in industry;
- Set up a special programme to support private innovative entrepreneurship at universities and facilitate university start-ups and spinoffs;
- Institute regular competitive grant financing to support innovative start-ups and ventures; consider measures of public support to private business angels and/or venture capital firms.

Recommendation 2.2

Initiate policy measures to improve connectivity and linkages in the national innovation system through appropriate policy instruments:

- Introduce grant project funding allocated through competitive open calls to support innovation and technology upgrading projects; such funding should cover the full innovation cycle, from R&D to developing new products and bringing them to the market;
- To improve connectivity and linkages, innovation project funding could be made conditional on the establishment, at the project planning stage, of collaborative linkages among innovation stakeholders, in particular between R&D and industry;
- Consider with other members of the Eurasian Economic Union possible joint instruments aimed at supporting cross-border innovation projects engaging partners from several countries;
- Complement these measures with non-financial coordination instruments to support connectivity (facilitating networking and information sharing among potential stakeholders; organising forums, exhibitions, fairs, etc.) that facilitate inter-firm linkages and linkages between industry and R&D institutions;
- Ensure the selection criteria applied by the above policy instruments match national strategic development priorities and policy objectives.

Recommendation 2.3

Develop new policy instruments aligned with and supporting the policy orientation towards industrial modernisation through technology transfer:

- Introduce incentives for the business sector (such as tax and tariff relief, access to subsidized credit, government guarantees, etc.) specifically targeting the technological upgrading of production facilities and the acquisition of technological equipment as well as the creation of virtuous supply-demand feedbacks, client-supplier interactions and clusters;
- Design and introduce mechanisms facilitating cost and risk sharing among business partners as well as public-private partnerships in implementing modernisation projects; engage collective technology transfer centres in this process;
- Discuss with the Russian-Kyrgyz Development Fund the development of a special programme for industrial modernisation whereby the government would commit to provide additional incentives for projects that target national priority areas.

Recommendation 2.4

Consider measures for improving the governance of the NIS:

- Undertake a critical review of NIS governance and define clearly the functional responsibilities of all public bodies tasked with innovation policy design and implementation;
- As part of this process, define a clear mandate for the Council on Science and Innovation as the highest decision making public body tasked with innovation management and policy coordination and the steering of national innovative development;
- The Council on Science and Innovation should become an operational body holding regular sessions to implement a work plan approved by the Government;
- All line bodies tasked with innovation management would report to the Council on their activities; where needed, the Council would coordinate policy implementation among line bodies;
- If Kyrgyzpatent remains the main line body tasked with innovation management, it should also be assigned with responsibilities and autonomous decision-making power to manage new innovation policy instruments to be introduced as per recommendation 2.2;
- All other line bodies responsible for innovation management should also be equipped with policy instruments under their control that match their responsibilities;
- All public NIS bodies need to be staffed and resourced adequately to be able to perform their functions; the authorities may consider a special capacity-building programme to this effect.

Recommendation 2.5

Develop a special plan for undertaking the planned reform of the science system in Kyrgyzstan, based on a gradualist approach:

- Consult all key stakeholders involved (in particular MES and NAS) on the scale and scope of the reforms, their sequencing and speed of implementation with a view to finding consensual solutions;

- Stage the reforms in steps, starting with an experimental phase where the envisaged reorganisation is only applied to selected parts of the science system; invite volunteers for this experimental stage by offering them incentives to participate;
- Review the results and outcomes of implementing the experimental phase and, based on lessons learned, make necessary amendments to planned reforms;
- Continue with the following phases of reform following a similar, gradualist approach;
- The reform process may imply the need for parallel science management models whereby the old management model will be gradually phased out as the new model is introduced.

Recommendation 2.6

Consider establishing an economy wide, microfinance-based entrepreneurship support scheme as an engine to drive development based on innovation and entrepreneurship:

- Liaise with international donor organisations to discuss the scheme concept and invite them to support its operations;
- Consider special incentives for attracting remittances to the scheme, including privileges for microcredit applicants who attract match funding from remittances;
- Entrepreneurship in agriculture and food processing can be a specific target;
- Include scheme options for entrepreneurial support to young people, including support to university start-ups and/or spin-offs;
- Target economy wide scheme coverage, with centres catering to local needs; facilitate local entrepreneurs in identifying their local development niches.

Chapter 3

KNOWLEDGE GENERATION AND DIFFUSION, INDUSTRY-SCIENCE LINKAGES AND INNOVATION FINANCING

This chapter first considers the overarching legal framework and policy priorities for innovation, including institutional mechanisms for the protection of intellectual property. It includes an assessment of the public financing of education, science and R&D, including universities and research centres, their international cooperation activities and their role in education and provision of human resources. The role of the enterprise section in intramural R&D and human resources development is also covered, along with the roles of FDI and foreign technology, industry-science linkages and public procurement. Finally, this chapter considers the role of innovative entrepreneurship and financing. This analysis serves as the basis for a number of policy recommendations.

3.1 Legal framework and policy priorities

Many laws, strategies and priority directions have been developed over recent years (see chapter 2). In relation to innovation, the most relevant recent document is the Concept of scientific and innovative development of the Kyrgyz Republic to 2022 (CSID 2022), approved on 8 February 2017, by resolution No.79. Other relevant laws relate to education, intellectual property, public-private partnerships, Free Economic Zones and the business environment, and is reviewed in detail in the previous chapter. This chapter focuses on measures to promote knowledge generation in CSID 2022 and the Law on Science and the Basics of State Scientific and Technical Policy (hereafter, "Law on Science").[24] Institutional mechanisms concerning the regulation of intellectual property are also summarized.

The Law on Science aims to:

- Increase the impact of science in addressing economic, social and cultural problems;
- Optimize and stabilize the functioning of scientific, technical and design and technological organizations, and preserve scientific and technical potential;
- Improve the organizational and material-technical conditions of scientific institutions;
- Ensure social guarantees for the stability of scientific and technical workers.

The following scientific and technical activities are financed:

- Fundamental research and development;
- Work on priority areas of scientific and technological development;
- Applied scientific and technical developments of national importance;
- Scientific and technical cooperation on the basis of interstate agreements.

[24] For more information on scientific priorities, see also the MES of the Kyrgyz Republic: Priority Directions of Science Development in the Kyrgyz Republic for 2017-2020.

Regarding innovative development, CSID 2022 complements scientific priorities by emphasizing innovation in the enterprise sector, in particular SMEs, as well as research infrastructure, and industrial modernization. Measures envisaged include:

- Developing a national programme to support innovation and industrial modernization,
- Using economic integration to access new markets for domestically competitive products and create joint ventures for future access to international markets;
- Institutional mechanisms to promote resource saving technologies;
- Import substitution and development of environmentally advanced technologies;
- Creation of a network of incubators, technology and innovation support centres and technology transfer centres;
- A system of initial stage state support and risk insurance for new innovative companies implementing technological investments;
- Protection of intellectual property rights;
- Provision of innovation training, including specialists in innovation management;
- Promoting mobility of research and technical staff between public and private sectors;
- Research into innovative economic sectors and regions to enable evidence-based guidelines for scientific and innovative development;
- Establishment of a system of coordination between NIS stakeholders.

Institutional mechanisms of IPR regulation

Intellectual property protection and measures to support commercialization is regulated by the State Programme for Intellectual Property and Innovation Development in the Kyrgyz Republic for 2012-2016. The follow-up State Programme for Intellectual Property 2017-2021 (SPIP 2017-2021) was developed in 2016 and at the time of this Review was under Government consideration for approval, with Kyrgyzpatent the responsible implementation agency. These State programmes contain action plans defining purposes and tasks, implementation stages and risks, required resources and monitoring and assessment for the following priorities:

- Creation of favourable framework conditions for innovative activities;
- Economic modernization through technology transfer;
- Improving the legislative base in the field of IPRs according to international norms;
- Cooperation between all interested parties;
- Raising awareness society of the role and benefits of IPRs;
- Creation of an effective system of IPR protection that enables innovators and inventors to earn a return on their efforts.

SPIP 2017-2021 is accompanied by measures in the areas of technology transfer, importing foreign advanced technologies for industrial modernization, trainings on patent and non-patent information using international databases, commercial, scientific and technical journals, and provision of new products and services.

3.2 Public financing of education, science and R&D

Public funding of science and R&D is mainly implemented by the MES and the NAS. Since 2011, scientific research institutes in the agrarian sector are funded by Kyrgyz State Agrarian University. Kyrgyzstan currently has more than 70 research institutions: of which 24 institutions

under MES, 24 under NAS and 20 under various universities. Science funding is provided only for fixed items such as salaries and social contributions. Thus, Government funding does not cover R&D, for which other sources of funding must be accessed. Research is mainly carried out at NAS institutes.

In 2013, around KGS 484 million (around $10 million) was spent by Government on scientific R&D and S&T services – an increase of 66% on 2009 funding. Around two thirds of this funding went to the NAS in 2009, directly from the Ministry of Finance under a separate budget line. The remaining one third of this funding was allocated to universities and applied sectoral science and research institutes through the MES, and organizations of central ministries and agencies (e.g. scientific research institutes under the Agrarian University) (Table 3.1). Universities and HEIs have additional (own) funds for science (extra-budgetary funds). The state budget for R&D currently amounts to around 0.1% of GDP, which is low compared to peer economies and means there should be a long term policy aspiration to increase R&D expenditure as a share of GDP (as per SDG indicator 9.5.1).

Table 3.1 Scientific R&D and S&T services by type of institution (KGS thousands)

	2009	2010	2011	2012	2013
Total	292,517	329,020	406,919	474,811	485,355
of which					
Organizations of central ministries and agencies	22,887	19,615	33,773	49,075	45,849
Organizations of the Academy of Sciences and sectoral academies	179,140	197,058	235,020	273,758	311,871
Engineering, research and development, technological organizations	5,672	5,404	5,909	4,049	6,431
Universities and other higher education institutions	25,787	28,505	46,679	78,688	45,060
Scientific research institutions/centres affiliated with higher educational institution	10,077	7,565	12,544	14,445	15,112
Sectoral science and research institutions	36,029	35,411	48,763	51,623	55,845
Industrial enterprises	9,059	30,606	21,841	1,115	2,150
Others (e.g. administrative bodies, design and survey organizations, test laboratories etc.)	2,867	4,857	2,389	2,059	3,037

Source: National Statistical Committee, UNICEF: Education and Science in the Kyrgyz Republic 2014

In addition to institutional funding, MES was at the time of this Review developing competitive funding criteria for scientific projects, with the first such competition launched in 2017 receiving around 300 funding applications. An expert council was in charge of the project evaluations. The key priorities are:

- Rational use of natural resources;
- Food security;
- Information and communication technologies;
- Health and quality of life;
- New technologies in the energy sector;
- Tourism and transport;
- Social and humanitarian issues.

Government funding for R&D currently amounts to just over 0.1% of GDP,[25] limiting ability to initiate innovations. Industrial enterprises able to fill the gap are largely missing. Given recent Government resolutions, the MES anticipates major policy changes for science and innovation, including:

- All funding disbursement and reporting merged under MES competence;
- Inspections and evaluation practices to be updated;
- New criteria for awarding academic degrees.

3.3 Role of universities and research centres

Universities and (public) research institutes are essential actors in national and regional innovation systems. Knowledge generation and its diffusion, as a key driver of economic performance, are the main objectives of public research. Since the mid-1990s, universities are increasingly engaged the so-called "Third Mission", going beyond their core tasks of research and teaching. Many universities in Western Europe or the U.S. are strongly engaged in technology transfer to companies, contract research, the generation of start-up companies and innovation activities. Innovation policy increasingly recognizes the importance of universities and implemented specific funding schemes and incentives to strengthen their role in the application of technologies and as a partner to the business sector. Public research institutes are also increasingly targeted by innovation policy.

For its size, Kyrgyzstan has a relatively large base of research institutes. With 24 research institutes, the NAS is the largest scientific research organization. There are another 20 research institutes at 53 universities plus more than 25 institutes under various ministries (e.g. Education and Science, Health). The number of public sector employees increased over 2009-2013 (Table 3.2), driven largely by increased numbers of research specialists.

Table 3.2 Number of employees engaged in R&D (public sector)

	2009	2010	2011	2012	2013
Number of employees engaged in scientific research and development (excluding part time employees)	3,533	3,129	3,333	3,264	4,241
of which					
Research specialists	2,290	1,974	2,224	2,349	3,063
Technicians	376	261	266	248	341
Support staff, assistants	462	428	411	369	422
Others	405	466	432	298	415

Source: National Statistical Committee, UNICEF: Education and Science in the Kyrgyz Republic 2014

Kyrgyzstan's scientific output as measured by publications is quite low compared to peer economies (Table 3.3), in contrast to a comparatively large number of research institutes.

[25] Source: http://data.uis.unesco.org/. In 2016, gross expenditure on R&D was 0.12% of GDP, of which 89% was funded by Government, 5% by business enterprises and 6% from other sources.

Table 3.3 Number of scientific and technical journal articles

	2001	2003	2005	2007	2009	2011	2013
Armenia	283	290	375	391	432	613	558
Belarus	1055	992	1207	1260	1160	1088	1001
Kazakhstan	163	212	229	207	265	376	879
Kyrgyzstan	26	19	43	37	35	46	60
Tajikistan	27	27	29	31	23	42	71
Uzbekistan	345	248	301	352	336	371	347

Source: National Science Foundation, Science and Engineering indicators.

The MES puts special emphasis on the following scientific fields, which match those of the aforementioned competition for research funding from the national budget:

- Rational use of natural resources;
- Food security;
- Information and communication technologies;
- Health and quality of life;
- New technologies in the energy sector;
- Tourism and transport;
- Social and humanitarian issues.

Other scientific priorities have been identified by the Ministry of Agriculture or the National Agrarian University, for instance in the fields of animal husbandry, livestock, and irrigation.

NAS, as the highest scientific institution, conducts and coordinates fundamental and applied research. The research priorities for 2013-2017 were as follow:

- Water and energy resources, renewable energy;
- New technologies and materials (biotechnology, nanotechnology);
- Information technology, mathematical modelling and management issues;
- Mechanical engineering and instrument engineering;
- Geosciences and natural resources;
- Reproduction of biological resources and bio-security;
- Ecology, human ecology and climate change;
- The individual and society: challenges of globalization.

At the time of this Review, the NAS had 1,810 employees, 53 research projects to which KGS 120.8 million was allocated from the State budget $1.04 million from international scientific foundations.[26] NAS is also involved in teaching: in 2016, 269 NAS employees delivered lectures or conducted practical training in HEIs.

Despite its size and potential as a centre for innovation, the main challenge for NAS has been a low level of research funding over the past two decades. Preservation of existing NAS capacities has been a major achievement, but progress cannot be implemented with such limited resources,

[26] see http://www.nas.aknet.kg/

resulting in reduced prestige of scientific research activities and loss of a generation of academics and inventors.[27] Nonetheless, regarding innovation, NAS can rely on a few physical-technical institutes, which are cooperating well with the private sector. Furthermore, there are various joint projects with universities (e.g. with the Kyrgyz National University (KNU) in the field of hydrometeorology) and efforts to integrate higher education with the NAS. [28] Meanwhile, there are no concrete plans at present to merge NAS science with higher education.

International cooperation and the role of intergovernmental organizations

Kyrgyz universities and research institutes are quite active in international cooperation. KNU, for instance, has implemented many schemes promoting student and faculty mobility (e.g. with China, the EU, Japan and Turkey), as well as in capacity building for faculty development, e.g. on the European Credit Transfer System (ECTS) and the introduction of a doctoral programme with European partners.

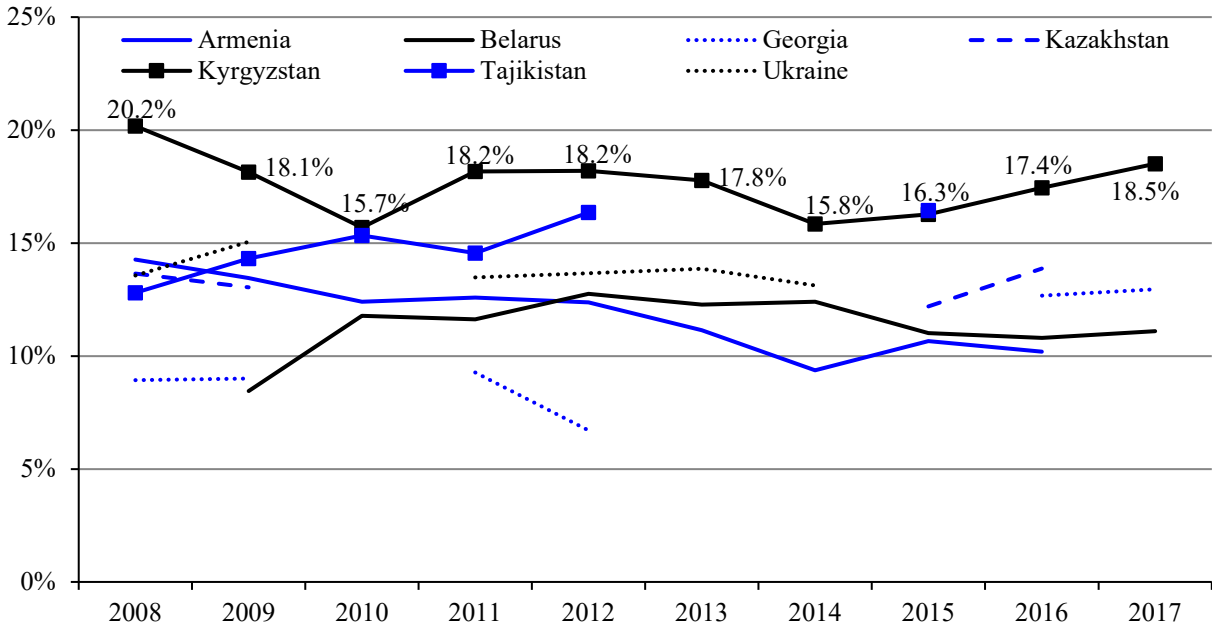
NAS has various international cooperation activities and is a member of many international organizations, e.g. the InterAcademy Partnership – the Global Network of Science Academies, the Association of Academies of Sciences in Asia and the International Association of Academies of Sciences, among others. The basic mechanisms for international collaboration are intergovernmental agreements, bilateral and multilateral agreements on scientific cooperation as well as establishing international scientific centres using unique equipment and laboratories, trainings and practical studies in the leading scientific centres as well as mutual recognition of diplomas. According to the NAS, more than 300 projects amounting to $5.4 million have been supported by international funds and organizations since 2012.[29]

Education and human resources

Kyrgyzstan has implemented a "business oriented" system of higher education, with governmental funding amounting to only 10% of the total. Around 80% of funding is from tuition fees and 10% from other sources. However, expenditure of the Kyrgyz government on education in general is higher than, for instance, in Armenia, Belarus or Tajikistan (Figure 3.1).

[27] IncoNet Central Asia (2016): Kyrgyzstan Country Report, see http://www.inco-ca.net/ for further information.
[28] For instance 17 MoU with universities have been signed regarding the exchange of staff and students.
[29] See http://www.nas.aknet.kg/ for further information.

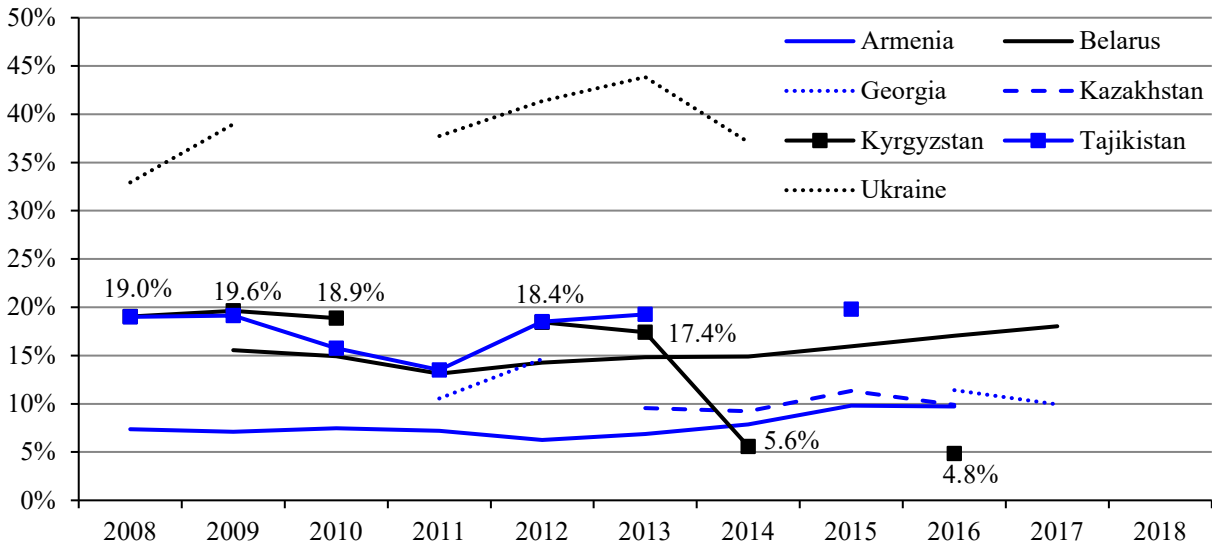
Figure 3.1 Expenditure on education (share of Government expenditure)



Source: UNESCO Institute for Statistics

Despite impressive overall spending on education, Government expenditure on tertiary education on a per student basis is less impressive compared to peer economies (Figure 3.2).

Figure 3.2 Government expenditure per tertiary student (share of GDP per capita)



Source: UNESCO Institute for Statistics

According to several interviewees, the education system in Kyrgyzstan is regarded as a weakness. Enterprises report a lack of engineers and technical personnel, which are often interns from the higher education system. Existing curriculum standards, including a list of compulsory

subjects, hamper the academic mobility of students and do not provide opportunities to respond quickly to changes in the labour market.

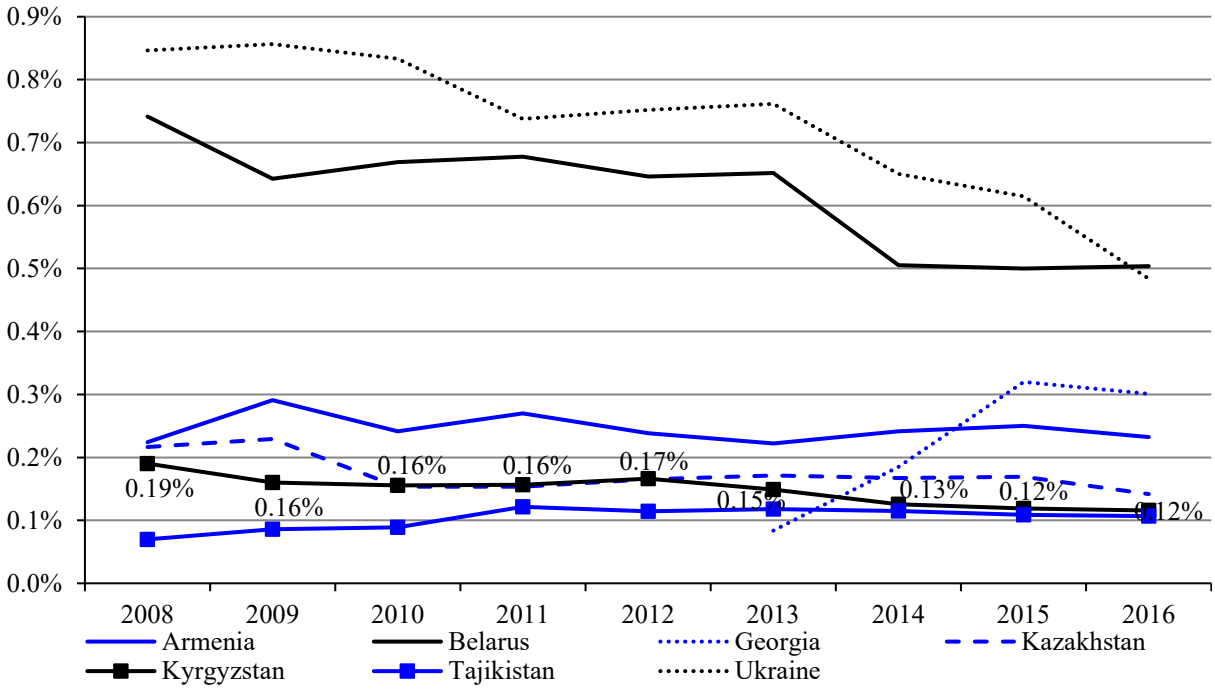
Assessment

Given its size, Kyrgyzstan has a large number of universities (53) and other non-university research institutes. Most are small, sometimes with as few as two researchers, and salaries are very low. Very few universities carry out R&D, with most focus solely on teaching and scientific research optional and requiring access to additional funding sources. MES is currently developing a competitive system of funding for scientific research projects, aiming to narrow the gap between the scientific practices of the NAS and universities, although a complete integration is not currently planned. NAS is currently working to optimize its structure and merge the two functions of science and innovation. Concrete planned actions include reducing the number of institutes and introducing a system of incentives and performance criteria. From 2018, funds will be disbursed by by the Science Fund under the MES Department of Science.

3.4 Role of the enterprise sector: intramural R&D and human resources

The Kyrgyz business sector performs very little R&D, and overall (public and private) expenditures on R&D amount to only 0.12% of GDP. This is a very low R&D intensity relative to its peer group, and has even decreased from 0.2% to 0.12% over 2008 to 2016 (Figure 3.3). No data are available regarding business sector R&D expenditures, but it can be presumed that the public sector accounts for the large majority of overall R&D expenditure. During interviews carried out during this Review, very few examples of R&D oriented companies or industries were mentioned.

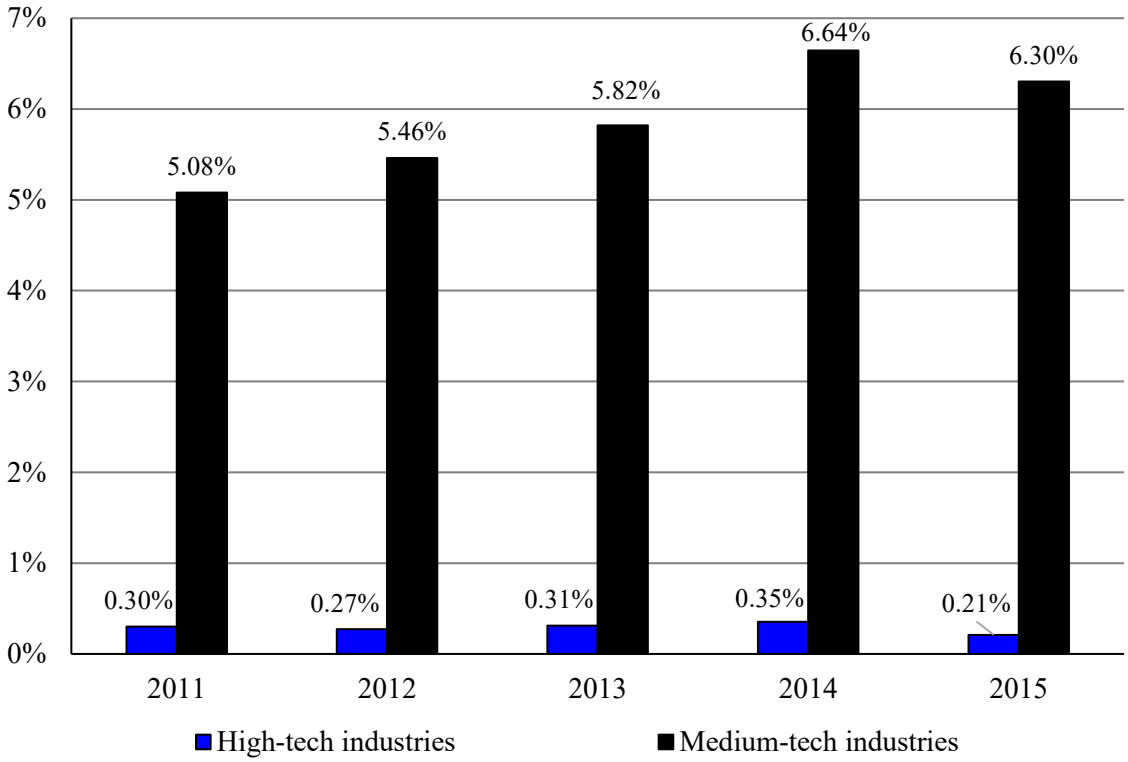
Figure 3.3 Gross Expenditures on R&D (GERD, share of GDP)



Source: UNESCO Institute for Statistics

A low share of employees in high- and medium-tech industries, at 6.5% of total employees in manufacturing in 2015 (Figure 3.4), support the view of relatively insignificant R&D activities in the business sector. High-tech industries in fact accounted for less than 200 employees in total – with 148 in the pharmaceutical industry. In the medium-tech industries, the manufacture of electrical equipment (3,475 employees) and chemical products (1,419 employees) provided significant employment. Of course, companies in lower tech industries may also have significant R&D activities, depending on a company's position in the value chain.

Figure 3.4 Employees in high-tech and medium-tech industries[30] (% of total employees in the manufacturing sector)



Source: National Statistical Committee (2016): Industry of the Kyrgyz Republic 2011-2015

There has been recent progress in the agriculture sector and food processing industry. Together with the energy sector, the industrial sector and tourism are key priorities for Kyrgyzstan, and the Kyrgyz-Russian Innovation Fund has disbursed more than 600 loans for these sectors. The Government also provides loans for the food processing industry. In agriculture, R&D or technology-oriented projects are carried out in the areas of irrigation systems, including deep and drip irrigation[31], greenhouse farming and water resource conservation, although there has been a lack of regular funding for agricultural projects.

Renewable energies are another area with great potential. The Committee on Energy and Industry has developed a legal framework and is working on legislation for small-scale energy

[30] The following definitions have been used: High-tech industries: Manufacture of pharmaceutical products, Manufacture of computers, electronic and optical equipment; Medium-tech industries: Manufacture of electrical equipment, Manufacture of chemical products, Manufacture of vehicles, Manufacture of machinery and equipment.

[31] According to the National Sustainable Development 2013-2017.

providers. Light industries also show potential, particularly textile production, clothing and footwear, and leather.

The available data and information provided by public authorities and Kyrgyz experts suggests that intramural R&D plays a minor role in the Kyrgyz innovation system, with technological development almost non-existent. The only technology-oriented sector is the computer, electronic and optical equipment industry, but with only 48 employees, it is too small to initiate spill over or cluster effects. The key constraints to technological development and innovation in the business sector are:

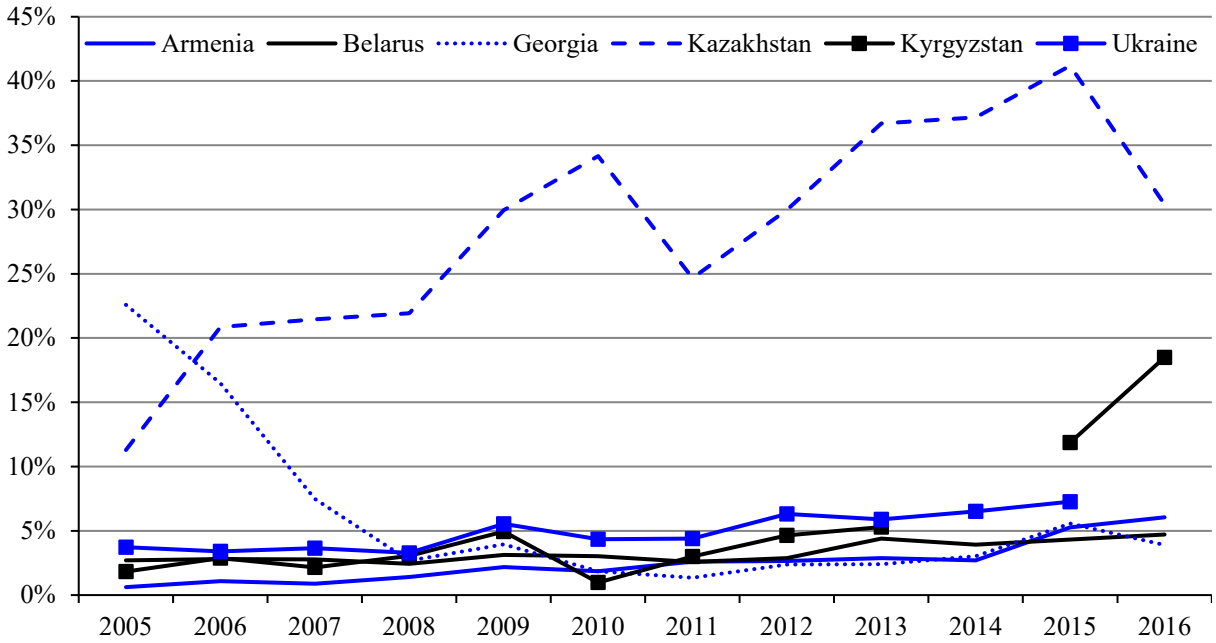
- An economy dominated by light industries, agriculture and the informal sector;
- Obsolete technical equipment and machines;
- Financial constraints to R&D and innovation investments;
- Many micro- and SMEs with insufficient infrastructure to implement innovations;
- No major Government funds or programmes to compensate for the lack of private investments in R&D;
- Skills of graduates from vocational schools do not meet commercial requirements;
- Vocational training insufficient (two months compared to two years in some countries).

Internationalization, FDI and foreign technology

Given a small and remote market, global economic integration and participation in the international division of labour are crucial, in particular for technology and knowledge transfer. The main features are trade relationships, international cooperation in the form of subcontracting/supplier-client relationships or (foreign direct) investments. Investments from foreign companies, particularly technology oriented or innovative firms and integration into global value chains are critical for domestic companies in terms of learning-by-doing, learning-by-interaction, or learning from the best. R&D and innovation activities of foreign companies are complementary to domestic R&D, often being in different industries or stages of the value chains. Openness to foreign investors and favourable framework conditions are essential preconditions for such integration. Many (small) countries emphasize improvements in investment conditions and seek to attract foreign companies to provide employment opportunities, technological and innovative know-how, competencies in global sales and access to the best practices of international business.

According to World Bank Development Indicators, Kyrgyzstan is largely dependent on the import of goods and services. At 72.2% of GDP in 2015, imports are much more important for Kyrgyzstan than for Uzbekistan (22.2%), Kazakhstan (24.6%), Tajikistan (42.3%) or Belarus (59.8%). While higher percentages of exports and imports are to be expected for smaller, open economies, exports were only 36.2% of GDP in 2015 - higher than Tajikistan (10.5%), Uzbekistan (20.7%) and Kazakhstan (28.5%), although lower than Belarus (60.0%). Important export sectors include mining, agriculture and light industries (textiles, clothing and footwear, wood and paper products, rubber and plastic products). However, Kyrgyzstan also exports technology-based products of high R&D intensity. According to UN Comtrade data, high technology had grown to reach 18.5% of manufacturing exports by 2016 (Figure 3.5) - pharmaceuticals as well as computers, electronic and optical equipment. However, a small manufacturing sector means absolute export volumes of all these industries are low. Still, the performance relative to peer economies since 2013 has been good.

Figure 3.5 High technology exports (share of manufacturing exports)



Source: United Nations, Comtrade Database

Direct foreign investment more than doubled over the period 2010 to 2015 (Table 3.4). Russia is the largest investor ($515.4 million in 2015), followed by China ($474.4 million), United Kingdom ($189.5 million), Canada ($130.2 million), and Turkey ($111.1 million), with CIS countries accounting for just over one third of total FDI inflows in 2015.

Table 3.4 Inflows of direct foreign investments (US$ million)

	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Direct foreign investments	666,1	849,2	590,7	964,5	727,1	1.573,2
Portfolio investments		5,47		2,46		437,8
Grants, technical investments	218,0	92,2	79,6	45,2	76,3	46,4
Other	2.688,2	4.001,1	3.665,5	4.474,9	4.612,2	3.557,9
Total	3.572,5	4.947,9	4.3355,8	5.487,0	5.415,7	5.615,4

Source: National Statistical Committee

Manufacturing was the most important sector (inflows of $564.7 million in 2015), followed by finance and insurance ($411.9 million), professional, scientific and technical activities ($261.9 million), electricity, gas, steam and air conditioning supply ($136.7 million) and construction ($107.0 million). Investors from China and Turkey are quite active in light industries. 90% of Kyrgyzstan's textiles are exported, mainly to countries of the Eurasian Economic Union (EAEU).[32]

[32] It is expected that the accession of Kyrgyzstan to the EAEU will have positive effects, for instance in food processing, with some investors starting operation in autumn 2017.

The Ministry of Economy and Investment Promotion Agency prioritize attracting investments with new technologies, and have implemented the following measures:

- National treatment of business activities, equal rights of domestic and foreign investors, no intervention in investors' business activities;
- Right to repatriation of investor profits, property and information;
- Protection against expropriation, including action or omission of action by public bodies resulting in seizure of investors' funds or inability to use results of investment;
- Investor rights to freely use income derived from their activities;
- Freedom to invest in any way in objects and activities not prohibited by national legislation, including activities subject to licensing;
- Freedom of monetary transactions;
- Free access to open-source information;
- Right to establish legal entities of any organizational and legal form allowed by national legislation; to open local branches and representative offices; select any organizational or managerial structure; acquire property, shares and other securities; participate in privatization of state property, establish associations and other unions; hire local and foreign employees; and engage in any other legal investment activities;
- Recognition of all intellectual property rights of foreign investors;
- Other guarantees specifically provided in bilateral and multilateral treaties on the promotion and protection of investment to which the Kyrgyz Republic is a party.

The Chamber of Commerce and Industry (CCI) cooperates with the Kyrgyz diaspora, as well as hosting or taking part in key exhibitions (e.g. Astana Expo 2017). CCI supports its members' participation in exhibitions in foreign countries such as India, Turkey or China, while the Union of Manufacturers and Entrepreneurs of Kyrgyzstan helps its members find foreign partners and attract investors.

Assessment

Policymakers recognize the importance of foreign technologies and knowledge, but there is currently no clear strategy linking FDI with technology inflows, and activities focus on special cases, e.g. textiles, agriculture or ICT. Current framework conditions represent important preconditions for foreign investment, but remain insufficient to attract technology- oriented companies. Kyrgyzstan's potential to absorb foreign technologies, e.g. through integration into international value chains or FDI attraction, is not fully exploited. With the exception of pharmaceuticals and some IT companies (computers, electronics), most exports are low-technology sectors, e.g. mining, agriculture and light industries. Most companies focus on local rather than foreign markets. A lack of capital prevents the few technology-based firms from scaling up and accessing foreign markets. The priorities of the largest foreign direct investors focus on sectors like energy, construction, mining and light industries, rather than high- and medium-technology industries.

3.5 Industry-science linkages

The innovation literature highlights industry-science linkages as a key structural characteristic of functional innovation systems, which typically feature interlinkages between the science and business sectors going far beyond provision of a qualified labour force for businesses. Important exchange mechanisms include contract research, R&D and advisory services, public-private

partnerships between scientific institutions and enterprises, technology and knowledge transfer through staff interchange or science-based start-ups. Many countries have specific policies to support science-business interaction at various levels. Important preconditions include a culture of cooperation and openness between science and business, business demand for innovative solutions, compatibility between the two sectors in terms of available and needed technologies, incentive structures at both universities/public research institutes and business companies, and favourable framework conditions in the area of IPR and exploitation rights.

As already discussed, Kyrgyzstan can rely on a fairly broad science and public research sector, with many universities, the NAS system and research institutes as the main pillars. However, universities primarily fulfill a teaching as opposed to research function, meaning cooperation potential is mainly in the areas of advisory services for companies and staff exchange rather than on joint research and technological development. The institutes of the National Academy of Sciences - due to their research orientation - meanwhile could potentially act as research partners or technology providers for business.

Current industry-science linkages are constrained by an underdeveloped manufacturing sector that is dominated by low-tech companies, and industry usually expresses no need for innovation. There is no articulated demand, financial resources or regular arrangements for cooperation between the two sectors. Although there is a Law on Public-Private-Partnerships in Kyrgyzstan, no Government programme has been implemented to support industry-science interaction. During the "fact-finding-mission" for this report, one interviewee touched on the main challenges by stating:

"Academia is separated from business (and from life at all!). It is a big problem. The gap is being covered by international organizations. A lot of programmes are aimed at filling these gaps. They (the companies) need new ways of thinking. It is even difficult to convince entrepreneurs to apply innovative solutions/methods into their operations."

The Law on Public-Private Partnerships goes far beyond the regulation of science-business cooperation and is applied to various sectors like electrical and thermal power, automobile, road and railways, tourism, water resources, etc. One of the guiding principles is the allocation of risks between the public and private partners as a mandatory condition of a PPP project. Meanwhile, the Concept of scientific and innovative development of the Kyrgyz Republic for the period up to 2022 (approved 8 February 2017) refers to the mechanism of PPPs as a basis for the development of an innovative economy:

"Creating a partnership between the state and private business is becoming a major area of innovation activity and solving current development challenges. The basis of the mechanism of public-private partnership is the organization of joint activities of public research organizations, public research and educational institutions, state unitary enterprises and private industrial, financial, scientific and business innovation".

However, the implementation of the Law on PPPs in the areas of science, research, industry and innovation is at the inception phase and according to several interviewees very complicated, with some planned initiatives stopped due to unclear procedures.

A promising initiative has the launch by Kyrgyzpatent of a regular call for specific applied projects. However, among 64 proposals submitted in 2017, only a very limited number received

funding. Different approaches to cooperation with the business sector have been implemented by several universities.

Models currently being piloted include:

- Project-based work at business schools;
- Internships or freelance work of students at research or consulting companies;
- Funding for equipment needed for commercialization (from Kyrgyz Innovation Fund);
- Exchanges whereby former students present their work to current students;
- Roundtables with employers to discuss curriculum development; and
- Internships, apprenticeships and practical training as a mandatory element of studies.

Public procurement

Public procurement is used as an incentive for innovation in many countries, e.g. thermal insulation of public buildings, regulations and standards to reduce air pollution, modernization of public administration with eGovernment solutions, etc. A precondition for public procurement as an element of innovation policy is for public institutions match business sector capability in terms of innovation and knowledge.

In Kyrgyzstan, the State Committee on ICT is planning a project called "Smart Nation".[33] Related topics include digital transformation, technical infrastructure including fibre optic networks, the 4th industrial revolution and smart innovations. The World Bank project "Digital CASA" will seek to increase affordable Internet access, crowd-in private investment in ICT, and improve Government capacity to deliver digital Government services in Kyrgyzstan, other Central Asian countries and parts of South Asia, through development of a regionally integrated digital infrastructure and enabling environment.

Other projects of the State Committee on ICT are in the area of transfer of government services into electronic formats (integrated service of electronic system), unified open data services, e-licencing, e-registration for business, education, IT academy (based on a vocational school), and electronic and digital signature. Regarding the formal procedure, the State Committee implemented a state procurement portal, which should guarantee transparency.

Assessment: Barriers to industry-science linkages

Policymakers recognize the importance of industry-science linkages for innovation and economic growth, but there are few concrete activities. Barriers include an underdeveloped business sector (low innovation demand), a large informal economy that makes formal academic-business cooperation difficult, and a lack of financial incentives or other policy mechanisms to support such linkages. A coherent strategy is missing. Promising initiatives developed by individual universities remain small and fragmented, with limited impact. Basic infrastructures like Technoparks at universities, patent exploitation departments or other possible organizational measures like "One-stop shops" for companies, innovation brokers or scouts are not in place.

[33] UNDP is currently working on a National Plan for eGovernment.

3.6 Innovative entrepreneurship and financing

Start-ups have crucial role to play in the renewal of industries, innovation systems and the wider economy, with innovations and new technologies often originating from new firms. Such firms generate employment, and may push mature companies and industries to also become more innovative. In other cases, new companies may also create new markets. Service sector start-ups are often characterized by a lower level of innovation and, with the exception of knowledge-intensive business services, are not targeted by innovation policy.

Given the importance of new firms and entrepreneurial activities to innovation outcomes, policymakers in many countries also target favourable framework conditions[34] for start-ups. Instruments include entrepreneurship training and education, advisory services for young entrepreneurs, incubators and similar infrastructure at universities and research institutes (focused on science-based start-ups), and entrepreneurship financing. Internationally, Silicon Valley is widely regarded as a role model for such an "entrepreneurial regime".

Kyrgyzstan ranks 29th out of 190 economies on the ease of starting a business in the World Bank Doing Business 2018.[35] This is an impressive performance, ranking above most peer economies, with the exception of Armenia (15th) and Georgia (4th), and a similar performance to Russia (28th). Starting a business requires four procedures, many of which are provided upon registration at the "One-Stop-Shop", takes 10 days and costs 2.1% of income per capita without minimum capital requirements. The most significant reform undertaken by the national authorities in the last couple of years referred to eliminating the requirement to have signatures of company founders notarized. Given the 4 bureaucratic and legal procedures necessary to start a business, the following authorities are involved: Ministry of Justice ("One-stop-shop", no online-registration yet), the State Tax Service, the Social Fund and the Sealmaker that provides company seals.

Despite a high ranking based on these procedural indicators, weaknesses regarding wider framework conditions for start-ups, in particular innovative and technology-oriented start-ups, are obvious. There is no current Government programme for start-ups, although there are plans at the Ministry of Economy to set up an entrepreneurship support fund and monitor start-up activities. Until now, no venture capital or investment funds have been established, either by Government or any other private financing institution. Guarantee Fund activities focus on SMEs rather than on start-ups, while the Kyrgyz Investment and Credit Bank (KICB) has no special funds or venture capital for start-ups, but has previously co-operated with the University of Central Asia on training and small funds to support start-ups. The Kyrgyz-Russian Development Fund did not at the time of this Review provide loans or other finance to start-ups.

International organizations, a few private companies or entrepreneurs (philanthropists) and industry associations are more active. Certain universities and research organizations are also experimenting with entrepreneurship support. EBRD provides start-up support alongside their general advisory services, which include business and financial planning, organizational questions, marketing and sales. ADB has implemented a small project on Women's

[34] The more general framework conditions like tax regime, IPR regime, financing or bureaucratic procedures – as these apply to SMEs and other existing business companies as well – are not part of this section.
[35] The indicator sets refer to a case scenario in the largest business city of an economy (Bishkek) and for a standardized company (private limited liability company).

Entrepreneurship Development, financed with the support of the Japanese Fund for Poverty Reduction in cooperation with two private banks and a microfinance institution. GIZ raises awareness by showcasing innovations, e.g. solar equipment, batteries and electricity metres. Training is provided in various start-up centres (e.g. in Jalalabad), and there are partnerships with business associations and the Chamber of Commerce.

KG Labs Public Foundation takes a public-private approach to supporting the start-up ecosystem in Kyrgyzstan, connecting the local community to the global start-up network, private equity and venture capital. KG Labs is financed by an eCommerce entrepreneur and international partners like UNDP and USAID, with additional fundraising from local communities. International start-up events and hackathons are conducted to build local skills to conduct nation-wide start-up competitions, and support provided to educational institutions to develop curricula on start-ups, create business angel networks, help build soft skills, e.g. in networking and communication. However, KG Labs does not directly provide financing to start-ups and is not an investor itself.

Ololohaus is an entirely private entrepreneurship support scheme in the field of art and music. It has established a creative hub (co-working space) for new businesses, and aims to create an entrepreneurship community and new business ideas. Support to start-ups is also provided by the Association of Software Manufacturers in the field of ICT and software development for foreign markets, and by matching IT Academy graduates with start-ups.

Ideagrad [36] is another private initiative supporting the local entrepreneurial community, focusing on specific sectors like tourism, clothing and education and providing financial solutions to entrepreneurs. Unlike KG Labs, Ideagrad initiates matchmaking for profit. A Summer Incubation Programme provides training to early-stage entrepreneurs to prototype their products and services. Start-up teams are selected for this 10-week full-time programme through a competitive process. Successful teams develop and implement their business plans, and share their progress with other participants. At the end of the programme, teams present their results to investors during “Demo Day”. Ideagrad also provides space for start-ups, and supports networking with people working abroad.

Certain universities are also considering organizational models to foster entrepreneurship support. No law currently regulates or allows the establishment of new companies from university laboratories, but the Kyrgyz National University is planning to set up a business incubator or Technopark, and skills development will be intensified through apprenticeships. The Turkish University has recently established an incubator, but activities are at an early stage with a focus on engineering and software. Limited state financial resources for entrepreneurship support in higher education. At the NAS, for example, almost no systematic approach to support entrepreneurship has been implemented. The American University supports entrepreneurship through its educational programmes, with an emphasis on IT in education and development, and several hackathons to identify early stage business concepts have been organized with KG Labs. American University plans to develop a technology incubator, although at present few university-based projects have succeeded.

[36] For further information, see www.ideagrad.com

Assessment

Policymakers recognise the importance of new companies for economic modernization, but a systematic approach is lacking. Regulations allowing the establishment of new companies from science and to establish business incubators to transfer commercialize R&D results are lacking. Administrative and compliance requirements are also very high, including tax administration, business regulation, construction permits and licensing. Entrepreneurship financing from both state and private institutions is absent, with no public venture or investment funds. The Association of Guarantee Funds, for instance, does not support start-ups. Private venture capital and business angels are more or less absent. The "entrepreneurial spirit" of students and wider society is also not well developed, with a need to build skills to start or run businesses. Until recently, entrepreneurial education was not part of the curricula, and there is a mentality of risk-aversion where many students prefer safe jobs in well-established companies, which also reflects an underdeveloped social safety net. Promising initiatives have been developed by private companies like Ideagrad, KG Labs and Ololohaus.

3.7 Business services and innovation intermediaries

Intermediaries play a crucial role in integrated innovation systems, fulfilling a bridging function between the various actors in the innovation process, and provide support to governance mechanisms. Typical intermediary actors are either semi-public or public institutions. Private companies supporting the innovation process (e.g. consultancies, private banks, venture capital firms, etc.) can be categorized in either the business or intermediary sectors, and we focus on support infrastructure that is either public or implemented by public institutions (e.g. universities, NAS).

Technoparks, start-up and innovation centres, incubators and technology transfer centres help bridge the gap between science and business, and support innovative and technology-oriented start-ups. They are the "hard" innovation-oriented infrastructure that complements technical infrastructure like Internet and telecommunication networks. While there is currently no Law on Technoparks in Kyrgyzstan, several plans to establish Technoparks and incubators have been developed. In addition, the "High-Tech Park" and Free Economic Zones have already been implemented.

The NAS developed a conceptual framework several years ago to collect innovative projects from its institutes. Based on Technoparks in Sweden and Germany, the idea was for NAS institutes to becom residents of a Technopark. However, the idea remained at a conceptual stage. In 2010, 15 development projects were prepared and submitted for commercialization and manufacturing application. The original structure had three self-financed institutes: "Shakirt" Information Centre, "Geopribor" Scientific Research Centre and "Geoservice" Scientific Industrial Centre.[37] The Technopark was later transferred to the Institute of Machinery.

The Technopark had the following objectives and planned implementation mechanisms:

- To serve as coordinator of innovative activities of all NAS institutes to generate competitive goods and services, and innovation based on the work of the NAS;

[37] Eastern Europe and Central Asia Cluster Work: Kyrgyz Republic – ICT Environment, Innovation Policies & International Cooperation. EAST-HORIZON Project.

- The Concept of Innovative Activity Development in the Kyrgyz Republic and Concept of Technopark Development were developed;
- The Scientific and Technical Council (STC) was established. The STC carries out coordinating and consultative functions of Technopark activity, and includes Technopark management, the scientific institutes of the NAS, innovative centres, and scientists and experts managing innovative projects;
- The Statute for Residents of the Technopark was developed, outlining the model of cooperation between participants, focused on innovative enterprises.

In contrast to models in other countries, the "High-Tech Park" (HTP) in Kyrgyzstan, founded in 2011 with a focus on innovation in ICT and software exports, is not a geographical entity but rather a preferential tax regime for IT firms, call centres, and gaming and Internet companies. HTP has three governmental members, three parliamentary members and three software associations (e.g. Association of Software Manufacture Association). An expert committee confirms the legal compliance of business activities. No information is available on the economic impact of the approach.

There are five FEZs, with the FEZ Bishkek (founded 1995) being the largest, and split between three locations. FEZ Bishkek has 324 resident enterprises with 3,700 employees. Its original concept foresaw a focus on innovative companies and projects. According to The State Agency for Investment and Export Promotion[38] under the Ministry of Economy, companies enjoy benefits including partial exemption from taxes, dues, fees and charges, low rents, simplified entry and exit procedures for foreign employees, accelerated business registration, and simplified customs procedures. Both foreign and domestic companies complying with the legal requirements may register in the FEZ, which also provides services including energy supply, administrative and visa support. Table 3.5 provides some output indicators for the FEZ Bishkek.

Table 3.5 Selected performance indicators for FEZ Bishkek (2013)

	2012	2013	Change
Total product sales (KGS million):	4,234	4,918	+16%
Of which			
Exports	*1,714*	*2,078*	*+21%*
Local market	*2,520*	*2,840*	*+13%*
Fulfilment of 70% quota	40.4	42.2	
Allocations to State budget (KGS thousand):	496,832	662,364	+33%
Of which:			
Customs duties	*272,747*	*395,099*	*+45%*
Taxes	*134,857*	*161,818*	*+20%*
Social fund	*89,229*	*105,448*	*+18%*

Source: General Directorate of FEZ Bishkek

Resident companies currently prioritize production over innovation, although this is changing as the FEZ develops certain Technopark characteristics, seeking to address issues like patents, trademarks and finance to support innovation based on scientific achievements.

[38] See www.invest.gov.kg

In addition, the following innovation support structures have been founded or are planned:

- The Kyrgyz-Turkish Manas University has recently founded an incubator for IT and engineering technologies.
- The Innovation Centre of Central Asia was established in 2015 as a private initiative by two entrepreneurs (one from Russia). The Centre promotes the use of innovative technologies for water management in Central Asia. Currently, technology is transferred primarily from Russia to Kyrgyzstan. Activities are currently early stage, with two projects carried out in 2016.
- The Eurasian Development Bank (EDB) plans a Technopark for IT in Central Asia.
- Kyrgyzpatent plans to establish a Technopark University, selected on the basis of a competition between universities and based on similar experience in Estonia. Kyrgyzpatent plans to provide guidance and grants, including methodological support. Future cooperation with a Russian Technopark is also planned.

The Chamber of Commerce and Industry has created a Centre for Business Education, providing training including a 6-month course in business English, business mediation, standardization in various industries, and internships with German enterprises.[39] A fee is charged for attending courses.

The Union of Manufacturers and Entrepreneurs of Kyrgyzstan runs an Excellence Center for the development of competencies, human resources and skills upgrading for the modern workplace. The Center supports development of over 700 new competencies (e.g. in tourism, local self-government). The Ministry of Labour and Social Development uses the Excellence Center to support vocational training and education, and has become a member of the Union to help match the student training with market needs.

Assessment

Intermediary actors and general business services are not yet fully developed, with innovation intermediaries virtually absent. Well working Technoparks, for instance, which are crucial for the generation of innovations, to support start-ups and bridge the gap between science and business, have not yet been established. There is currently no Law on Technoparks. Kyrgyzpatent and Eurasian Development Bank, and others, have plans for Technoparks, but – with the exception of the Innovation Center of Central Asia – these have yet to be implemented. NAS created a Technopark concept, but no major activities can yet be seen. FEZs currently emphasize production rather than innovation, although the future plans of FEZ Bishkek include Technopark elements of support for residents. Overall, the current intermediary landscape is not well suited to support innovation in general, or interaction among innovation stakeholders.

[39] In 2017 the Chamber of Commerce and Industry already selected 18 candidates for internships, which will be completed in German enterprises. Basic training regarding negotiation skills or public presentations will provided prior to the internship.

3.8 Recommendations

Given the importance of knowledge generation and its commercialization, Kyrgyzstan can draw upon its scientific and economic potential, but faces many challenges to be addressed by research and innovation policy to reach a higher level of competitiveness and welfare. Policymakers recognize the importance of innovation and have designed specific policy measures to improve innovation performance. These include improvement of general framework conditions, concrete R&D funding schemes and international cooperation and partnerships. Nonetheless, implementation is hampered by various factors inherent to the policy environment and innovation system.

Recommendation 3.1

Policymakers should take steps to increase innovation activities in the business sector, helping boost both knowledge generation and absorption capacities. Support schemes should pay particular attention to internationalization and FDI. Promising industries for such policy interventions include: pharmaceuticals, ICT, textiles, food processing, agriculture (including irrigation and greenhouse technologies), energy, mining technologies and new models of tourism. There should also be a focus on small engineering companies that can generate locally invented technologies or adapt imported technologies. Further niches for Kyrgyzstan could include disaster related innovations, recycling and waste management, air pollution reduction technologies and water treatment. The authorities could consider the following:

- Identify sector-specific R&D and innovation capacities and support these through modernisation of technical equipment and by initiating specific R&D and innovation projects (with domestic, international or scientific partners);
- Implement an independent innovation fund to support investment in R&D (see also chapter 2) and increase R&D expenditure as a share of GDP (SDG indicator 9.5.1). Support from international donors could be requested for this purpose;
- Identify the “driving factors” of successful companies and draw lessons for improving innovation framework conditions. Consider an awareness-raising campaign on the social benefits of innovation;
- Take a systematic approach to attracting foreign technologies or technology-oriented firms by promoting Kyrgyzstan’s unique capacities in terms of existing firms, societal needs and scientific potential;
- Actively support export-oriented companies; and
- Help innovation-oriented companies to find suitable technologies abroad and support their adoption and adaption.

Recommendation 3.2

The national authorities should consider strengthening and restructuring the science sector to become an integral part of the national innovation system. Such a shift could include a focus on specific local technological needs, a concentration of activities and organisations and differentiation between institutes according to their specific mission (e.g. education and teaching, scientific basic research, applied research, small-scale production). A further recommendation concerns the establishment of internal structures for the exploitation and commercialization of inventions and technologies and to develop linkages with the business sector. The authorities could consider the following:

- Improve framework conditions for scientific research by increasing institutional funding and competitive funding; applied research for companies could be rewarded by additional grants, with possible support from international donors;
- Implementing a system of incentives and performance criteria in the science sector to improve outputs and processes;
- Reduce legal impediments to commercialization of scientific results, including the possibility to establish start-ups at scientific research institutes;
- Consider reducing the number of research institutes and universities (53) to larger and more focused units; "mini-institutes" with only a few researchers should be merged with other institutes to achieve a "critical mass" of competencies;
- The future university landscape could be differentiated into a group of research-oriented universities (with possible industry linkages) and teaching universities; funding mechanisms should be reconsidered to ensure adequate financing so universities can focus on their core missions of teaching and/or research;
- Promising (but currently fragmented) approaches at specific universities and institutes to cooperate with the enterprise sector could be strengthened by the identification and support of "pilot projects"; support should also be provided for student internships;
- Consider favourably in the recruitment process evidence of (international) business contacts of university professors;
- Provide financial support to create technology transfer centres at HEIs, and patent exploitation departments to support scientists on IPR issues. This could be in cooperation with donor organisations and the private sector.

Recommendation 3.3

It is now important that policymakers develop systematic and programmatic support measures for new enterprises to drive economic modernization, including regulation to allow the establishment of new companies in the science sector. The practical implementation of legislation to protect investors needs to be improved, with enforcement of contracts a particular challenge. The authorities could consider the following:

- A start-up programme for innovative companies, including the necessary infrastructure (e.g. establishment of incubators at research institutes), improvement of financing conditions for new companies and advisory services;
- Creating a culture of entrepreneurship in the science sector and administration; motivate local investors to be open to new technologies and innovations;
- Strengthen existing and successfully operating private initiatives by supporting their specific approaches and models;
- Consider the potential role of the Kyrgyz diaspora as investors, scientific and business contacts abroad (see chapter 1);
- Support teaching and research institutes in introducing entrepreneurship education in their curricula.

Recommendation 3.4

Human resources and the education system need to be strengthened to support the transition to a knowledge-based and innovative society. Kyrgyzstan has implemented a "business oriented"

system of higher education, with public funding only around 10% of the total. Government expenditure on tertiary education is lower than, for instance, in Belarus or Armenia. According to several interviewees, the education system is regarded as a weakness, with businesses highlighting a lack of engineers and technical personnel, and graduates from vocational schools with poor skills unsuited to market needs. Existing state curriculum standards - a mandatory component with a list of compulsory subjects - hamper the academic mobility of students and are not responsive to changes in the labour market. The following could be considered:

- Improvement of human resources development programmes and qualifications at all levels as a policy priority;
- Expansion of engineering and technical programmes at universities, with improved quality standards;
- Establishment of business schools at universities where students of technical disciplines can receive a complementary education, building on efforts made at the Kyrgyz National University;
- Improved vocational training matching business needs, and of suitable length and intensity (currently two months in Kyrgyzstan compared to two years in many countries);
- Continued cooperation with foreign institutions on vocational training (e.g. Germany) and adoption of good practices.

Recommendation 3.5

The business services and intermediaries typical of modern innovation systems need to be fully developed. Technoparks that support start-ups and bridge the gap between science and business are so far absent. NAS has made progress in creating the concept of a Technopark, but without major activities so far, while Bishkek FEZ emphasizes production rather than innovation. Overall, the intermediary landscape is not suited to support innovation in general, or interactions between innovation stakeholders in particular. The following measure could be considered:

- Providing the legal and financial basis to create Technoparks at selected universities or research centres with existing business linkages or commercialization activities;
- FEZs should be supported to also become innovation centres with international linkages. Support should be provided to build managerial and institutional capabilities and establish functional linkages with domestic research institutes;
- Existing plans to establish incubators at universities (e.g. the Kyrgyz Turkish Manas University) should be strengthened and transferred to other research institutes;
- Technology transfer centres, start-up centres and a (private) venture capital or business angel culture should be initiated, with the support of international organizations or donors (e.g. Eurasian Development Bank plans to establish a Technopark for ICT).

Chapter 4

INNOVATION CAPACITY FROM AN INTERNATIONAL PERSPECTIVE

This chapter explores the enablers and potential drivers for innovation-led, sustainable economic growth in Kyrgyzstan. Enablers are factors that underpin future growth, such as infrastructure. Several of these factors will require substantial investment to avoid holding back further development. Investment has been skewed towards specific sectors, such as mining, but has neglected essential hard infrastructure, such as transport and telecommunications. Although, as an open economy, Kyrgyzstan's trade intensity is high, an overreliance on imports combined with an overdependence on raw materials exports have undermined the emergence of strong productive capacities and meaningful integration into global value chains. While boasting relatively high levels of education, the quality of the education system has fallen since independence, and business surveys point to growing pockets of skills shortage that hold back innovative entrepreneurship and investment. Deficiencies in governance and the rule of law will hold back innovative, complex, highly interrelated activities in particular. Finally, the absorptive capacities of the private sector, essential to absorbing new technologies and business ideas, are falling behind those of other CIS countries and require concerted action.

Improving these enablers will open up a range of opportunities. Among these potential drivers of innovation-led growth are sectors, driven by a few dynamic entrepreneurs, such as clothing, food, tourism, and IT and business process outsourcing. Substantial potential is inherent in promoting FDI in activities with large potential for learning spill-overs, such as export-oriented manufacturing along regional or global value chains. Local level experimentation, around foreign investors, dynamic firms, or islands of excellence, and existing, early stage free economic zones, will be essential to find out where the country's competitive advantages of the future may lie – this should be a priority for innovation policies in particular. The funds, dynamism, and opportunities that One Belt One Road and regional integration efforts such as the Eurasian Economic Union will bring are essential and promising for a country with an educated work force, an open economy, and a strategic location – but failing to direct resources to improving enabling factors and promoting potential drivers of growth may result in missed opportunities.

4.1 Understanding drivers and enablers for innovation-led growth

A broadened perspective

A pathway to growth based on technology upgrading would be based on two capabilities: production capability and innovation capability:

- *Production capability* is the capability to operate facilities with internationally competitive efficiency and productivity levels given current technology. It is about implementing business and engineering processes based on current best practice, and is based on learning-by-doing and accumulation of know-how through repetition.
- *Innovation capability* is the capability to improve productivity by improving existing technology through product and process innovation. Innovation is about the capability

to change the forms and configurations of current technologies in use (Bell, 2007[40]). This requires new concept design capabilities rather than just implementation capacity or work based on manuals.

Both notions can be considered part of the broader understanding of innovation going beyond pure science and basic and applied R&D and reflecting the fact that technological efforts in countries with economies in transition such as Kyrgyzstan is often focused on non-R&D activities, including process and product engineering and production capability (Table 4.1).

Table 4.1 A broad spectrum of innovation related activities

Pure science	Basic research	Applied research	Exploratory development	Advanced development	**Process and product engineering**	**Production capability**
Intrinsic knowledge	New knowledge for radically new marketable product	Differentiated product 'on paper.'	Prototype in a system	Prototype in manufacture	**Improvements of existing products and processes**	**Improved quality of products and processes**
PhD	PhD required with experience in R&D		PhD not required/MSc and BSc required		**Skilled engineers**	**Skilled technicians**

Source: S. Radosevic (2016).[41] Extended and adapted based on A. Amsden and F. T. Tschang, Research Policy 33 (2003)

Benchmarking the broad innovation capability of Kyrgyzstan should therefore be based not only on R&D capabilities, which do not represent the core of technology upgrading activities in lower-middle-income economies, but should focus much more on non-R&D activities, including assimilation and diffusion based technology strategies, the implementation of which require skilled engineers and technicians. An R&D sector equipped to interpret and disseminate foreign technologies among local enterprises with limited absorption capacities will be crucial. Most innovation is new to local firms and focused on the adaptation of new equipment and mastering production capability through learning by doing (Fu et al., 2014[42]). The aim of such a strategy should be to improve absorptive capacities of local firms.

Growth, productivity and structural change

Based on a broad understanding of innovation – which, in lower-middle-income economies concerns mainly non-R&D activities – we benchmark Kyrgyzstan's innovation capacity using

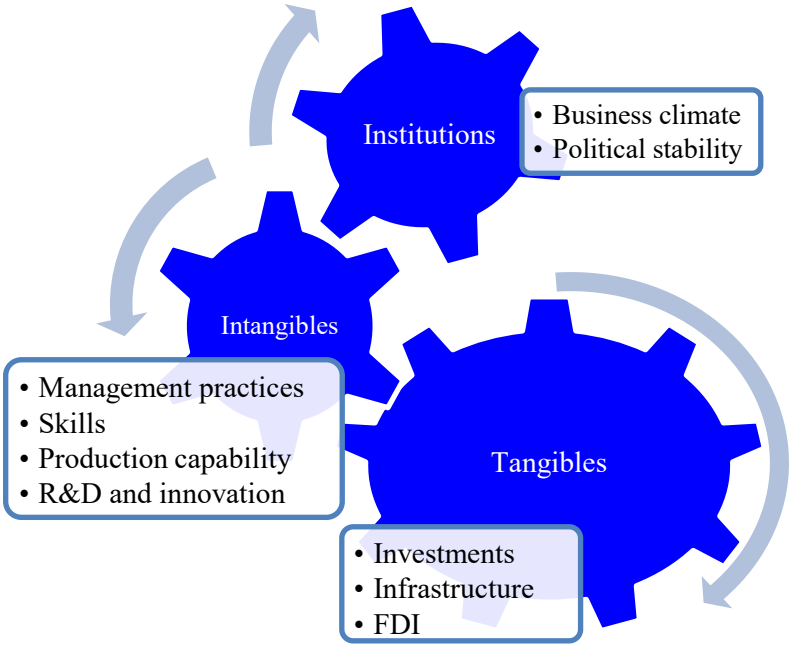
[40] Martin Bell (2007) Technological Learning and the Development of Production and Innovative Capacities in the Industry and Infrastructure Sectors of the Least Developed Countries: What Roles for ODA?, UNCTAD The Least Developed Countries Report 2007 Background Paper, University of Sussex

[41] Radosevic, S (2016) Technology Upgrading and Innovation Policy In Central And Eastern Europe, Synthesis report for WP3: Innovation, Entrepreneurship And Industrial Dynamics: Final Report, "Growth – Innovation – Competitiveness: Fostering Cohesion in Central and Eastern Europe" (GRINCOH) project

[42] Xiaolan Fu, Giacomo Zanello, George Owusu Essegbey, Jun Hou, and Pierre Mohnen (2014) Innovation in low income countries: A survey report, The report within the framework of the DFID-ESRC Growth Research Programme (DEGRP), November

the framework in Figure 4.1. This captures the major factors driving knowledge transfer, generation and absorption of new knowledge that are relevant for lower-middle-income economies where most local firms operate well behind the technology frontier. Factors driving technology upgrading are grouped into: tangible investments and activities, intangible investments and activities, and institutional constraints. These complementary factors operate jointly and cannot be treated in isolation, and are thus presented as a ring. A weakness in one factor may impede the functioning of others. What matters are the complementarities, rather than the individual levels of each factor.

Figure 4.1 Major drivers of technology upgrading



Source: S. Radosevic

Physical infrastructure investments are critical in lower-middle-income economies, but often far from sufficient. Physical investment alone can be a waste of resources if they are not in areas of latent comparative advantage,[43] or not accompanied by intangible investment in new skills and productivity improvements. Physical investments require adaptation of equipment, which often requires new knowledge. Complementary infrastructures and capacities are also crucial. For example, firms' export efforts may be hindered by the absence of certification and standard supporting public bodies. Public investment must target infrastructure of relevance to firms and addressing the systemic failures facing firms. FDI is a significant potential driver of growth – not only as physical investments, but more importantly as packages of technology, managerial skills and foreign market access. Nonetheless, foreign investors may be reluctant to invest in training without public support, or programmes to improve local vocational training capacities, which is crucial to technology upgrading and growth.

In lower-middle-income economies like Kyrgyzstan, the main focus of technology upgrading and applied R&D activities should be the absorption of foreign knowledge and adoption of new technologies, rather than creation of new knowledge at the world frontier. Equally, firms'

[43] Justin Yifu Lin (2015) New Structural Economics, World Bank, Washington

productivity improvements are about improvements in production capability and related management practices, as demonstrated by research showing large productivity differences among firms that are not explained by differences capital or labour inputs, but by differences in managerial quality.[44]

Finally, the institutional and political environment influences firms' behaviours and prospects for technology upgrading, as key agents in the innovation process that respond to signals in the business and broader institutional environment. Research shows that competition, the rule of law and enforcement of contracts are all positively related to greater total factor productivity (TFP) growth,[45] while corporate governance is a determinant of enterprise investment in skills. Previous UNECE reviews have noted that "when the external environment is stable, predictable, transparent and when it encourages competition but also a long-term planning horizon the enterprises are induced towards productive forms of entrepreneurship based on costs, quality and innovation. When the business environment is unstable, unpredictable, abundant in red tape and under the strong influence of the discretionary state, this encourages corruption, buying favours and the anti-innovative search for short-terms profits and their use in unproductive purposes."[46]

4.2 Enablers of innovation-led growth in Kyrgyzstan

Investment and capital accumulation

As noted in Chapter 1, like many lower-middle-income economies, Kyrgyzstan has substantial investment needs as a precondition for further growth, in particular in physical and technical infrastructure, in improving housing and in productive physical capacities. Remittances have been directed to a large extent into housing, with associated welfare improvements. However, remittances have been insufficiently directed to domestic economic activity due to a range of systemic factors related to weak local entrepreneurship, limited domestic demand, lack of skills and barriers to export markets.

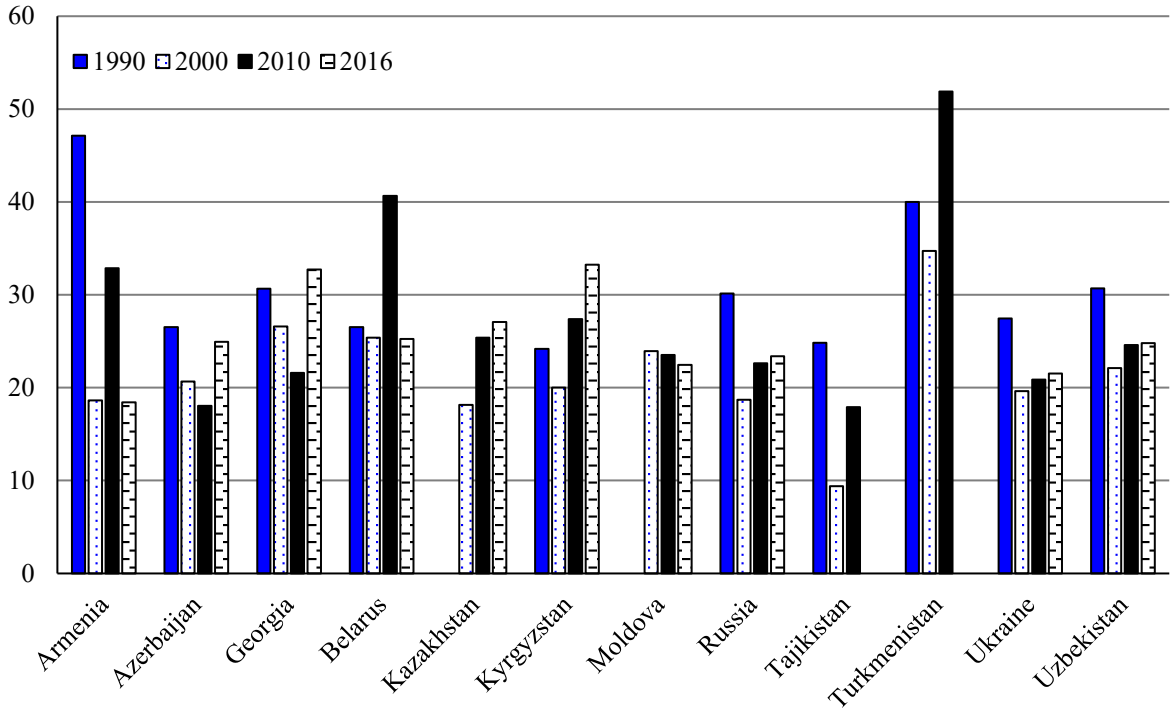
The 1990s saw a significant drop in investment as a share of GDP, but since 2000 there has been a strong increase, unaffected by the global financial crisis, to reach 33% of GDP in 2016 - among the highest in the region (Figure 4.2).

[44] Nicholas Bloom and John van Reenen (2010) Why Do Management Practices Differ across Firms and Countries? *Journal of Economic Perspectives*, Volume 24, Number 1, Winter 2010, p.203–224

[45] Hulten, Charles, and Anders Isaksson. 2007. "Why Development Levels Differ: The Sources of Differential Economic Growth in a Panel of High and Low Income Countries." Geneva: United Nations Industrial Development Organization.

[46] UNECE Innovation for Sustainable Development Review of Tajikistan, United Nations, New York, 2015. See https://www.unece.org/index.php?id=41877.

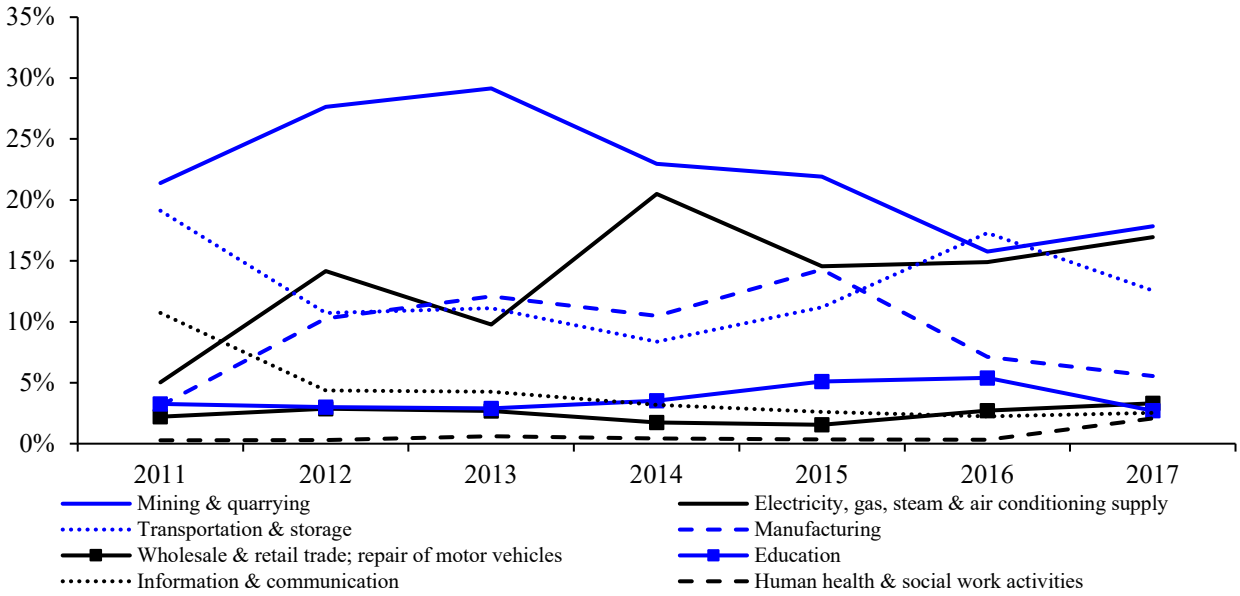
Figure 4.2 Gross capital formation (% of GDP)



Note: Tajikistan figure for 2013
Source: World Bank Development Indicators 2017

While investment is significantly driven by the mining and quarrying sectors, the share of investment in the transportation and storage reached 19% by 2017, while the share of investment in energy supply reached 17% (Figure 4.3). Still, serious issues remain regarding the frequency of and value lost due to power outages.[47]

Figure 4.3 Structure of investment by type of activity, 2011-17



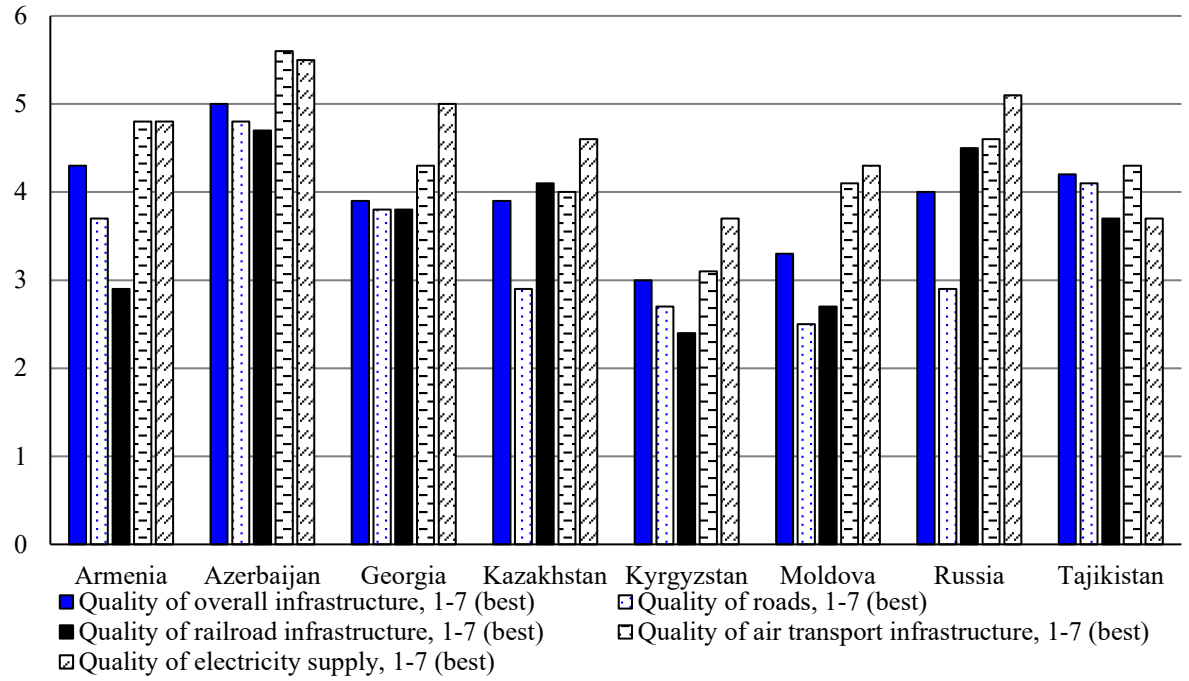
Source: Based on http://www.stat.kg/en/opendata/category/169/
Note: Total derived based on investments for individual activities

[47] For details see UNECE (2016) Assessing Innovation capacity of Tajikistan report

A growing need for investment in hard infrastructure

Huge infrastructure investment needs can be seen from the very low assessment of overall infrastructure quality and electricity supply by the business community, with Kyrgyzstan ranking poorly against peer economies in terms of quality of overall infrastructure, air transport, railroad infrastructure, electricity supply and roads (Figure 4.4). Poor rail services and roads add substantial transport costs to the country's exports, and old equipment coupled with heavy consumer subsidies cripple supply and boost demand for electricity, as unclear regulations, a poor grid, and indebted incumbents disincentivise further investment among the country's power companies – indeed, the country ranked 164th in the world on the topic getting electricity in the 2017 Doing Business Index. The same goes for internet connectivity, with less than 10% of the population reporting access to fixed broadband.

Figure 4.4 Assessment of overall infrastructure quality and electricity supply



Source: WEF GCR 2017

Internet related infrastructure is becoming equally or if not more important than physical infrastructure, and is an area where low and middle-income economies may generate latecomer advantages and achieve "quick wins" to overcome current constraints. This will require coordinated public and private investments in ICT infrastructure to overcome Kyrgyzstan's current poor rating among its peer group on indicators for Internet-related infrastructure.

The gap is by far the biggest in international Internet bandwidth - an important direct constraint to growth of the emerging ICT service sector in Kyrgyzstan. Despite improvements to Internet infrastructure, Kyrgyzstan falls behind many peer economies, e.g. regarding the number of secure Internet servers per million inhabitants (Table 4.2).

Table 4.2 Secure Internet servers (per million people)

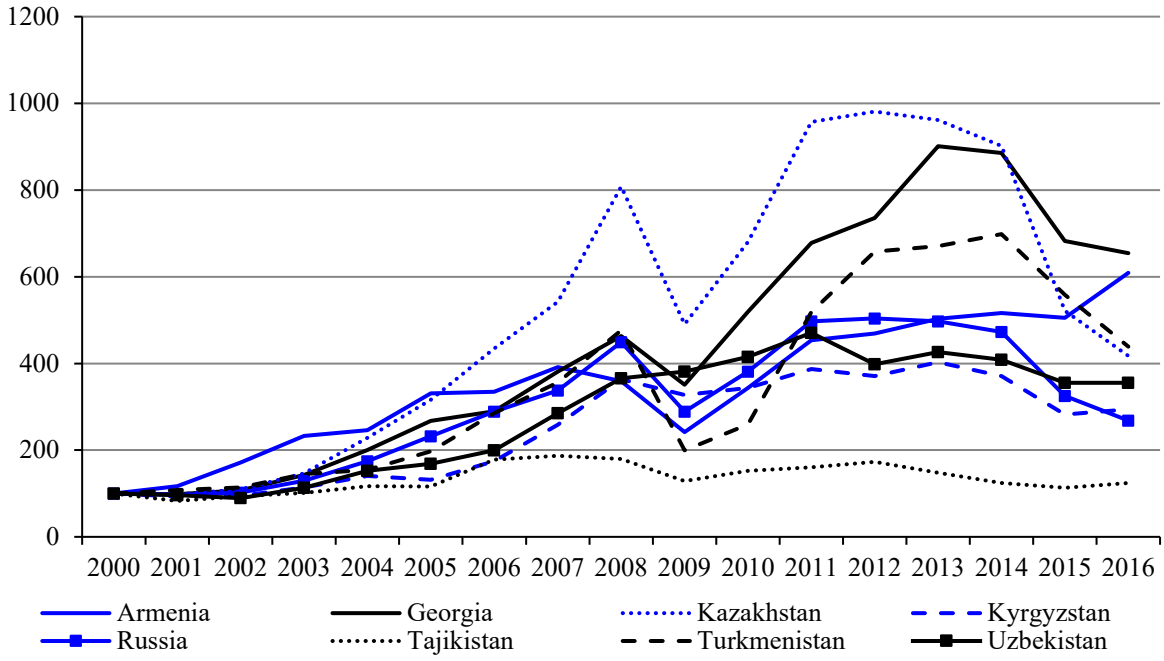
	2007	2015
Russia	4	126
Belarus	1	63
Georgia	8	63
Moldova	4	62
Armenia	4	49
Kyrgyzstan	**1**	**11**
Tajikistan	0	3
Uzbekistan	0	3

Source: WBDI 2017 database
Note: Data for Tajikistan are for 2009

Acquisition of foreign knowledge via trade, global value chains and FDI

Kyrgyzstan is a small, open economy requiring access to foreign markets and intensive import of technology, and the share of trade in GDP has been high among its peer group in recent years, as noted in chapter 1. There was evidence of an increasing trend on exports of goods and services from 1990-2010, although there has been some reversal since then. The relative decline of export intensity is confirmed by the index of export value, which rose until 2008 but has since stagnated (Figure 4.5). This coincided with reduced demand in foreign markets, but also indicates weak export competitiveness, e.g. a weak role of qualitative factors in export. Kyrgyz performance in this regard has been similar to its peers.

Figure 4.5 Export value index (2000 = 100)[48]

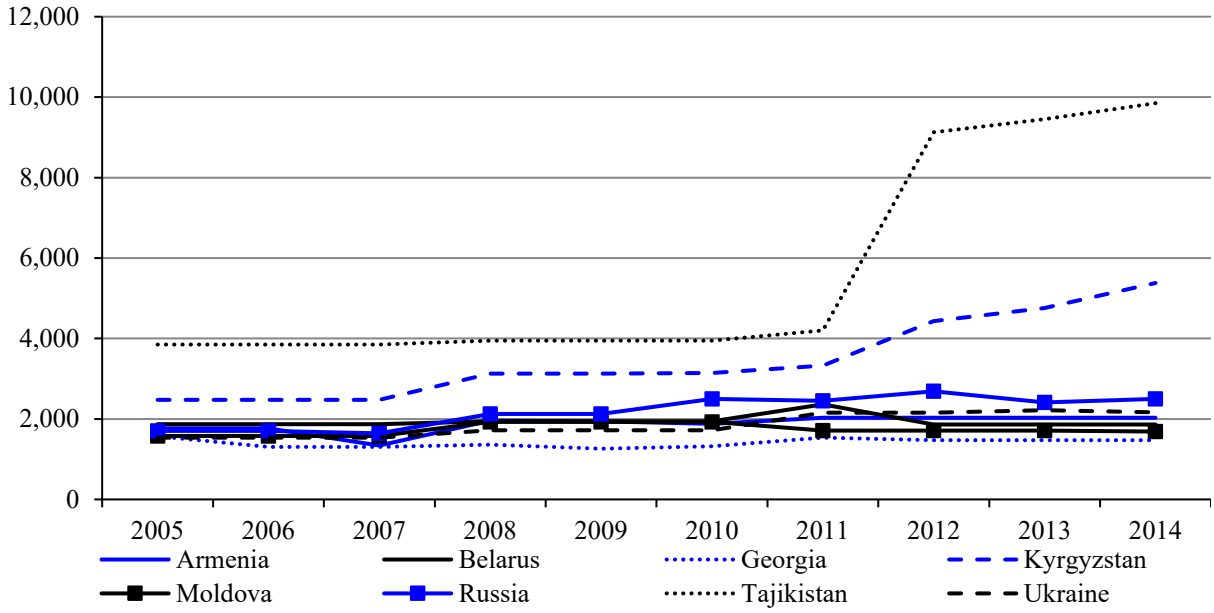


Source: World Development Indicators - World Bank Open Data

[48] Export values are the current value of exports (f.o.b.) converted to U.S. dollars and expressed as a percentage of the average for the base period (2000).

Given a low unit value and geographical isolation from large markets, Kyrgyz exports are sensitive to high transport costs. In 2014, import costs were $6000 per container, and exports $4,760 per container (Figure 4.6). While in line with Central Asian peer economies, such costs are much higher than for Armenia, Georgia or Moldova, although median lead time to export from Kyrgyzstan is similar.

Figure 4.6 Cost to export/import (average US$ per container)



Source: World Development Indicators - World Bank Open Data

Such elevated costs can be partly explained by very poor overall logistics, e.g., ability to track and trace consignments, competence and quality of logistics services and efficiency of customs clearance process. Nonetheless, the main factor seems to be the very poor quality of trade- and transport-related infrastructure, placing Kyrgyzstan in last place among its peers. Weak trade infrastructure may be one reason for, as noted in Chapter 1, low levels of FDI, and the predominance of investment into mining and electricity production – capital-intensive, employment poor activities with limited potential spill-overs, such as technology transfer or supply opportunities, on the rest of the economy. Like other CIS countries, limited attractiveness for FDI has resulted in Kyrgyzstan being bypassed by the expansion of global value chains.

FDI inflows are crucial, not just as a source of capital but, more importantly, as a source of new technologies and access to world markets. The import of disembodied knowledge through payments for intellectual property (technology balance of payments) is, however, rather low, and in line with peer economies. The latest data, from 2012, showed payments of only $7.7 million.

Human capital and skills

Moving towards a more knowledge-based development will depend critically on human capital and skills. 16.2% of the population possesses a bachelor-level degree or higher level of education, which is, as discussed in Chapter 1, towards the lower end of Kyrgyzstan's peer

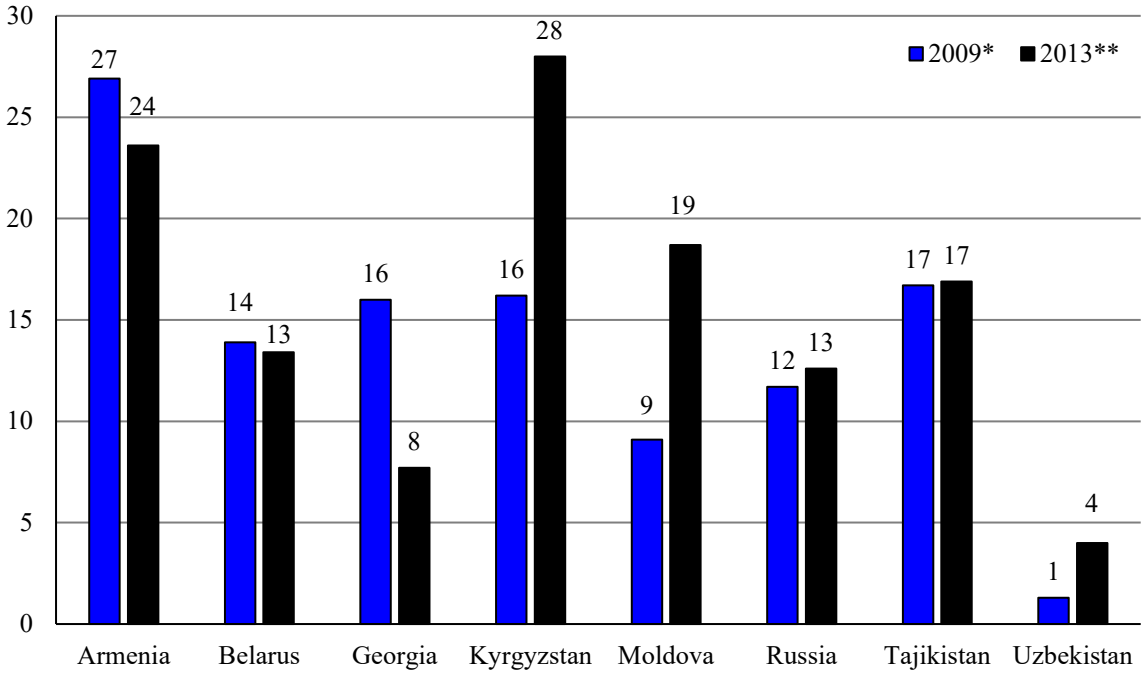
group, while performance is better in terms of secondary and tertiary education enrolment rates. The Kyrgyz extensive school system is also struggling to cater to the needs of a large, young population. It is widely perceived as producing a low overall quality of education, with specific challenges in maths and science education, primary education, and management schools compared to its peer group.

As discussed in Chapter 3, a positive trend has been the increased government expenditures on education, which show a clear policy commitment to investment in education and have been persistently higher than in peer countries, and stood at 18.5% of GDP in 2017 (figure 3.1). Although the trend in terms of funding per student as a percentage of GDP per capita (figure 3.2) has been less impressive. Unfortunately, there are no data on vocational training and skills, and greater policy attention should be paid to vocational training.

Productive capabilities and management practices

Kyrgyz firms focus largely on production capability or the ability to produce at high levels of productivity given current technology, for which a good proxy is the level of internationally-recognized quality certification, which is also often related to export orientation or trade intensity of the economy. In this regard, Kyrgyz firms have moved an above average standing among its peer group in 2009 to a leader in 2013 (Figure 4.7), although this may partly reflect a high share of exports where in-house quality control is a precondition for export. However, the most important explanation may be the subjective nature of answers which are given by business owners and top managers as well as the scope of the BEEPS Survey sample.[49]

Figure 4.7 Internationally-recognized quality certification (% of firms[50])



Source: World Bank, Enterprise Surveys based on BEEPS data
Note: *2008 for Belarus, Georgia, Tajikistan, and Uzbekistan; **2012 for Russia

[49] World Bank, Enterprise Surveys (http://www.enterprisesurveys.org/).
[50] Internationally-recognized quality certification is the percentage of firms having an internationally-recognized quality certification, i.e., ISO 9000, 9002 or 14000

A more reliable indicator may be International Organization for Standardization (ISO) certificates per million inhabitants, for which Kyrgyzstan ranks in last position among its peers (Table 4.3). Aside from a limited sample size, this may be explained by many certified firms having a low intensity of certification, e.g. limited quality controls. Nonetheless, such specific figures may change quickly depending upon companies' awareness of certification schemes, and may not fully reflect true competitive advantage.

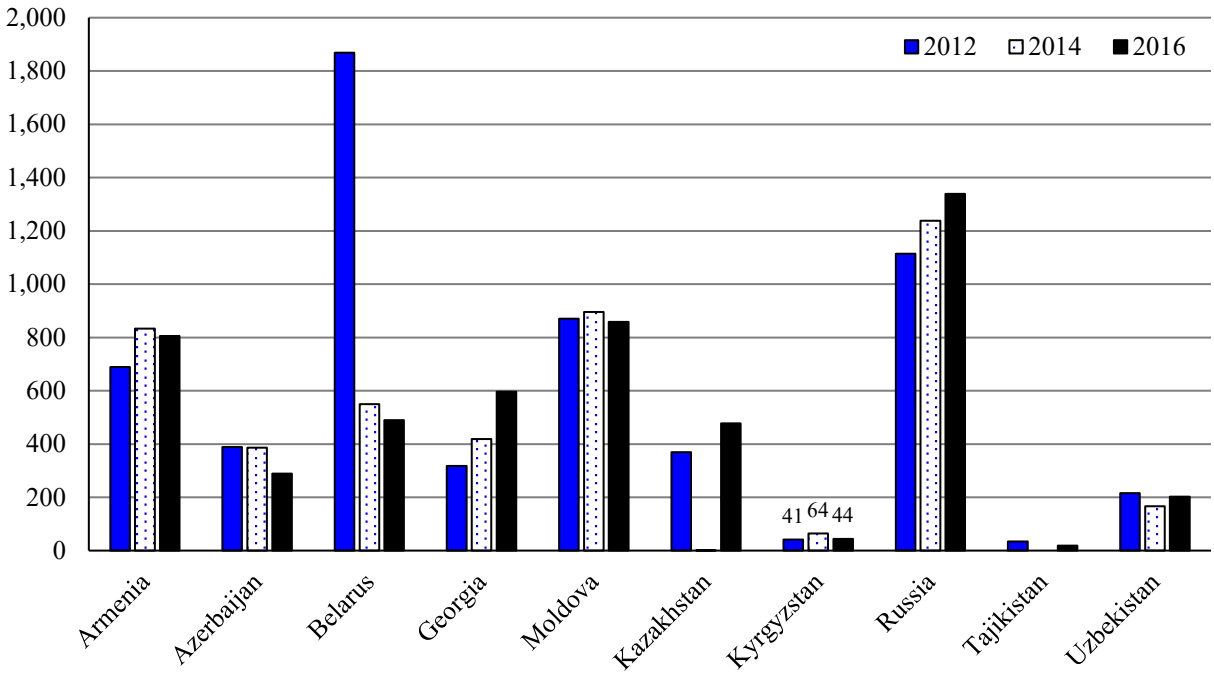
Table 4.3 ISO 9001 certificates per million population

	2000	2007	2008	2009	2010	2011	2012	2013	2014	2015
Belarus	5.8	136.8	183.6	211.8	15.9	18.1	18	13.7	306.6	385.4
Russia	7.7	80.7	112.4	372.3	435.9	93.1	87.2	82	78	63
Moldova	4.1	14	26.9	46.8	23	24.2	36.8	33.7	34.6	36.6
Georgia	1.6	21.6	26.6	28.7	18.3	19.9	20.7	25.2	25.2	22.9
Armenia	1.3	26.4	22.9	26.3	20.6	11.8	8.7	5.7	5.3	8.9
Uzbekistan	0	3.2	5.7	8.8	4.5	5.1	6.4	2.1	2.4	2.2
Tajikistan	0	0	0.1	0.1	0.1	0	0.4	0.6	0.5	0.5
Kyrgyzstan	0	0.8	0.6	3	1.3	0.9	1.1	1	0.7	0.2

Source: Based on ISO 9001 database and WBDI Database

Trademarks are a convenient proxy for firms' ability to achieve product "differentiation", and thereby competitiveness. Kyrgyzstan ranks relatively poorly within its peer group (Figure 4.8), but has seen some increase in the relative number of trademarks per million population.

Figure 4.8 Trademark applications, per million residents[51]

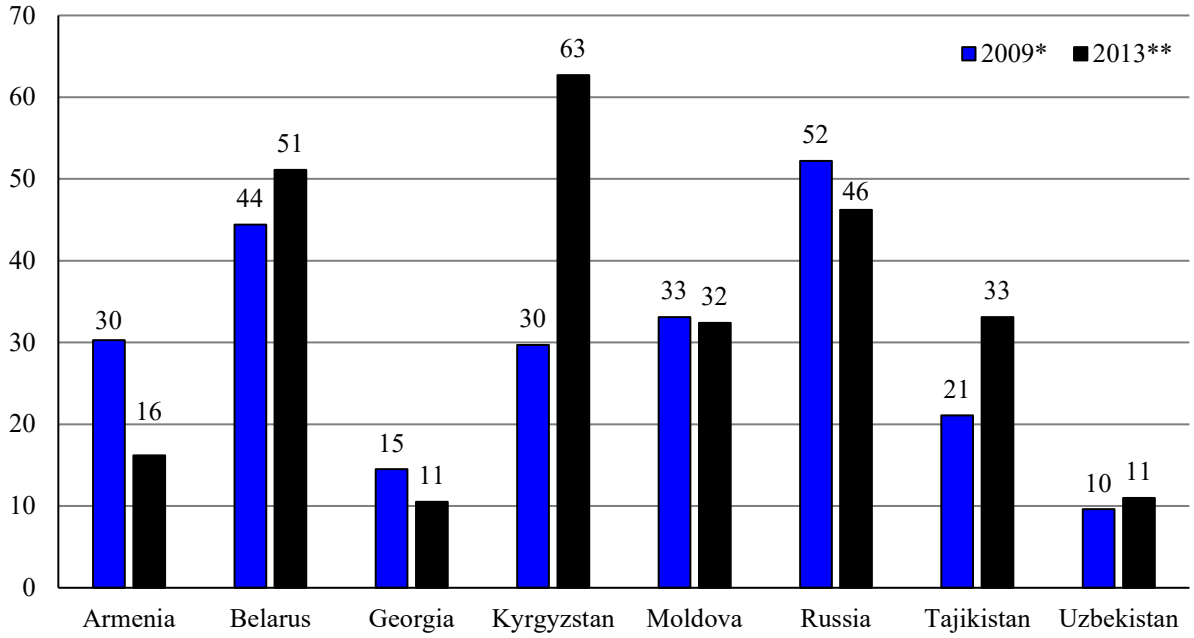


Source: World Development Indicators - World Bank Open Data

[51] Unlike patents, trademark registrations can potentially be maintained indefinitely, as long as the trademark holder pays the renewal fees and actually uses the trademark. Trademark rights are limited to the jurisdiction of the authority that issues the trademark. (WIPO definition)

An important input into production capability is whether firms are offering formal training. In this regard, Kyrgyzstan has moved to a leading position among its peers over recent years, with 63% of firms' offering formal training (Figure 4.9). Again, in interpreting such data, we must recall that these are subjective answers based on the BEEPS survey sample, although any biases should in principle affect country samples equally.

Figure 4.9 Firms offering formal training (% of firms[52])



Source: World Development Indicators - World Bank Open Data
Note: *2008 for Belarus, Georgia, Tajikistan and Uzbekistan; **2012 for Russia

BEEPS data may also be used to assess the production capabilities of Kyrgyz firms (Table 4.4). The proportions of Kyrgyz firms with their own website and using email to communicate with clients or suppliers are average among its peer group, and lagging behind leading peers. Only 11% of Kyrgyz firms in the BEEPS sample reported using technology licensed from a foreign owned company, reflecting a low level of payments for disembodied technology knowledge. The proportion of Kyrgyz firms having their financial statements externally audited is comparable to other peer economies, but has been continuously declining (from 56% in 2002).

[52] Firms offering formal training are the percentage of firms offering formal training programs for their permanent, full-time employees.

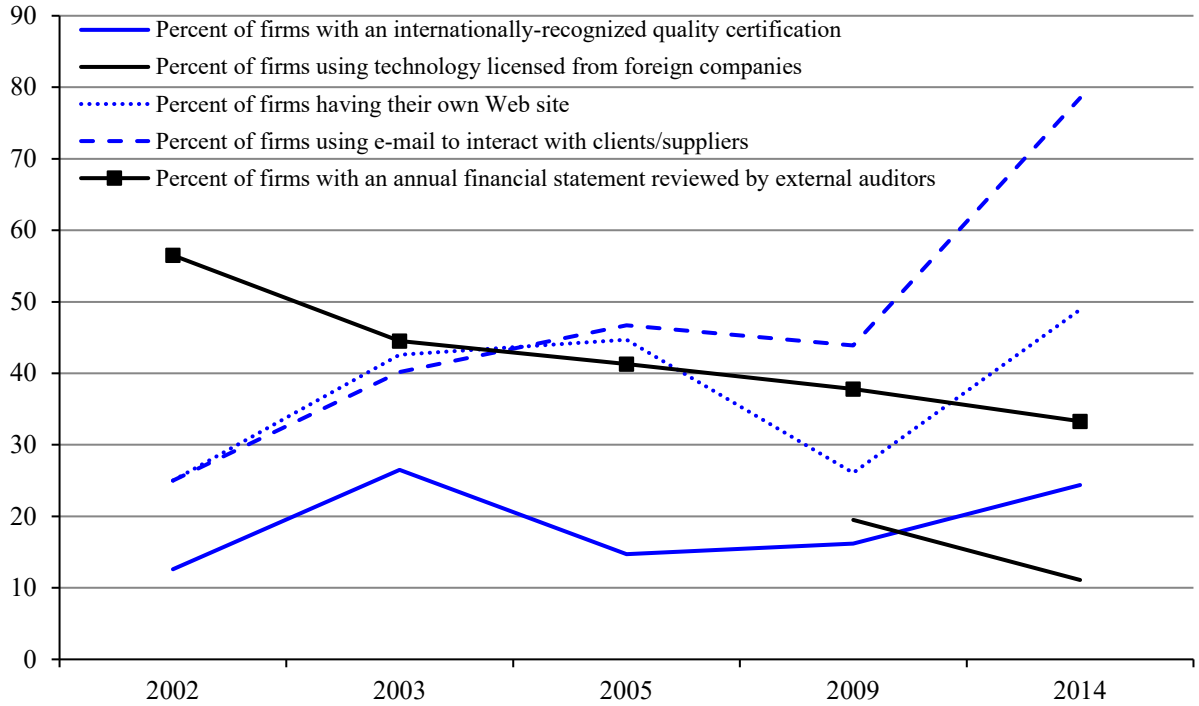
Table 4.4 Selected indicators of firms' organizational capabilities

2012-14	Have its own website?	Use e-mail to communicate with clients or suppliers?	Technology licensed from a foreign-owned company	Annual financial statements checked and certified by an external auditor?
Armenia	73%	91%	19%	23%
Belarus	62%	86%	6%	44%
Russia	62%	94%	8%	21%
Moldova	56%	67%	18%	31%
Kyrgyzstan	**49%**	**79%**	**11%**	**33%**
Georgia	46%	76%	16%	28%
Tajikistan	37%	56%	17%	43%

Source: BEEPS Survey 2014

While imperfect, the indicators suggest weak production and organizational capabilities, and show the majority of firms to have weak "differentiation" capabilities and relatively limited use of new technologies (Figure 4.10).

Figure 4.10 Selected indicators of Kyrgyz firms' organizational capabilities



Source: BEEPS Surveys 2002-14

Own R&D and technological capability

Production capability is an important precondition for technological capability, which is about improving existing products and prpocesses and has more demanding organizational

requirements. "Industry of Kyrgyzstan" statistics are produced by the National Statistical Committee, which has adopted a modified version of Oslo manual, and provide an insight into firms' innovative activities. Based on a sample of 752 enterprises, only 7.4% (56 firms) are engaged in innovative activities (Table 4.5). The food industry was the most frequent innovator, accounting for 18% of these firms. However, the number of innovation active enterprises actually selling innovative products was only 7. This is less than 1% of firms sampled, and has declined in recent years, from an already low absolute number of 15 firms in 2011.

In terms of key types of innovation activity among Kyrgyz firms in this sample, 55% purchase machinery and equipment and 24% purchase software, while only around 3.5% do any R&D. However, in financial terms expenditures on the purchase of machinery and equipment completely dominates, with intangible investments being very marginal, although figures for 2015 were strongly influenced by one big investment in processing of oil products. Overall expenditure on innovation activity was highly marginal, at around KGS 5.5 million, or $80,000 in total, across the 752 enterprises surveyed.

Table 4.5 Distribution of enterprises' innovation expenditures by activity

	Number of enterprises	Share of expenditure	Absolute expenditure, KGS
R&D	2	0.6%	32,343
Purchase of machinery and equipment	38	97.8%	5,402,158
Purchase of new technology	1	0.0%	1,643
Purchase of software	17	0.4%	20,668
Project design	3	0.2%	13,781
Training of personnel	2	0.1%	3,179
Marketing research	1	0.0%	6
Other innovations	5	0.9%	49,493
Total	56*	100%	5,523,271

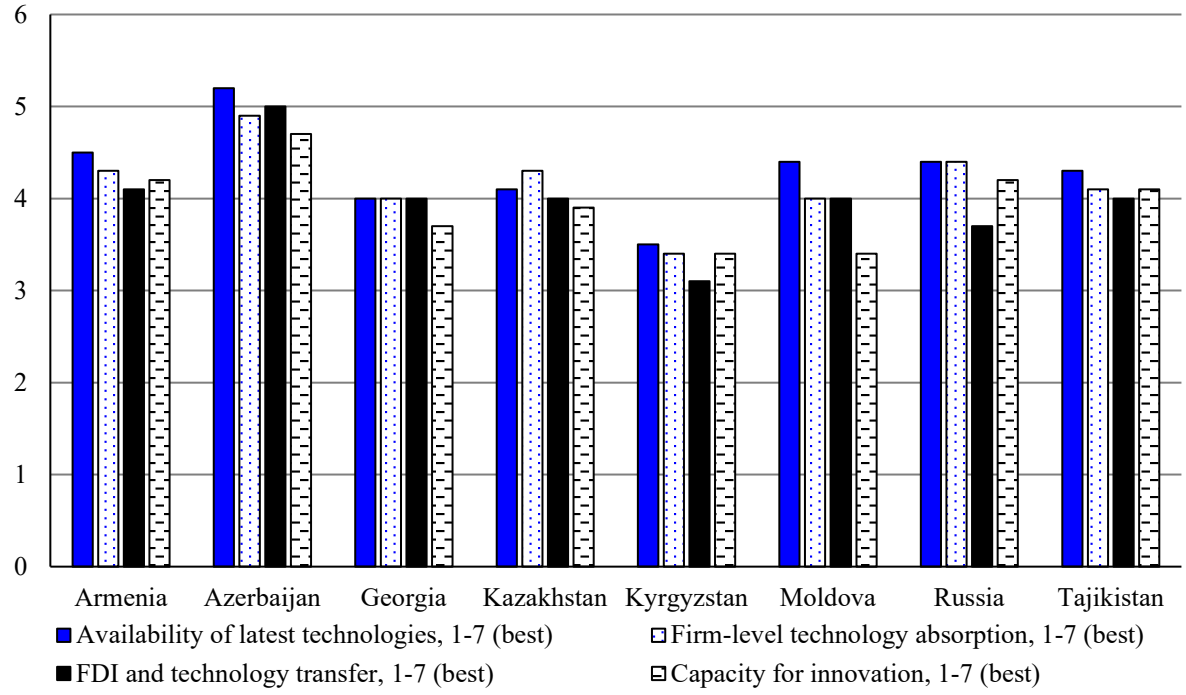
Source: Промышленность Кыргызской Республики 2011-2015 (2016) Национальный статистический комитет Кыргызской Республики, Бишкек 2016

* Some firms perform more than one innovation activity type.

The share of export in total innovation based sales is 37%, confirming the policy consensus that innovation and internationalization are closely related. However, the overall significance of innovation is very marginal, with the share of innovation based sales in total exports around 0.10%.[53] This picture is complemented by subjective indicators from the WEF GCI, with Kyrgyzstan ranking well behind its peers on all dimensions of technological capability (Figure 4.11).

[53] Source: Промышленность Кыргызской Республики 2011-2015 (2016) Национальный статистический комитет Кыргызской Республики, Бишкек 2016

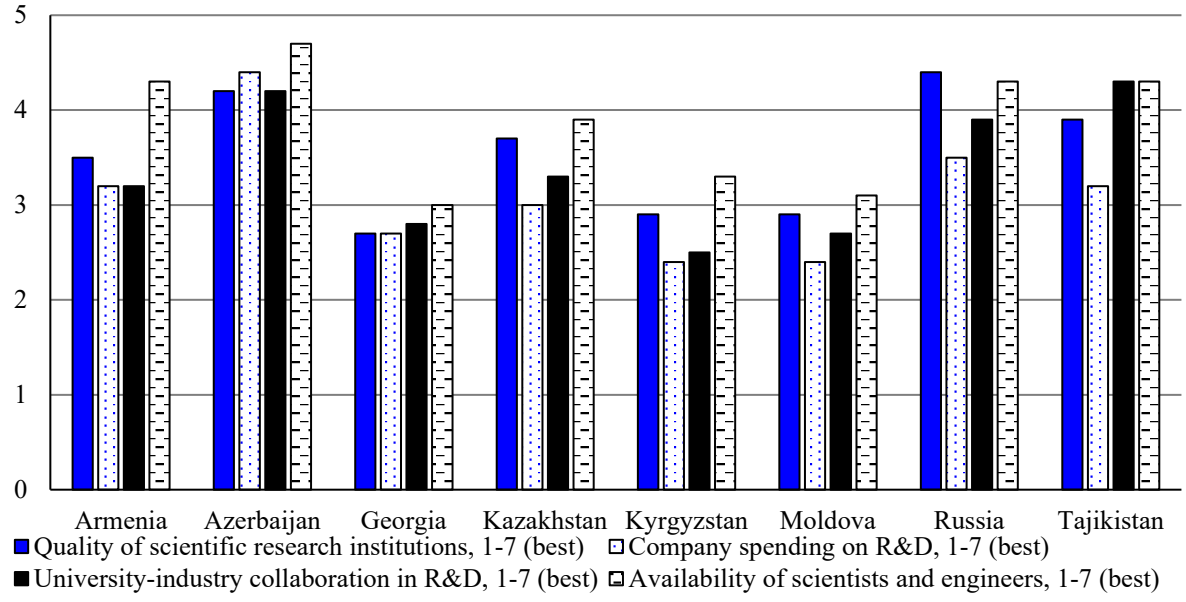
Figure 4.11 Indicators of technological capability



Source: WEF GCI 2017

As well as firm-level technology capabilities, it is crucial that firms have well-equipped supporting R&D organizations and skilled R&D personnel to help solve technological problems. Firms evaluate their R&D capability as being the least developed part of R&D system, but also do not rate highly the external factors such as availability of scientists and engineers, quality of scientific research institutions, and university-industry collaboration in R&D (Figure 4.12). This suggests that very low technological and R&D capability at the firm level is not helped by the external R&D organizations.

Figure 4.12 R&D system indicators



Source: WEF GCI 2017

The R&D system provides not just direct assistance to firms, but also has an educational role to transfer world knowledge into the local economy. Resident patent applications per $100 billion GDP provide an indicator of relative strength, and Kyrgyzstan compares favourably to its peers on this metric (Table 4.6), possibly as a result of preserved islands of strength in extramural R&D and engineering competencies. However, most FSU countries have seen a continuous decline of relative "technology generation intensity" of their economies (as proxied by resident patents), although in Kyrgyzstan this decrease has been less pronounced.

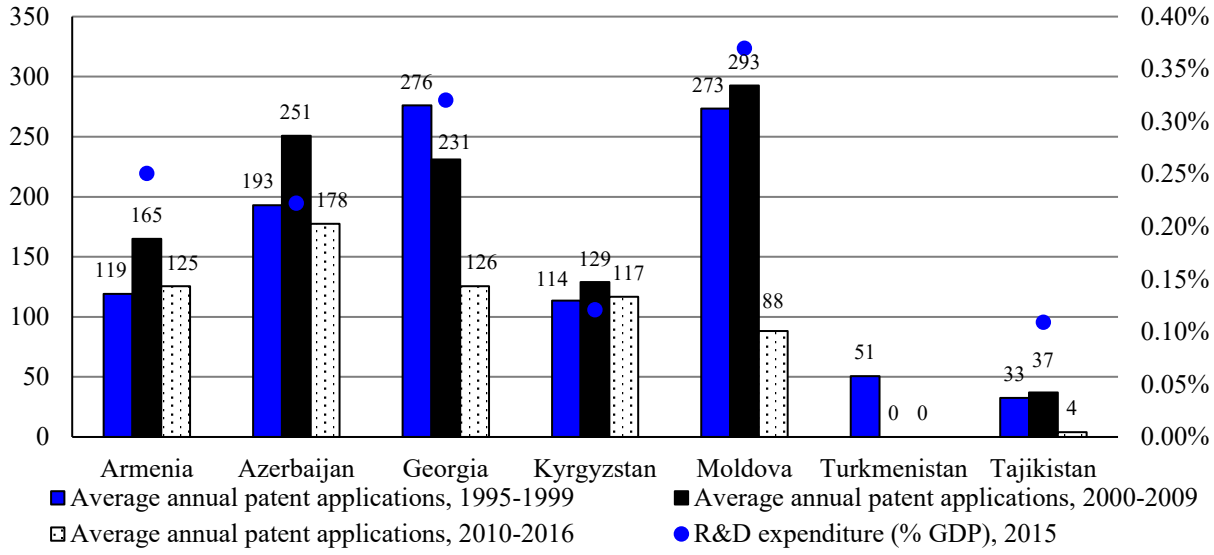
Table 4.6 Resident patent applications per $100 billion GDP (2011 PPP) (by origin)

	2000-05	2005-10	2010-15
Belarus	1,195	1,208	832
Russia	1,016	860	785
Kyrgyzstan	**1,071**	**1,011**	**712**
Armenia	1,405	827	572
Moldova	3,138	1,842	508
Georgia	1,337	922	389
Uzbekistan	940	302	195
Tajikistan	488	117	22

Source: World Intellectual Property Organization (WIPO) statistics database.

Still, the overall scale of patenting activity is somewhat marginal, at slightly more than 100 patents annually, which is broadly comparable with similar size peer economies (Figure 4.13). The overall picture of a marginal R&D system with weak capacity to follow technology developments and support knowledge absorption and commercialization is confirmed by low aggregate expenditures on R&D in the range of 0.1-0.2% of GDP.

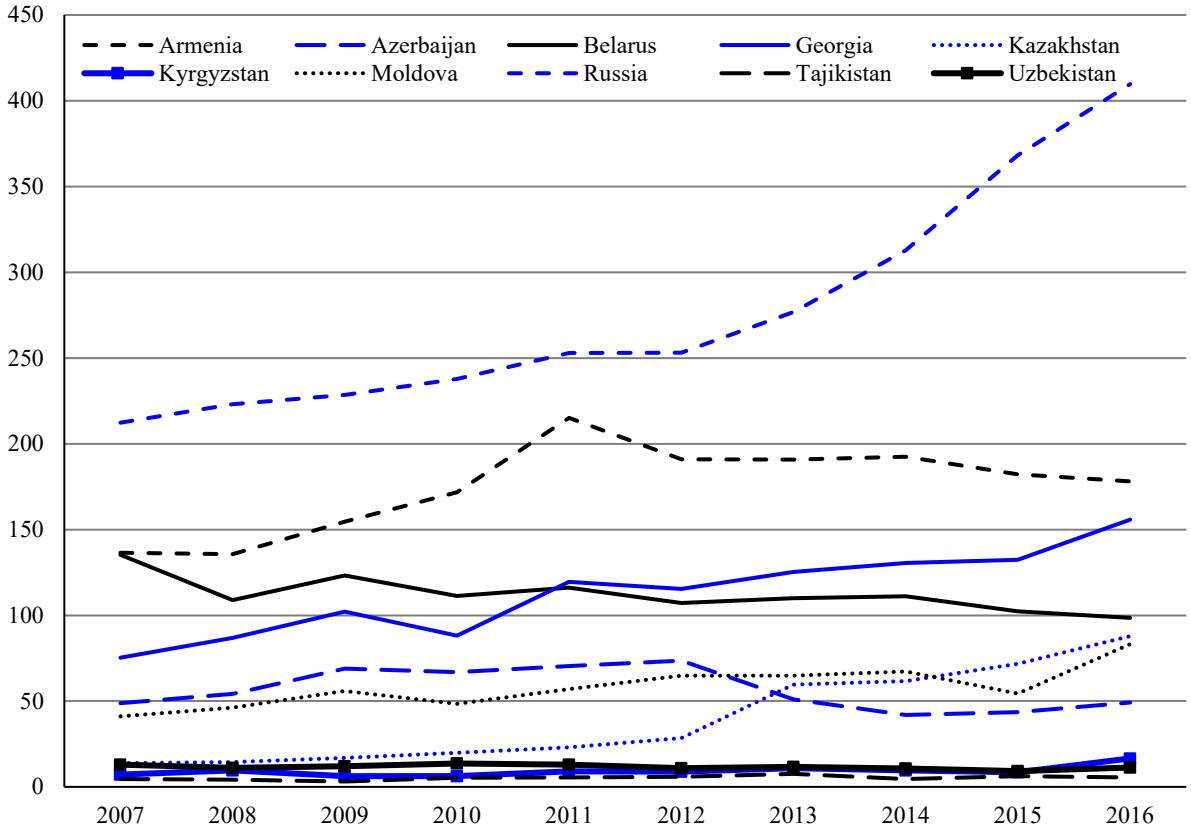
Figure 4.13 Resident patent applications versus gross R&D expenditure (share of GDP)



Source: World Development Indicators - World Bank Open Data

Like other peer economies with marginal R&D spending, publication output is also marginal, at levels around ten S&T papers per million population, although this increased to reach 17 S&T papers per million population in 2016 (Figure 4.14). This also affects education and availability of suitably trained employees, with university teachers unable to keep up with the world knowledge frontier.

Figure 4.14 S&T articles per million population



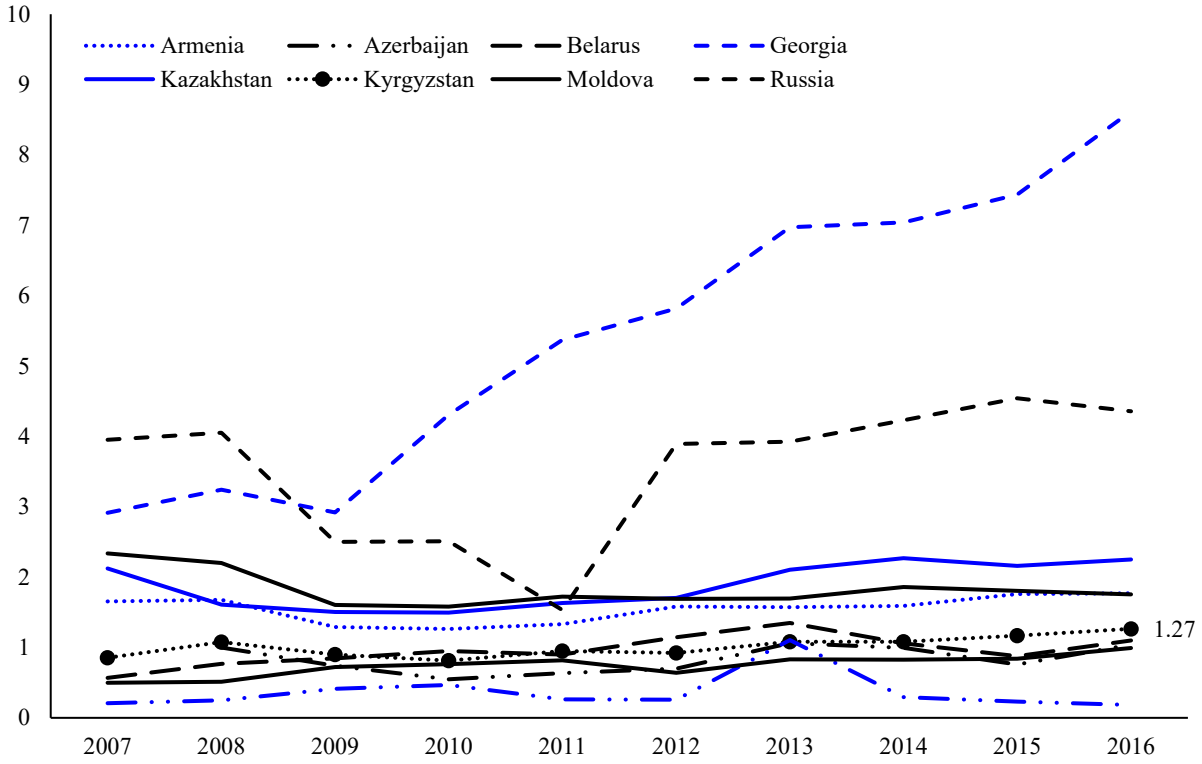
Source: World Development Indicators - World Bank Open Data

Business environment

In addition to the level of investment, the institutional set up in which investment activities take place is possibly an even more important driver of growth and catching up, determining the nature of demand and supply for research and technological development, as well as the effectiveness of investments.

An important proxy for the dynamism of the institutional environment is the rate of new firm formation, considered an indicator of favourable conditions for local entrepreneurs in terms of available business opportunities and job creation. Kyrgyzstan has lagged behind peer economies in this regard (Figure 4.15), but new business registration rates have climbed somewhat in recent years to reach 1.27 per thousand people aged 15-64 in 2016. However, in times of crisis, individuals may set up companies due to a lack of other opportunities on the job market, and tax incentives for self-employment may also distort comparisons between countries.

Figure 4.15 New business density (new registrations per thousand people aged 15-64)



Source: World Development Indicators - World Bank Open Data

The World Bank (2017[54]) observed that "the private sector is not productive: firms are too small and informal to be competitive and create jobs". A high share of the informal economy (40-60%[55]) reflects an orientation towards construction, trade and services, as opposed to longer term investment. It may also be due to the poor quality of state governance. Almost 52% of firms have reported making informal payments to public officials – higher than in peer economies (Table 4.7). In terms of time of senior management spent dealing with Government regulations, Kyrgyzstan ranks around the middle of its peer group, suggesting scope for further improvement to address a principal driver of corruption.

[54] World Bank presentation on Country Partnership Framework consultations (2017) for the Kyrgyz Republic "What will it take to transition: From vulnerability to prosperity", http://pubdocs.worldbank.org/en/470731515167086579/Kyrgyz-Republic-CPF-2018-22.pdf

[55] World Bank (2013) Country Partnership Strategy For The Kyrgyz Republic For The Period Fy14-17, June 24, 2013

Table 4.7 Indicators of corruption and quality of state governance, 2013

	Informal payments to public officials (% firms)	Time spent dealing with government regulations (% senior management time)
Kyrgyzstan	**51.2**	**12**
Tajikistan	37.2	21.9
Moldova	16.4	6.8
Belarus	13.2	13.7
Armenia	4.6	12.2
Uzbekistan	3.5	19.9
Georgia	1.9	0.9

Source: World Development Indicators - World Bank Open Data

Kyrgyzstan does however rank well among its peers for strength of legal rights (together with Georgia and Moldova). However, this strength is not reflected in a low ranking in the World Bank Doing business index, with Kyrgyzstan in the bottom group (with Tajikistan and Uzbekistan) (Table 4.8). This reflects the gap between *de jure* rules and *de facto* application.

Table 4.8 Legal and business environment

	Strength of legal rights index (0=weak to 12=strong)	Ease of doing business ranking (1=most business-friendly regulations)[56]
Georgia	9	9
Kyrgyzstan	**9**	**77**
Moldova	8	44
Russia	8	35
Armenia	6	47
Uzbekistan	6	74
Kazakhstan	4	36
Belarus	3	38
Tajikistan	1	123

Source: World Bank Doing Business 2018

Overall, there is more work to be done in converting successful democratic reforms into institutional changes on the ground. A high share of the informal sector is unfavourable for innovation, and weak governance is holding back local entrepreneurs. The financial system is crucial to entrepreneurship and as a driver of modernization. Taking borrowers from commercial banks as a proxy for financial system development, Kyrgyzstan ranks relatively well (Table 4.9).

[56] The index averages the country's percentile rankings on 10 topics covered in the World Bank's Doing Business. The ranking on each topic is the simple average of the percentile rankings on its component indicators.

Table 4.9 Borrowers from commercial banks (per thousand adults)

	2009	2010	2011	2012	2013	2014	2015	2016
Georgia	271	333	456	486	627	716	685	724
Kyrgyzstan	23	29	37	40	42	56	86	95
Uzbekistan	27	36	40	44	47	49	58	68
Moldova	43	38	37	41	47	52	50	40
Tajikistan	16	18	21	26	34	..	..	..

Source: World Development Indicators - World Bank Open Data

Nonetheless, the banking system is not developed to the extent that it is a driver of modernization. Real interest rates are around 13%, which is at the top of its peer group (Table 4.10). Such high rates are problematic for innovation-related projects.

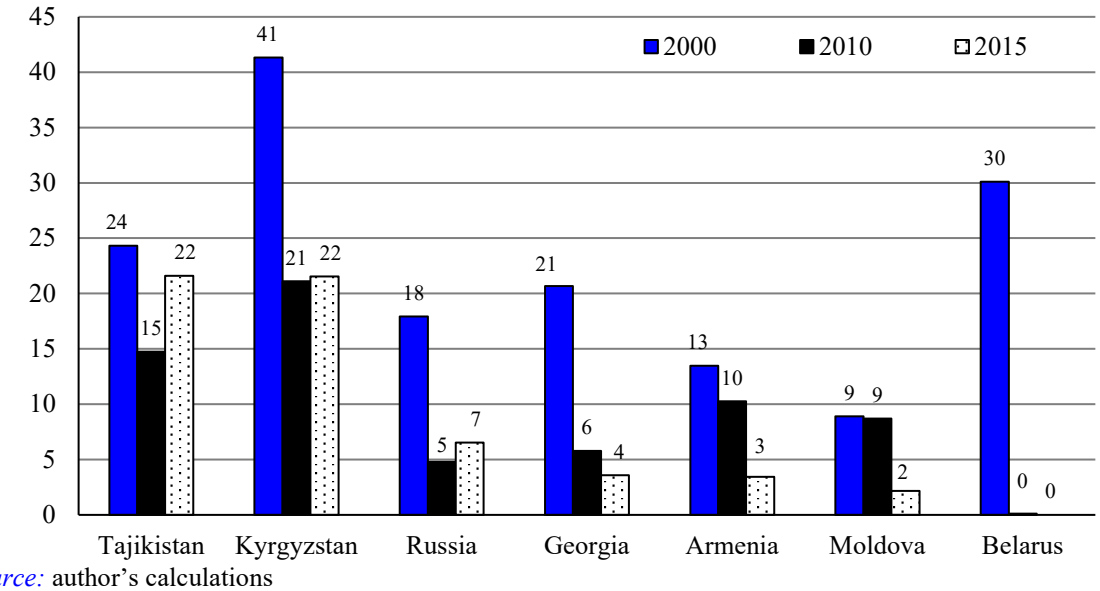
Table 4.10 Real interest rate (per cent)

Country	Average, 2007-2015
Armenia	13
Kyrgyzstan	**13**
Tajikistan	10
Georgia	10
Moldova	7
Russia	0
Belarus	-10

Author's own calculations

High real interest rates indicate a shallow financial system, and reflect both inherent risks as well as inefficiencies in the financial system. Interest rate spreads are falling, but inefficiencies in the financial system (both external and internal) make funding of innovation based projects in Kyrgyzstan much more difficult compared to many peer economies (Figure 4.16)

Figure 4.16 Interest rate spread (lending rate minus deposit rate, percentage points)



Source: author's calculations

Enablers of growth: a summary

An assessment of tangible, intangible and institutional factors indicates similar constraints to catch-up that characterize lower-middle-income economies in the region. While *positive drivers* are limited, they include:

- Rising physical investment;
- Limited but increasing FDI;
- Extensive education with relatively high educational expenditure; and
- liberal reforms providing a good basis for transformation of the business environment.

In terms of constraints, finance may seem an obvious binding constraint. However, addressing financing constraints will achieve little given equally important constraints such as a poor business environment, weak infrastructure or a lack of relevant skills for firms. Taking account of the large share of remittances used for consumption rather than investment, the cost of finance is secondary to the lack of market opportunities.

Key constraints based on the previous benchmarking exercise are:

- Undeveloped infrastructure, both transport- and Internet-related, which directly impinge on firms' costs competitiveness;
- Low quality of education;
- Undeveloped production capabilities of firms, which face issues of export competitiveness and quality and lack a strategic approach to such activities;
- An R&D system that is marginal to the economy and does not operate as a driver of absorptive capacity; and
- Poor business environment

However, relaxing some of these constraints will not necessarily open new opportunities, given the range of interrelated challenges. Extensive education is a huge opportunity but would need to be accompanied by improved quality through curriculum reform, teacher training, improved education standards and international performance criteria. Cost competitiveness should represent a great potential source of comparative advantage, but is undermined by poor infrastructure and high trading costs, many of which are of regulatory nature.

Firms are increasingly aware of the importance of quality, product differentiation and requirements to access foreign markets. However, this would require a strategic approach to improve quality standards and promote exports. Use of ICT is increasingly, but cannot fully overcome certain disadvantages such as poor geographical position, lack of a collective brand, and market access issues.

4.3 Potential drivers of innovation-led growth

Interviews as part of this Review revealed a range of potential drivers of economic growth in Kyrgyz economy (Table 4.11). The economy is dominated by cottage-type SMEs with a few mid-sized corporations in metal and non-metal ores. Such SMEs are particularly affected by weaknesses in infrastructure and deficiencies in external technical, marketing and other business services, which cannot always be developed without public support. They are also more affected by informality and corruption. Large firms can compensate for lacking

preconditions for growth through, for example, internal capital markets, in-house training programmes, focused investment in R&D, and by challenging discretionary state behaviour.

Table 4.11 Potential sources of economic growth: opportunities and constraints

	Opportunities	Constraints
Multinational Corporations (MNCs) (FDI)	Local market driven FDI	Small local market and constraints to exports
GVCs (subcontracting)	Supply chain organizers (assembler, buyers) can support supply network of SMEs	Not yet local or foreign supply chain organisers
Individual local firms ("islands of excellence")	Island of accumulated know-how and new technology-based firms growing based on skills of entrepreneurs/engineers	Skills shortages and lack of support for engineering labs
Clothing	Comparative advantages in labour costs	Weak supply chain
Food	Comparative advantages in specific niches	Lack of "collective brand"
Free economic zones	Potentially useful tools of regional development	
IT outsourcing	Skilled programmers High Tech Park to facilitate and provide training support Government support	Education system that does not train quality programmers Undeveloped local public procurement
Local innovation ecosystems of new ICT-based firms	Bottom-up initiatives Potential for discovery of new business models	Uncertain potential of the existing initiatives to substitute for missing external preconditions for innovation ecosystem
Tourism	Comparative advantages	Undeveloped transportation and tourism-related infrastructure
International aid organizations	Good service delivery	Weak impact on development of local capabilities

Kyrgyzstan has several rare metal and non-metal ore producers. It is unclear to what extent these can be restructured, and whether they can operate as sources of growth, employment and technological upgrading.

MNCs (FDI) and GVCs (subcontracting)

Kyrgyzstan's FDI regime is relatively favourable, but does not seem sufficient to attract investors, with only one major FDI in the gold mining sector. The wider business environment and unfavourable regional factors, such as low income markets, seem to outweigh cost advantages. This absence, however, does not exclude investors emerging as Kyrgyzstan's potential advantages becomes apparent to foreign investors. In particular, there is unexploited potential for Kyrgyzstan to connect with Chinese and Russian markets.

Individual local firms ("islands of excellence")

Fieldwork as part of this Review revealed local firms that can be considered "islands of excellence" – well-managed companies with distinctive products, unique technology or technical know-how. This may be based on either accumulated past capabilities the know-how of entrepreneurs' and engineers in new technology-based firms. Examples include several confectionary producers and a firm that has developed a vacuum based process for drying fruits. Avtomash Radioator is a leading company in the machine building industry and produces coolers for cars and vans, having preserved technical know-how to maintain its position on the CIS market. Several SMEs have unique technologies, e.g. an electric heater producer in the Bishkek Free Economic Zone.

Such firms should be considered sources of future growth and employment based on their unique capabilities, but currently have very limited local links and experience numerous problems with the quality of local suppliers. They also struggle with numerous constraints regarding skills, outdated technical laboratories and access to foreign markets. Such firms could develop in future as organizers of local supplier network, with appropriate policy support.

Clothing and food

The garment and food industries represent potential sources of further growth, given availability of the required skills, low labour costs and proximity to the Russian market. The garment industry employs two hundred thousand people. Exports are quite modest at $40 million, but have much greater potential. A main focus should be on achieving certifications for export markets, which will require coordination within the sector. Associations of garment producers should play a much more active role in assisting technological upgrading. Food companies also need to invest in ISO 9001 standards, while farmers and SMEs require technical assistance. Much better coordination is required between actors in the agri-food chain, which is currently dominated by sales intermediaries. Building on latent comparative advantages in both sectors will require attention to industry-specific constraints. Nonetheless, there is huge employment potential in both sectors, and constraints for further growth are comparatively smaller than in other sectors.

Free Economic Zones

There are currently five FEZs in Kyrgyzstan. FEZs usually focus on FDI attraction, but in Kyrgyzstan due to very limited FDI are instead used as tools for regional development. FEZ resident benefit from zero profit tax, zero duties on export and import and submarket rents for premises. FEZ Bishkek has 60 resident enterprises, of which 99% are start-ups, and employ 3,500 people. The technical and managerial level of enterprises is above the national average, with a number of enterprises are engaged in import substitution activities. FEZ activities could be considered as "entry points" for growth and export of Kyrgyz firms.

Spill over benefits from the FEZ to local content and supplier links are not yet clear, although such effects cannot be expected to materialize in the short term. Instead, the FEZ currently functions as an example of managerial good practice. The lack of a long waiting list for the FEZ suggests that, even with preferential taxation, local entrepreneurial opportunities and skills are lacking. This reinforces the case for continued policy support for the FEZ with the aim to attract more foreign investors and attract more technology-based firms.

IT outsourcing and the local ecosystem for ICT start-ups

ICT is a sector with low barriers to entry and represents a natural entry point for Kyrgyz entrepreneurs. IT services outsourcing, like software and call centres, is emerging as a potential source of growth, alongside ICT start-ups. The Kyrgyz High-Tech Park (HTP) and the Association of Software Firms (established in 2008) have a mission to promote Kyrgyz IT companies and assist them in software development for outsourcing. While the IT industry started in the "shadow economy", HTP has helped the sector to go public. Advantages of HTP membership include low taxation (5% payroll tax plus 12% for social security) when exporting software services, introduced in 2011. HTP residents do not pay profit tax, VAT or sales tax, but contribute 1% of sales to the HTP. In return, companies are helped with issues arising with public administration and tax inspections. Residents are subject to a simplified tax system if their annual sales are below $15k. Once annual sales exceed this level, HTP provides supporting accounting services. There is a requirement for HTP residents to export 80% of their services, which should be 90% in the software business. The HTP is not a territorial entity, but operates as an extra-territorial unit and a tax regime environment. As of 2017, the HTP has 30 members that employ around 250-300 people with sales of $3-3.5 million.

The HTP has launched an "IT Academy" – a one-year study of programming in cooperation with universities to provide HTP firms with more programmers. The IT Academy expects this year to produce more programmer graduates than local universities, and that 80% of these trainees will obtain jobs in HTP companies.

While local investors are still not involved in the HTP, it has helped to concentrate a rather fragmented sector and raise awareness. Local economic linkages are a crucial issue, with the HTP operating almost by design as an export enclave. The only internal ICT market is for government services. However, public procurement rules are not suitable for Kyrgyz IT companies, which are too small to meet complex administrative requirements. For example, the latest public procurement call eligibility criteria stipulating sales of at least $2.6 million. This often favours larger foreign firms that then rely on local IT firms as subcontractors. This hinders the development of local project implementation capabilities, required for export capability and all the more important given a local IT Market of only $15-20 million.

An alternative path of ICT development is through support of the local ICT innovation ecosystem. The cases of OLOLO art studio[57] and KG Labs[58] public foundation are instructive. OLOLO art studio is de facto a co-working space for start-ups that offers a co-working environment and event space. Started a year ago, it already employs 70-80 people in several start-ups that are plugged into global IT networks. The goal of KG Labs is to connect the local community with the global start-up network, private equity and venture capital. In 2015 they organized their first hackathon as part of a plan to boost start-ups in Kyrgyzstan. Both OLOLO art studio and KG Labs were established as grassroots initiatives without state support. Overall, while ICT firms do not yet operate as innovation ecosystem, this approach warrants support, and is complementary to other ICT upgrading efforts.

[57] http://ololo.kg/about/
[58] http://kglabs.org/

Tourism

Given Kyrgyzstan's natural beauty, ecology and cultural heritage, tourism has strong growth potential. While outside the scope of this Review, tourism's advantages and opportunities are obvious, but its constraints equally visible: poor infrastructure, lack of sector-specific skills, and lack of new business models in strong niche areas such as eco- and adventure-tourism.

International aid organizations

International aid organizations are active, focusing on distinct parts of the development agenda, e.g. the World Bank on poverty reduction, Asian Development Bank on infrastructure investment, the European Union on rule of law, education and rural development, among others, and the Eurasian Development Bank on financing economic integration projects. Most programmes are effective in term of implementation. The key question is whether they develop local project management and service capabilities (e.g., in health, energy efficiency, etc.) for self-sustained activities. A key current challenge is that people trained within international programmes often leave the country and apply the skills gained elsewhere.

4.4 Recommendations

Kyrgyzstan *de facto* lacks an innovation policy. This is not exceptional for a lower-middle-income economy. With R&D expenditures only 0.1% of GDP and a very limited number of innovative firms, innovation policy cannot be framed in conventional terms by focusing on R&D and organized innovation activities that are very marginal. Innovation policy is complex. Major challenges for industrial and innovation polices are not known *ex ante*. Knowledge and technical skills requirements are demanding, with results delivered across electoral cycles and needing private sector collaboration while avoiding regulatory capture and rent seeking.

Nonetheless, effective innovation and industrial policies are essential for catch up through technological upgrading. However, given huge resource and institutional differences, it would be a mistake to imitate best practice in high income economies. For example, adopting only horizontal innovation policy instruments focused solely on R&D "commercialization" ignores key areas of technology upgrading to enhance productivity, management practices, production capability and quality. Likewise, a narrow focus on technology transfer or technoparks/clusters fails to address a sector-specific barriers to growth, productivity and internationalization.

An entirely horizontal approach, while usually correct in identifying generic constraints to growth, ignores sectoral heterogeneity and can therefore be very slow to yield results. In fact, there is limited evidence on the effects of horizontal policies, despite their dominance. Sector-specific (vertical) policies are explicitly selective and target technological upgrading in specific industries. The key challenge is how to define sector-specific policies without being unduly captured by specific sectoral interests. The authorities could formulate specific policy support packages in sectors with strong growth potential. Such policy packages should evolve over time based on initial support measures and the active involvement of non-government actors, primarily industrial associations and other non-governmental organizations.

Finally, a focus on innovation policy does not negate the urgent need for continued structural reform, improvements to the business environment and infrastructure investment.

Recommendation 4.1

Kyrgyzstan should develop a strategic approach to FDI and integration into Global Value Chains (GVCs), including new opportunities such as the Eurasian Economic Union and "One Belt, One Road". This could include:

- Identifying promising sectors for further support through a process of "smart specialization" and public-private dialogue;
- Building on existing free economic zones;
- Tailor made packages to attract investors in key sectors like textiles, food, call centres, etc., including skills and training programmes that may be based on cost-sharing with foreign investors or international donors;
- Assist export promotion in the textiles and food industries linked to improving quality and meeting health and safety and international export standards in collaboration with industry associations and international donors;
- A specific package of support measures for companies willing to meet quality and other requirements within an internationally assisted programme of technology upgrading.

Recommendation 4.2

There is a need for investment and strengthened industry-science linkages to drive modernization of the science and research sectors. Policymakers should recognize the extent to which the network of research institutes of the National Academy of Sciences has already been transformed under challenging conditions of limited public funding and a "survival mode of operation". There are potentially large untapped demands from an SME dominated private sector for technical and testing services. R&D institutes and some universities already operate as a substitute for the lacking knowledge-based services sector. Some research institutes are already engaged in collaboration with SMEs and could develop further in a direction similar to German Fraunhofer or Steinbiss Foundation institutes. In particular, the authorities should consider:

- A programme to transform existing research institutes into a network of technology institutes that support industry, in particular SMEs;
- Using technology institutes to create small but profitable improvements by extending established technologies to smaller firms;
- Support to SME demand for innovation support from research institutes and the knowledge-intensive business services sector through appropriate policy measures such as innovation vouchers and tax incentives;
- Upstream scientific institutes in areas closer to basic research should be integrated into universities, improving teaching quality and building on existing formal and informal collaboration between research institutes and universities.

Recommendation 4.3

Kyrgyzstan has an extensive education system that currently provides mass education of low to intermediate quality. Increased educational investment needs to continue and be matched by impoved quality standards. The authorities should consider:

- Increasing quality of education with a programme of international training for teachers;

- As recommended in Armenia and Tajikistan, the authorities could consider a similar scheme to Kazakhstan's Bolashak programme for teachers, based on highly competitive selection followed by promising career opportunities. The Government could approach the donor community and propose funding based on cost sharing;
- Educational curricula should be modernized in consultation with industry to ensure they correspond to the needs of employers. Harmonization with the EU Bologna process should be considered.

Recommendation 4.4

Public procurement as an instrument of innovation policy is undeveloped and is a missed opportunity to couple local demand in public sector development to local technological capabilities. In a small economy with limited local demand and problematic access to foreign markets, innovation-focused public procurement should be a priority. Policy makers are currently unaware of this potential. A first application could be in the ICT sector, given demands linked to eGovernment reforms, and could include local content requirements in public procurement contracts with foreign operators.

Recommendation 4.5

The National Statistical Committee is often highlighted as an island of excellence that has overseen substantial modernization and harmonization with international statistical standards. While existing innovation statistics represent a good first step, they are not fully harmonized with international standards. Coverage should be expanded to include Structural Business Statistics (SBS); Trade by Enterprise Characteristics (TEC) and Entrepreneurship Indicators (Business Demography, BD) to give policymakers a better understanding of business dynamics and micro-level industrial changes.

Chapter 5

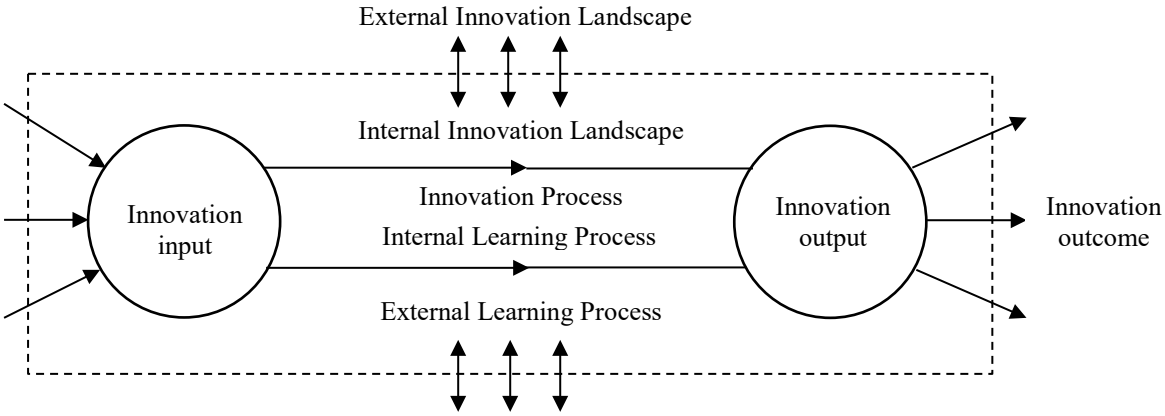
INNOVATION IN THE ENTERPRISE SECTOR

This chapter focuses on innovation and innovation performance in the enterprise sector, how enterprises innovate and what constraints they face. The chapter provides a critical assessment of Kyrgyz firms' innovation ecosystem resulting in policy recommendations for fostering innovation in the enterprise sector. A "*bottom-up approach*" is adopted. Thus, the needs of firms are examined first and the policy recommendations are concluded through the lenses of different kinds of innovating and non-innovating firms.

5.1 Conceptual framework

This chapter follows a broad, input–process–output–outcome framework to examine innovation performance in firms (Figure 5.1). This comprises six elements: innovation landscape, innovation input, innovation process, internal and external learning processes, innovation output and innovation outcome. Innovation input demonstrates the potential of firms to innovate, while innovation output demonstrates the direct results of innovation activities. Two processes are flowing between the input and the output, upon which both the external business environment and internal innovation landscapes have an important impact. The innovation process consisting of activities for developing innovations and learning process consisting of activities for deepening and expanding existing knowledge. Finally, innovation outcome demonstrates how successfully innovations are exploited.

Figure 5.1 Framework used to assess innovation performance in enterprise sector



Note: Designed based on Adams, R., Bessant, J. and Phelps, R. (2006). Innovation management: A review. International Journal of Management Reviews, 8(1), 21–47; and Forsman, H. and Temel, S. (2014). Measuring for Innovation. In Gupta, P. & Trusko, B. (Eds), Global Innovation Science Handbook, New York: McGraw-Hill.

The rich diversity of innovation patterns in enterprises suggests a need for diverse policies and instruments to support innovation development.[59, 60] However, the system also needs coordination, external coherence and synergies between instruments, with both firm-oriented and system-oriented policy instruments that cross firm boundaries (cf. Asheim et al., 2003).[61] Innovation policy instruments have traditionally been reactive tools, providing resources and allocating inputs[62] – appropriate where the window of opportunities is clear. This may not be the case in smaller firms, which need additional, proactive policies aimed at fostering innovation to change behavioural factors like innovation culture, management, strategic thinking, collaboration and interactive behaviour, or the level of awareness of opportunities. Table 5.1 presents the typology used in this chapter.

Table 5.1 Typology for assessing policy support

	Firm-oriented approach	**System-oriented approach**
Reactive approach for exploiting the window of opportunities	Support for innovation development	Resources for co-operative schemes and R&D programmes
Proactive approach for creating and changing the window of opportunities	Support for improving the abilities to innovate	Resources for co-operative learning, networking, strategic planning, innovation culture

Note: Modified from Asheim et al. (2003).

5.2 The enterprise sector and entrepreneurship in Kyrgyzstan

Government statistics classify the enterprise sector as peasant farms (agricultural activities conducted by one family), individual entrepreneurs, small firms and medium-sized firms. In particular, s*mall enterprises* include the firms in agriculture, mining, processing, production, and distribution of electricity, construction (50 employees), trade enterprises, hotel and restaurant services, transportation services, healthcare, and education services (15 employees). *Medium-sized enterprises* consists of firms in agriculture, mining, processing, production and distribution of electricity, construction (51-200 employees), trade enterprises, hotel and restaurant services, transportation services, healthcare and education services (16-50 employees).

The economy is dominated by small firms, individual entrepreneurs and peasant farmers, with significant increases in their number in recent years (Table 5.2). While the share of GVA accounted for by peasant farmers has declined, the share of GVA and employment of individual entrepreneurs has grown strongly. Nevertheless, the World Bank (2015) warns that the number of very small business entities tends to increase as the informal sector increases.[63]

[59] J.P.J. de Jong and O. Marsili (2006). The fruit flies of innovations: a taxonomy of innovative small firms. Research Policy, 35(2), 213–229

[60] H. Forsman and S. Temel (2016), From a non-innovator to a high innovation performer: Networking as a driver. Regional Studies, 50(7), 1140–1153.

[61] B.T. Asheim, A. Isaksen, C. Nauwelaers and F. Todtling (2003). Regional Innovation Policy for Small-Medium Enterprises. Cheltenham: Edward Elgar Publishing Ltd.

[62] Borrás, S. and Edquist, C. (2013). The choice of innovation policy instruments. Technological Forecasting and Social Change, 80(8), 1513–1522.

[63] World Bank (2015). Transition to Better Jobs in Kyrgyz Republic. A Job Diagnostic. Report No. 99777-KG. Online. Available at: www.worldbank.org. Accessed 15 May 2017.

Table 5.2 The SME sector in Kyrgyzstan

	2001		2005		2010		2015	
Number of firms	N	%	N	%	N	%	N	%
Medium-sized enterprises	1,024	0.5%	782	0.2 %	823	0.1 %	795	0.1 %
Small enterprises	7,555	3.7%	7,689	1.6 %	11,338	1.9 %	13,232	1.7 %
Individual entrepreneurs	111,295	54.4%	163,119	34.6 %	244,950	41.6 %	366,734	46.9 %
Peasant farms	84,692	41.4%	300,162	63.6 %	331,059	56.3 %	400,794	51.3 %
Total	204,566	100%	471,752	100 %	588,170	100 %	781,555	100 %
Gross Value Added in GDP	SOM (m)[1]	%	SOM (m)[1]	%	SOM (m)[1]	%	SOM (m)[1,2]	%
Medium-sized enterprises	4,600	6.2	3,935	3.9	11,539	5.2	15,300	3.6
Small enterprises	5,983	8.1	6,671	6.6	16,325	7.4	29,229	6.9
Individual entrepreneurs	9,907	13.4	16,740	16.6	37,421	17.0	93,618	22.1
Peasant farms	11,203	15.2	17,052	16.9	25,479	11.6	33,495	7.9
Total	31,693	42.9	44,397	44.0	90,763	41.2	171,642	40.5
No.[3] and share of employees	N	%	N	%	N	%	N	%
Medium-sized enterprises	66.3	3.7	44.8	2.3	38.4	1.7	36.1	1.5
Small enterprises	47.6	2.7	39.4	2.0	50.2	2.2	52.2	2.2
Individual entrepreneurs	111.3	6.2	163.1	8.4	245.0	10.9	366.7	15.6
Total	225.2	12.6	247.3	12.8	333.6	14.9	455.1	19.3

Source: National Statistical Committee of the Kyrgyz Republic (2016).
Note[1]: Million SOM at current prices.
Note[2]: Some inconsistencies for 2016 in different documents.
Note[3]: Number of employees in thousands.

The proportion of SMEs' share of employment is declining. One reason for this could be a simplified tax payment regime encouraging registration as individual entrepreneurs. SMEs' share (without peasant farms) in total employment is still much lower (19.3 %) than their share in GDP (32.6 %), which could reflect underreporting of the number and salaries of employees (Asian Development Bank, 2013).[64] There is a trend toward a smaller business size can be observed, although a few larger firms are growing with significant market power and scale economies, if not in terms of employment (World Bank, 2015). Small firm struggle to grow to a medium-size, and to stay medium-sized. One reason may be that, when a firm starts growing, it faces a more challenging regulatory and compliance environment, e.g. complex employment regulations. Corruption may become more significant, e.g. demands for bribes, or security payments. Firms may choose to stay small and establish a bundle of less visible small firms operating under various brand names.

New business density is rather low (Table 5.3). Corruption, economic freedom and property rights have found to be the key determinants of start-up density between countries.[65] Time to start a business in Kyrgyzstan, at 10 working days, is one of the longest among comparator countries, although the time to resolve insolvency is better.

[64] Asian Development Bank (2013). Private Sector Assessment. Kyrgyz Republic. Update Online. Available at: www.adb.org. Accessed 14 March 2017.
[65] Dyck, A. and Ovaska, T. (2011). Business environment and new firm creation: An international comparison. Journal of Small Business and Entrepreneurship, 24(3), 301–317.

Table 5.3 Indicators of new venture creation across FSU countries

	New business density[1,2]	No of registered new firms[1]	Time to start a business (days)[3]	Time to resolve insolvency (years)[3]	Attitudes towards entrepreneurial failure[3,4]	Government's decisions foster innovation[4,6,7]
Armenia	1.5	3,139	3.0	1.9	4.3	2.9
Azerbaijan	1.0	6,803	3.0	1.5	4.2	4.2
Belarus	1.1	7,019	n.a.	n.a.	n.a.	n.a.
Estonia	16.1	13,867	3.5	3.0	4.2	3.5
Georgia	5.7	17,136	2.0	2.0	4.1	3.1
Kazakhstan	n.a.	n.a.	5.0	1.5	4.9	3.4
Kyrgyzstan	**1.1**	**4,100**	**10.0**	**1.5**	**4.6**	**2.8**
Latvia	10.6	13,991	5.5	1.5	3.6	2.9
Lithuania	4.2	8,481	3.5	2.3	4.1	2.9
Moldova	n.a.	n.a.	4.0	2.8	3.8	2.2
Russia	4.2	427,388	10.5	2.0	4.0	3.3
Tajikistan	n.a.	n.a.	11.0	1.7	5.4	3.9
Ukraine	n.a.	n.a.	7.0	2.9	5.0	3.1
Median	4.2	8,481	4.2	2.0	4.2	3.1
Kyrgyzstan rank	n.a.	n.a.	12/37[5]	3/35[5]	4/37[5]	109/138

Source[1]: World Bank (2014). Open data.
Note[2]: New registrations per 1,000 people ages 15-64
Source[3]: WEF (2017). Inclusive Growth and Trade Index.
Note[4]: Scale 1-7 in which 7 is best.
Note[5]: Ranking within 37 Lower Income Countries.
Source[6]: WEF (2016) GCI.
Note[7]: Respondents' answer to the question of: "*In your country, to what extent do Government purchasing decisions foster innovation?*"

The above table reflects only the formal sector. The informal sector plays a critical role in Kyrgyzstan (e.g. Asian Development Bank, 2013; World Bank, 2015). This may be considered a result of an overly regulated economy and inefficient governance.[66] Little information is available on the informal sector. However, in the Business Environment and Enterprise Performance Survey (EBRD–World Bank, 2013), almost half of respondents claimed to compete against informal firms. Abdih and Medina (2013), using a multi-indicator system, estimate the informal sector at approximately 26 per cent of GDP,[67] while the IMF (2016) assumes that it may be as high as 40 per cent.[68] The World Bank (2015) estimates that most employment growth occurs in less productive informal sector. Finally, the Asian Development Bank (2013) estimates that almost 70 per cent of the employed population in Kyrgyzstan works in the informal sector. Innovating firms, with differentiated offerings, may be better placed to compete against informal actors.

[66] Loayza, N. V. (2016). Informality in the Process of Development and Growth. Policy Research Working Paper 7858. World Bank Group.
[67] Abdih, Y. and Medina, L. (2013). Measuring the Informal Economy in the Caucasus and Central Asia. IMF Working Paper WP 13/137.
[68] IMF (2016), Kyrgyz Republic, Selected Issues, Country Report No. 16/56. International Monetary Fund. Online. Available at: www.imf.org. Accessed 15 May 2017.

Formal sector employment is mainly urban and in large firms, while informality dominates outside Bishkek. Formal sector jobs can be found in public administration, education, health and social services. Instead, agriculture, trade, wholesale, hotels, restaurants and construction dominate informal sector employment. While formal sector workers are well-educated, the vast majority of informal sector workers have completed only primary school. Finally, there is a significant household poverty gap between workers in the formal and informal sectors (World Bank, 2015, Asian Development Bank, 2013, IMF 2016). Informal firms operate without paying taxes, they pay lower salaries, offer poor working conditions and little or no social protection (IMF, 2016). Nonetheless, the informal sector can foster entrepreneurial intentions, and provide job opportunities for the less educated.

Entrepreneurial motivations include the intrinsic (e.g. recognition, challenge, excitement or accomplishment) and extrinsic (e.g. financial).[69] Aziz et al. (2013) carried out research among 211 entrepreneurs in Kyrgyzstan, and found the desire to earn money the most important, [70] which could be related to the large informal sector and high unemployment rate. Higher levels of informality will increase the levels of self-employment and individual entrepreneurs (Abdih and Medina, 2013). A Yalcin and Kapu (2008) case study among the 71 Kyrgyz firms found local entrepreneurs to be driven by a desire to earn more money and a lack of appropriate job opportunities. Tynaliev (2014) studied individual entrepreneurs across the seven provinces of Kyrgyzstan and found poverty rates, microcredit recipients and crime rates to substantially affect individual entrepreneurship, with significant differences between regions that may require tailored policies. [71] Overall, the profile is one of necessity-driven entrepreneurs "pushed" by a lack of other opportunities.

There is evidence of an "entrepreneurship culture" emerging among the younger generations. A comparison of the entrepreneurial motivation of university students in Kyrgyzstan, Georgia and United States, and found students' desire to be an entrepreneur was highest in Kyrgyzstan, driven by recognition, finance, family traditions (including family businesses) and perceived market opportunities.[72] It is important that both vocational schools and universities include entrepreneurship in their study programmes. Practical training, mentoring and hands on experience in a safe learning environment is important to strengthen students' confidence to solve real-life business problems,[73] and entrepreneurship education could be integrated into university-industry collaboration as a first step. Where feasible, educational institutions should establish business accelerators and incubators under their activities.

Attitudes towards entrepreneurship have improved in Kyrgyzstan (Table 3) - important given that successful entrepreneurs tend to experience failures that give them the knowledge and understanding to later establish a successful business. The entrepreneurial process can be boosted by providing opportunities for people to make entrepreneurial experiments. One

[69] Yalcin, S. and Kapu, H. (2008). Entrepreneurial dimensions in transitional economies: A review of relevant literature and the case of Kyrgyzstan. Journal of Developmental Entrepreneurship, 13(2), 185–204.
[70] Aziz, N., Friedman, B.A., Bopieva, A. and Keles, I. (2013). Entrepreneurial Motives and Perceived Problems: An Empirical Study of Entrepreneurs in Kyrgyzstan. International Journal of Business, 18(2), 163–176.
[71] Tynaliev, U.M. (2014). Is individual entrepreneurship necessity of an opportunity in the Kyrgyz Republic? A panel study. European Journal of Business and Economics, 9(2), 20–28.
[72] Friedman, B.A., Aziz, N. Keles, I. and Sayfullin, S. (2012). Predictors of students` desire to be an entrepreneur: Kyrgyzstan, Georgia, and the United States. Eurasian Journal of Business and Economics, 5(9), 129–140.
[73] Forsman, H. (2009). Balancing capability building for radical and incremental innovations. International Journal of Innovation Management, 13(4), 501–520.

example of this in Kyrgyzstan is the start-up community that has grown around the KG LABS and Ideagrad (Box 5.1).

Box 5.1 A new generation of entrepreneurs emerges

KG LABS, Ideagrad and Art Studio

KG Labs is a public foundation supporting the technological start-up ecosystem, connecting the local community with the global start-up network, private equity and venture capital. KG Labs is involved in organizing global competitions, Hackathons, start-up safaris (open doors), pitching competitions and events featuring successful innovators, educators and investors, all of which support cross-fertilization of ideas. Its helps entrepreneurs develop their prototypes and business models, and meet professional investors.

However, ideas must be turned into viable business concepts. Ideagrad is a business incubator that plays an important role in supporting start-ups and young entrepreneurs to achieve business success. Its Incubation Programme helps early-stage entrepreneurs design their business plans, share experiences, produce prototypes and, finally, present their plans to investors. Ideagrad also provides seed funding, consulting and advisory services and organizes networking events.

ArtAsian is a successful start-up that has emerged from this support community within one year of establishment. It has developed a platform for talented artisans to sell their products worldwide. It presented itself to international investors in the Global Mobile Challenge competition, a mobile application competition for young entrepreneurs in Barcelona.

No one actor makes the start-up ecosystem a success – instead, a network of strongly interconnected actors promotes provide processes and facilities for exchange of ideas and collaboration, and promote an entrepreneurial spirit and culture of experimentation. A critical mass of expertise allows each member of the community to enjoy the benefits of scale. Failure, as well as success, is a valuable result of experimentation, as far as people learn from their mistakes. An innovative environment creates a spiral of success by attracting talents, talents and their viable ideas attracting investors and experienced investors attracting new talents.

Source: Information gathered during the fact-finding visit to Bishkek in April 2017. See also: www.kglabs.org, www. ideagrad.com, artesian.co and www.globalmobilechallenge.com

Government policy can also support start-ups, including through procurement. However, Table 5.3 suggests Government's decisions foster innovation only weakly, with a ranking of 109 out of 138 countries. A promising ICT start-up community would be one candidate for support. While Kyrgyzstan plans to develop extensive eGovernment systems, interviews during this Review process suggest that ICT start-ups do not expect to have the opportunity to sell their services or products to Government. Including such start-ups could be an opportunity to upgrade the local ICT sector.

Table 5.4 summarizes the potential policy instruments to support growth and new venture creature.

Table 5.4 Potential policy support instruments (growth and new venture creation)

	Firm-oriented approach	System-oriented approach
Reactive approach	Incentives for firms to grow Incentives for starting a formal business	Government purchasing decisions to support new venture creation Establishing the acceleration and incubation activities to universities and vocational institutions Schemes for training universities and other educational institutions to promote motivation and capabilities to become an entrepreneur
Proactive appproach	Co-operative schemes for fostering emerging entrepreneurial communities and sectors Co-operative scheme for firms with growth intentions Publishing cases of positive role models to support entrepreneurial behaviour	Integrating entrepreneurship into education at all educational levels Disseminating the start-up ecosystem approach

5.3 Innovation in firms

Innovation is examined from two perspectives: degree of difference and degree of novelty. The degree of difference is examined by focusing on the innovation outputs of Kyrgyz firms. Degree of novelty is explored by separating these innovation outputs into incremental and radical ones. Incremental innovations are developed for making things better while the radical innovations are developed for making things differently.[74] Innovation that is new to the local market is considered as incremental, innovation that is new to international market is considered as radical and finally, innovation that is new in Kyrgyzstan is considered as semi-radical (cf. Johannessen et al. (2001)[75]; Garcia and Calantone (2002)[76]. In this analysis, the term radical innovation includes both radical and semi-radical innovations.

[74] Damanpour, F. and Aravind, D. (2012). Managerial innovation: Conceptions, processes, and antecedents. Management and Organization Review, 8(2), 423–454.
[75] Johannessen, J-A., Olsen, B. and Lumpkin, G.T. (2001). Innovation as newness: what is new, how new, and new to whom? European Journal of Innovation Management, 4(1), 20–31.
[76] Garcia, R. and Calantone, R. (2002). A critical look at technological innovation typology and innovativeness terminology: a literature review. Journal of Product Innovation Management, 19(2), 110–132.

Table 5.5 presents share of innovating and non-innovating firms in the FSU countries, according to the Business Environment and Enterprise Performance Survey (BEEPS V).

Table 5.5 Innovating and non-innovating firms across FSU countries

	Average no of employees[1]	Innovating firms[2]	Non-innovating firms
Armenia	6	25.0 %	75.0%
Azerbaijan	13	13.0 %	87.0%
Belarus	9	66.9%	33.1%
Estonia	5	40.4%	59.6%
Georgia	7	15.8%	84.2%
Kazakhstan	10	33.0%	67.0%
Kyrgyzstan	**15**	**54.5%**	**45.5%**
Latvia	4	34.5%	65.5%
Lithuania	5	40.5%	59.5%
Moldova	9	43.3%	56.7%
Tajikistan	10	39.3%	60.7%
Ukraine	14	36.4%	63.6%
Uzbekistan	20	6.7%	93.3%
Average	10	34.6%	65.4%

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V). Sample of 256 SMEs (individual entrepreneurs and peasant farmers excluded). www.ebrd-beeps.com
Note[1]. Due to the departure of normality, median is used.
Note[2]: Innovating firm = a firm has developed at least one type of innovation during past three years

More than half (54.5%) of Kyrgyz respondents were firms that innovate, with the highest share of innovators in the food, publishing, wholesale and retail, and business support sectors. The lowest shares of innovators were in the construction and transportation sectors. Overall, only Belarus had a higher share of innovating firms (66.9 %). However, Kyrgyz respondents were, on average, larger than respondents from other FSU countries. Especially in manufacturing, innovation intensity tends to increase with firm size,[77] although similar trends are not as clear in the service sector. While the share of innovating SMEs can be high, it is an empirical fact that degree of novelty is quite low (cf. Forsman, 2011).[78] Table 5.6 shows some evidence of a higher proportion of large firms innovating. Logistical or business support innovations are especially infrequent in SMEs.

[77] Forsman, H. and Rantanen, H. (2011). Small manufacturing and service enterprises as innovators: A comparison by size. European Journal of Innovation Management, 14(1), 27–50.
[78] Forsman, H. (2011). Innovation capacity and innovation development in small enterprises. A comparison between the manufacturing and service sectors. Research Policy, 40(5), 739–750.

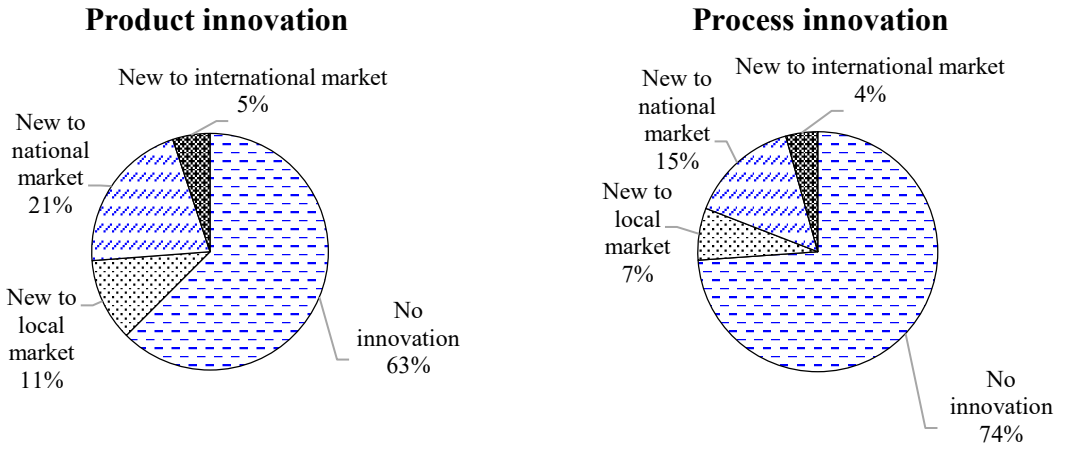
Table 5.6 Types of innovation developed, by firm size

	Small	Medium	Large	Total
	N=107	N=113	N=35	N=255
Innovating versus non-innovating firms	%	%	%	%
Non-innovating firms	45.8	48.2	35.3	45.5
Innovators	54.2	51.8	64.7	54.5
	100.0	100.0	100.0	100.0
Developed innovation types[1]				
Product or service innovation	38.3	33.6	50.0	37.8
Process innovation	29.0	19.3	41.2	26.3
Organisational innovation	32.7	33.3	58.8	36.5
Marketing innovation	35.5	40.4	50.0	39.6
Logistical or business support innovation	15.0	17.7	42.9	20.0

Source: EBRD-World Bank, (2013), Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: The total number of firms with responses (N) varies between 253 and 255. Micro enterprises (<5 employees) classified with small due to restricted sample size.

Surveys have shown around 6.6 percent of firms to have carried radical innovation that is new to the international market (either product or process, or both). However, the majority of product and process innovations developed by the Kyrgyz firms are new to local or national markets (Figure 5.2).

Figure 5.2 Novelty of product and process innovations among Kyrgyz firms

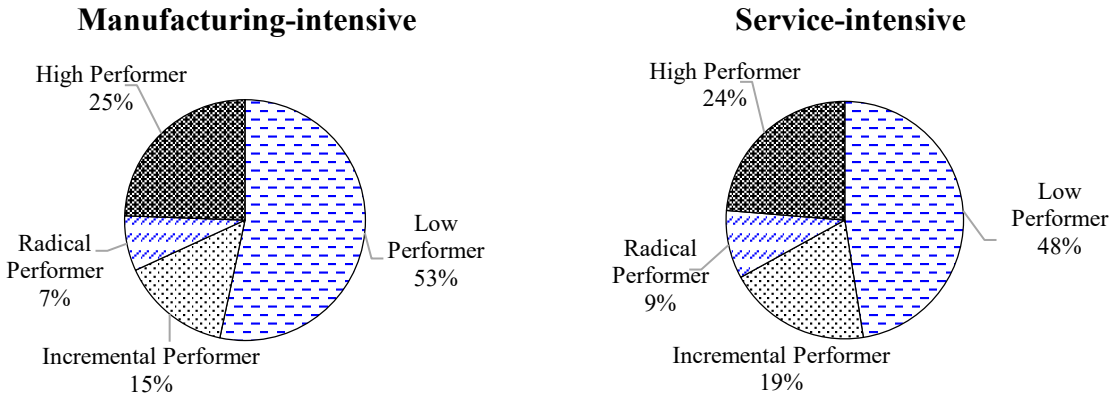


Source: EBRD-World Bank, (2013), Business Environment and Enterprise Performance Survey (BEEPS V)
Note: Percentage of Kyrgyz firms (N=256)

Four innovator profiles emerge from the data for Kyrgyz firms, which a classification analysis suggested to be a good fit: Low Performer, Incremental Performer, Radical Performer and High Performer (cf. Forsman and Annala, 2011).[79]

Low Performers are non-innovators or firms that have only occasionally developed a minor incremental improvement. 50.6 per cent of Kyrgyz firms in the BEEP V data hold this profile. *Incremental Performers* consists of firms that are entirely biased towards incremental innovation activities. These firms are frequent innovators that have reported about several activities for developing incremental improvements to their existing offerings or production processes, and comprised around 17% of Kyrgyz firms. *Radical Performers* are biased towards radical and/or semi-radical innovation development. The data suggest around 8% of Kyrgyz firms hold the profile of Radical Performer. *High Performers* are characterized by the high diversity of innovation activities. These firms are continuous innovators that during the period of three years have developed incremental and semi-radical innovations, and some even radical innovations. 24% of Kyrgyz respondents fit the profile of High Performers. Figure 5.3 illustrates these profiles, disaggregated by manufacturing-intensive and service-intensive Kyrgyz firms.

Figure 5.3 Innovator profiles by manufacturing- and service-intensive businesses



Source: EBRD-World Bank, (2013), Business Environment and Enterprise Performance Survey (BEEPS V)
Note: N=253, includes firms with complete information on developed innovations

[79] Forsman, H. and Annala, U. (2011). Small enterprises as innovators: Shift from a low performer to a high performer. International Journal of Technology Management, 56(2/3/4), 154–171.

The fact-finding mission for this *Review* provided the opportunity to interview and conduct case studies of a number of local enterprises and entrepreneurs in Kyrgyzstan. There was evidence of Radical Performers of innovation emerging, and Box 5.2 presents an (anonymised) case study of one such enterprise.

Box 5.2 Radical Performer – Inventor or Entrepreneur?

The Case of SolarEnergy Ltd. (Name changed to ensure confidentiality)

SolarEnergy is a small, private enterprise founded in 2009 that develops products using solar energy. Its staff comprises its founding director, and two additional full time workers. The owners are Kyrgyz citizens, with one female owner. The founding director is an electrical engineer who loves to innovate but has limited entrepreneurship skills. He prefers to innovate alone, approaching friends and former colleagues for help as needed. The Internet is the most important source of external knowledge.

SolarEnergy is a frequent, often radical, innovator. The firm has made only one minor improvement to management practices, and no incremental product innovations. While the number of innovations is quite high, their diversity is low, which affects the firm's ability to learn. This firm does not provide time for employees to innovate, and does not hire consultants. The founding director is the staff member with the best technical knowledge. There is no separate budget for innovation, and financial resources are gathered as needed. It has a bank loan with the owner's personal assets as collateral, as well as loans from family members.

SolarEnergy anticipates changes with a medium-term vision emphasizing competitive technology and project management. While its approach to product innovation is proactive, it avoids changes leading to other types of innovations and innovation management practices are weak. Activities are focused on technological development with pilot customers, who usually do not pay market prices, and for certain risky pilot projects prices have not even covered costs.

After patenting and product testing with pilot customer(s), the founding director begins preparation for the next project. Marketing is mainly by word of mouth, with no sales outside the national market. The firm has several competitors, but does not compete against the informal sector. A product's progress to the pilot phase absorbs almost all employee resources, preventing the firm from exploring market needs for the products previously piloted.

The firm is unprofitable, but the founding director is optimistic for future profits. Key problems are cited as political instability and corruption, as well as daily challenges with electricity, telecommunication, transportation and tax administration. SolarEnergy is inspected approximately twice a year, with bribes paid from time to time and 1.7 per cent of revenues paid for protection.

Source: This is an anonymous profile description of one Radical Performer from Kyrgyzstan. Some details are added based on what is known about this type of innovator (cf. Boly et al., 2014; Forsman, 2015)

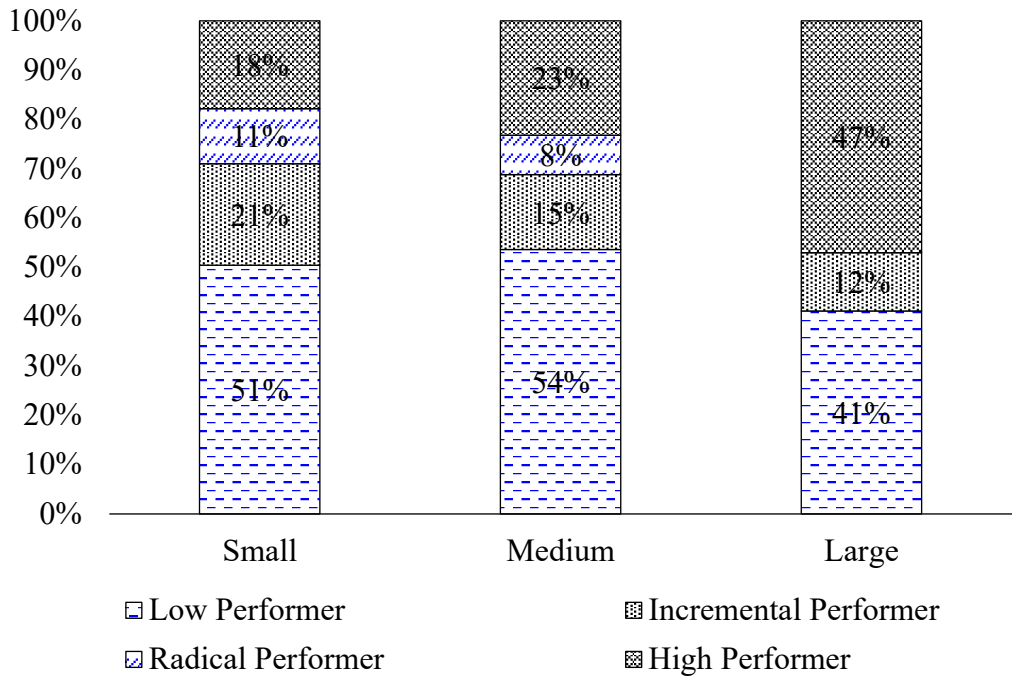
It is a common assumption that manufacturers are more innovative than service sector firms. However, especially among small firms, innovation patterns are as diverse in the service sector

as in manufacturing.[80] This could be because firms are increasingly marketing solutions, which are combinations of products and services.

Across sectors and countries, as knowledge-technology intensity increases, the diversity and degree of radical innovation also increases. Among manufacturing-intensive businesses, science-based firms and specialized suppliers have the most diverse innovation activities. These sectors accommodate technology-intensive firms that transfer knowledge to other firms as machinery, communication equipment and instruments. Among the service-intensive businesses, the KIBS firms (Knowledge-Intensive Business Services) and firms that rely heavily on information and its management are active innovators, including radical innovations. They include software developers, IT solution providers and engineering services firms.

Finally, it can be observed that smaller firms have a higher share of Radical and Incremental Performers while larger firms have a higher share of High Performers (Figure 5.4). Medium-sized firms have the highest share of Low Performers. Thus, the relationship between innovation and firm size is not linear (cf. Bertschek and Entorf, 1996).[81] Smaller firms often benefit from entrepreneurial owners, while larger firms benefit from resources and systematic processes, while medium-sized firms may lack the best of either world.[82]

Figure 5.4 Innovator profiles by firm size



Source: EBRD-World Bank, (2013), Business Environment and Enterprise Performance Survey (BEEPS V)

[80] Evangelista, R. (2000). Sectoral patterns of technological change in services. Economics of Innovation and New Technology, 9(3), 183–222.
[81] Bertschek, I. and Entorf, H. (1996). On nonparametric estimation of the Schumpeterian link between innovation and firm size: evidence from Belgium, France and Germany. Empirical Economics, 21(3), 401–26.
[82] Forsman, H. and Rantanen, H. (2011). Small manufacturing and service enterprises as innovators: A comparison by size. European Journal of Innovation Management, 14(1), 27–50.

5.4 The external innovation landscape

The external innovation landscape includes the business environment, including regulatory, economic and cultural aspects. Smaller firms have limited opportunities to affect their business environment, and so may be more sensitive to problems. The World Bank's Doing Business indicators are widely used for assessing the business environment. In 2017, Kyrgyzstan was ranked to 75 out of 190 countries. Kyrgyzstan performs well in terms of starting a business and registering property, while it performs less well for resolving insolvency, getting electricity, enforcing contracts and paying taxes. Other indicators are close to the average among FSU countries, as shown in Table 5.7.

Table 5.7 Doing Business Statistics for the FSU countries

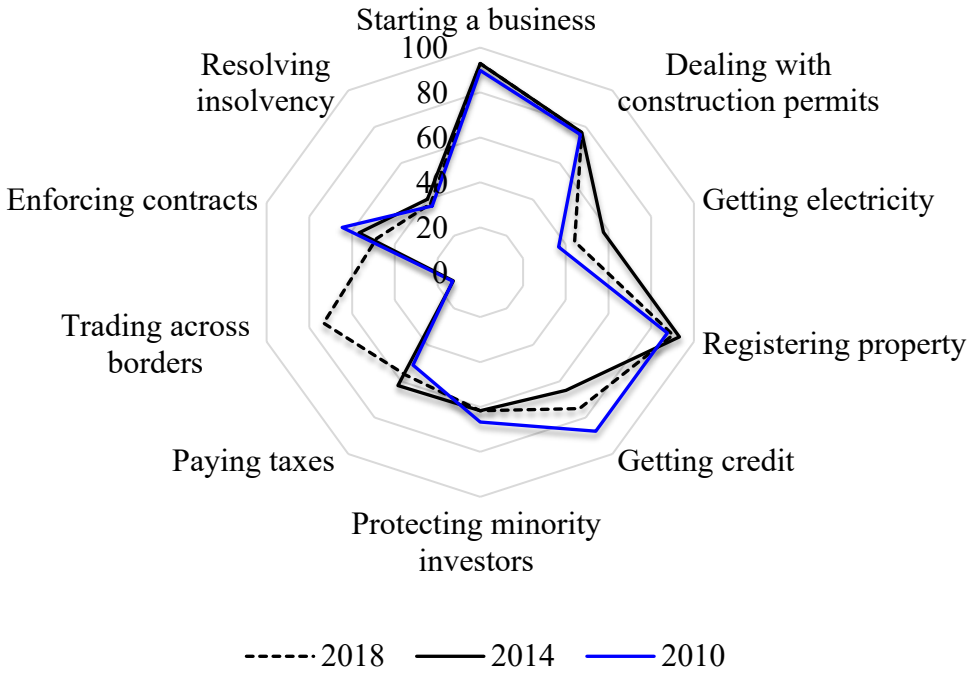
	Starting a business	Dealing with construction permits	Getting electricity	Registering property	Getting credit	Protecting minority investors	Paying taxes	Trading across borders	Enforcing contracts	Resolving insolvency
Armenia	96.1	70.0	73.2	87.4	75.0	60.0	72.5	86.5	69.7	46.1
Azerbaijan	97.7	63.6	64.8	82.5	40.0	65.0	83.5	72.3	65.7	44.8
Belarus	92.9	78.3	86.0	92.2	45.0	63.3	70.4	93.7	70.4	49.1
Estonia	95.1	82.6	83.2	91.0	70.0	60.0	88.0	99.9	75.2	65.5
Georgia	96.1	82.8	82.7	92.9	85.0	76.7	87.4	85.2	73.2	40.0
Kazakhstan	91.9	79.1	73.6	83.7	55.0	80.0	79.5	63.2	75.7	69.2
Kyrgyzstan	**93.0**	**76.7**	**44.1**	**90.6**	**70.0**	**63.3**	**56.4**	**74.9**	**48.6**	**34.1**
Latvia	94.2	78.9	82.1	81.9	85.0	63.3	89.8	95.3	71.7	64.0
Lithuania	93.0	80.4	80.1	92.9	70.0	61.7	85.4	97.7	77.9	49.2
Moldova	92.0	54.1	74.6	82.9	70.0	63.3	84.8	92.3	60.9	52.6
Russia	93.6	65.9	84.4	90.6	65.0	60.0	83.0	58.0	75.0	56.7
Tajikistan	86.6	54.8	35.2	62.0	40.0	66.7	58.8	57.1	63.5	28.7
Ukraine	94.4	61.4	58.5	69.6	75.0	56.7	72.7	64.3	59.0	27.5
Uzbekistan	93.9	59.8	71.8	66.2	65.0	56.7	59.1	44.3	67.3	46.3
Average	93.6	70.6	71.0	83.3	65.0	64.1	76.5	77.5	68.1	48.1
Kyrgyzstan rank	30/190	32/190	163/190	8/190	32/190	42/190	148/190	79/190	141/190	130/190

Source: World Bank. (2017), Doing Business Report.
Note: The frontier = 100, the higher the number, the better the performance and shorter the distance from frontier.

Figure 5.5 illustrates recent trends in Kyrgyzstan's Doing Business scores. The trading across borders indicator improved significantly between 2014 and 2018. In particular, Eurasian Economic Union membership has decreased the time and cost of exporting (World Bank, 2017), building on previous improvements to administrative requirements and inspection procedures.[83] There has, however, been little progress in getting electricity, getting credit and enforcing contracts.

[83] World Bank (2011). Doing Business, Making Difference for Entrepreneurs. Online. Available at: http://www.doingbusiness.org. Accessed 15 May 2017.

Figure 5.5 Doing Business scores in 2010, 2014 and 2018



Source: World Bank, (2010, 2014, 2018), Doing Business Reports.
Note: An economy's distance to frontier is reflected on a scale from 0 to 100, where 0 represents the lowest performance and 100 represents the frontier.
Please note the changed methodologies for "Getting credit" and "Protective minority investors", effective 2014.

Table 5.8 presents the *c*apacity scores of FSU countries to facilitate the flow of goods over borders and to their destinations – particularly important for small, open economies. Kyrgyzstan falls below average, except for a stronger performance on foreign market access. Transport infrastructure and transport services are especially weak. Availability and use of ICT as well the domestic market access also require attention.

Table 5.8 Capacity to facilitate trade among FSU countries

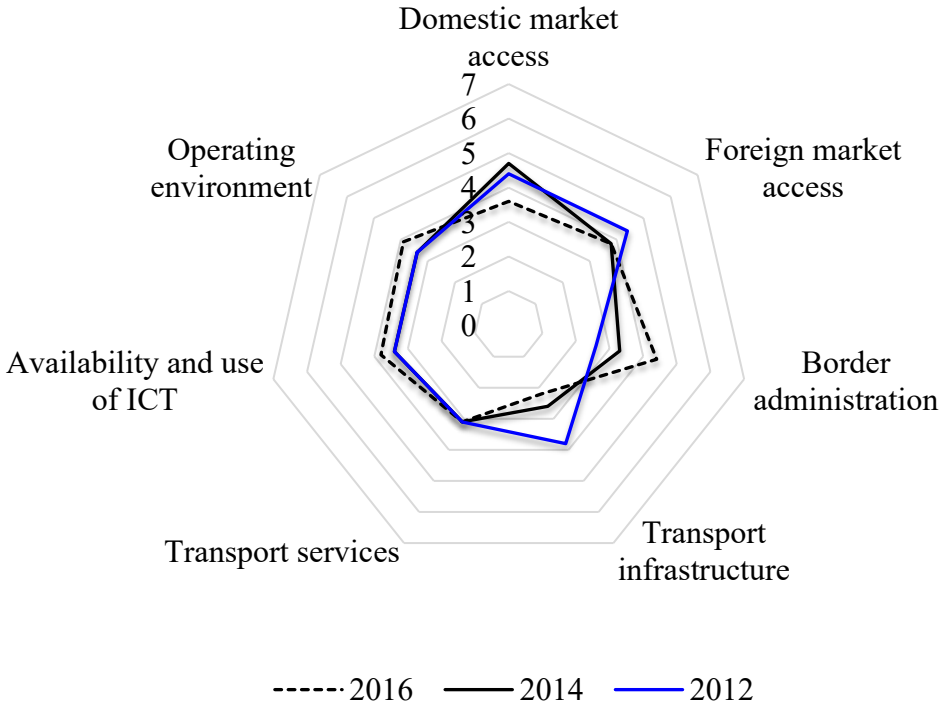
	Domestic market Access	Foreign market access	Efficiency and transparency of border administration	Availability and quality of transport infrastructure	Availability and quality of transport services	Availability and use of ICT	Operating environment
Armenia	4.4	4.5	4.8	2.9	3.4	4.3	4.6
Azerbaijan	4.3	2.8	4.7	4.0	3.6	5.2	4.6
Estonia	5.4	4.3	6.1	3.8	4.9	6.3	5.3
Georgia	5.9	4.6	5.3	3.3	3.6	4.6	4.8
Kazakhstan	3.9	2.7	4.2	3.5	4.0	5.2	4.5
Kyrgyzstan	**3.6**	**3.8**	**4.4**	**2.2**	**3.1**	**3.8**	**3.9**
Latvia	5.4	4.1	5.5	3.7	4.7	5.5	4.6
Lithuania	5.4	4.2	5.6	3.9	5.1	5.8	4.7
Moldova	5.2	4.4	4.5	2.7	3.7	4.4	3.9

Russia	3.9	2.2	3.9	4.1	3.8	5.5	3.8
Tajikistan	4.5	2.7	3.9	3.0	3.0	2.7	4.5
Ukraine	5.5	3.3	4.1	3.4	4.0	4.4	3.5
Average	4.8	3.6	4.8	3.4	3.9	4.8	4.4
Kyrgyzstan rank	122/136	91/136	77/136	132/136	123/136	96/136	102/136

Source: WEF (2016), Enabling Trade Index by World Economic Forum (Scale 1-7 in which 7=best)

Figure 5.6 demonstrates recent progress on "Enabling Trade" indicators for Kyrgyzstan. Transport infrastructure scores have weakened and require serious policy attention. Infrastructure, services demand and domestic market access all also require attention.

Figure 5.6 Comparison of WEF Enabling Trade scores in 2012, 2014 and 2016



Source: World Economic Forum (2012, 2014, 2016), Enabling Trade Report

Table 5.9 shows that senior managers spend on average 14 per cent of their time dealing with Government regulations. Tax inspections are a considerable factor, with businesses experiencing on average 2.4 inspections per year, with average numbers higher for innovative firms, and reports of widespread corruption.[84] Innovative firms also appear to be more prone to need to pay bribes to get things done. Small firms also tend to be more heavily affected.

[84] Transparency International (2016), Corruption Perceptions Index. www.transparency.org, accessed 21 May 2017.

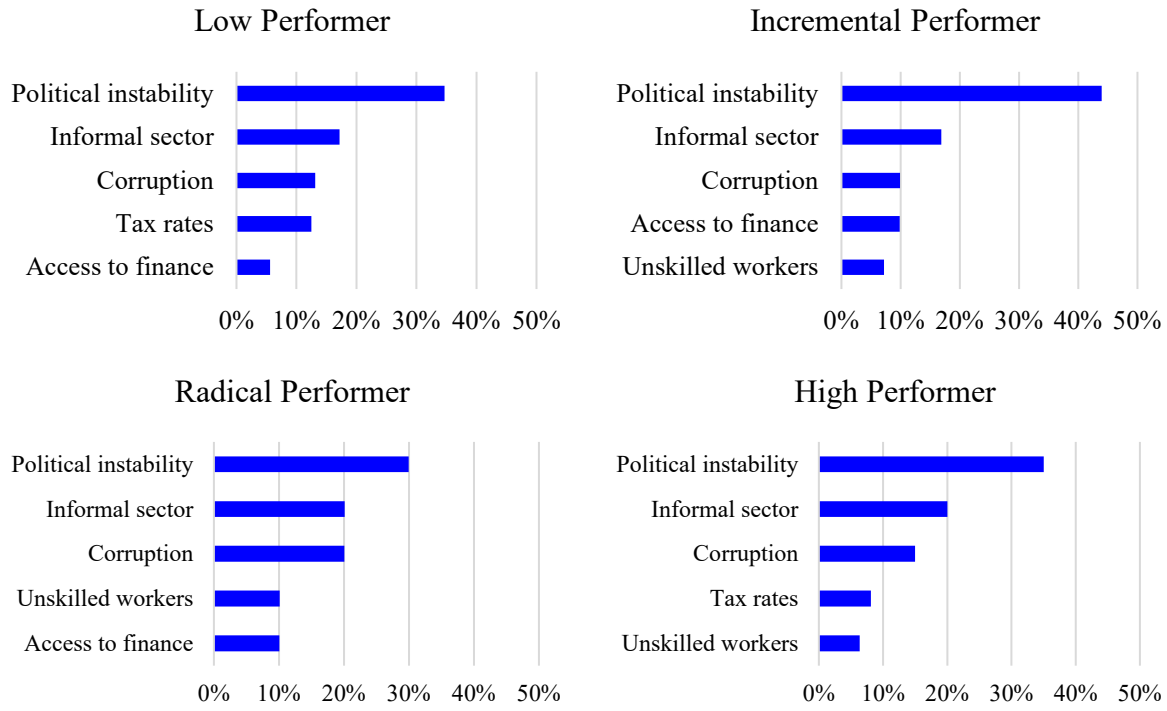
Table 5.9 Kyrgyz firms under pressure from corruption and crime

	Low Performer	Incremental Performer	Radical Performer	High Performer	Total
Senior management time dealing with Government regulations (%)[1]	15.2 %	11.0 %	14.1 %	13.6 %	13.9 %
Inspected by tax authorities[2]	89.1 %	95.3 %	90.5 %	93.4 %	91.3 %
No of tax inspections in last year[1]	2.3	2.2	2.6	2.8	2.4
Bribes paid for construction permits[3]	23.1%	20.0%	40.0%	68.4%	40.0%
Bribes paid for import license[3]	62.5%	66.7%	n.a.	54.5%	59.1%
Bribes paid for water connection[3]	25.0%	0.0%	100.0%	85.7%	53.3%
Bribes paid for electrical connection[3]	0.0%	40.0%	100.0%	69.2%	48.1%
Bribes paid for operating licence[3]	32.5%	70.0%	100.0%	61.5%	47.0%
Bribes paid for tax inspection[3]	35.5%	63.2%	55.6%	54.7%	46.8%
Bribes - share of value to secure Government contract[1]	5.8 %	2.4 %	7.2 %	2.9 %	4.4 %
Bribes - % of annual sales to get things done[1]	2.0 %	2.3 %	3.3 %	2.4 %	2.3 %
Crime - paid for security[2]	67.7%	72.1%	76.2%	83.6%	73.0%
Crime - % of annual sales paid for security[1]	5.8 %	3.1 %	3.9 %	3.6 %	4.3 %

Source: EBRD-World Bank, (2013), Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: Mean value
Note[2]: Percentage of all firms that have been inspected/paid for security
Note[3]: Percentage of firms that have applied the permit/license/connection or who have experienced an inspection

Crime figures show similar patterns, with a higher share of innovators needing to pay for security than non-innovative firms – perhaps indicating a targeting of innovative firms by criminals and corrupt officials as prolific "cash cows". Perhaps the three biggest challenges in the external business environment in Kyrgyzstan are political instability, the informal sector and corruption (Figure 5.7). Thereafter, tax rates, access to finance and unskilled workers emerge as the biggest obstacles.

Figure 5.7 Biggest obstacle by innovator profile



Source: EBRD-World Bank, (2013), Business Environment and Enterprise Performance Survey (BEEPS V)

eGovernment is a promising potential tool to streamline administrative processes and reduce corruption but requires simplified procedures and restructured activities to complement technical solutions. Transport infrastructure is another area requiring urgent and sustained policy attention. Overall, however, the biggest problem in the external innovation landscape is the prevalence of corruption, crime, and a large informal sector. Addressing this requires not only improved law enforcement, but also the creation of a culture of integrity, e.g. by using only formal sector suppliers, developing anti-bribery and ethical codes of conduct and initiatives against paying protection money. Such international investors and customers prefer to collaborate with the firms that have a good reputation.

Some possible policy options to improve the external innovation landscape are presented in table 5.10.

Table 5.10 Potential instruments for policy support (external innovation landscape)

	Firm-oriented approach	**System-oriented approach**
Reactive approach	United efforts for eliminating crime, corruption and informal sector	Streamlining the procedures for setting up and running a business Streamlining the procedures for enabling trade Strengthening the role of auditing agencies
Proactive approach	Implementing ethical code of conduct Co-operative business foresight activities	Strengthening attitudes and demand for anti-corruption Promoting transparency and access to information

5.5 The internal innovation landscape

The internal innovation landscape of firms is crucial to performance, with business ethics, customer orientation, quality management, creativity, and diversity of staff and other internal stakeholders all favouring innovation.[85],[86] Innovative people want to work for innovative firms, with the creative innovation process built on values of respect, trust and open communication. Ethical firm behaviour is crucial to its internal innovation landscape. Based on the Executive Opinion Survey (WEF GCI, 2016), Kyrgyz firms fall below average on this (Table 5.11) – an important problem, given the importance placed by international investors and customers on reputation. Development of firm-level indicators for sustainability as well as integrating sustainability reporting into financial statements could help with progress.

Innovations are often developed in close collaboration with clients, and require strong customer orientation to understand and anticipate client needs. This is another area of weakness, with Kyrgyzstan ranking 100th out of 138 countries. Creative outputs, quality of management education, as well as decision-making practices, where Kyrgyz firms are reported as having hierarchical decision-making practices dominated by senior management, are other areas where Kyrgyz firms perform poorly. It is well-documented that, to foster innovation, decision-making powers should be shared with those responsible for implementing decisions in practice.

Table 5.11 Factors affecting firms' internal innovation landscape in FSU countries

	Ethical behaviour[1]	Customer orientation[1]	Decision making[1]	Quality of management education[1]	Creative outputs[2]
Armenia	3.9	4.9	3.4	3.6	35.6
Azerbaijan	4.2	4.7	3.6	3.9	24.1
Belarus	n.a	n.a	n.a.	n.a.	9.5
Estonia	4.8	5.4	4.5	4.9	54.7
Georgia	3.9	4.1	3.2	3.8	26.6
Kazakhstan	4.1	4.4	3.9	3.7	21.4
Kyrgyzstan	**3.4**	**4.3**	**3.4**	**2.9**	**17.1**
Latvia	3.9	4.9	4.0	4.6	46.2
Lithuania	4.3	5.2	3.8	4.2	39.0
Moldova	3.1	4.1	3.4	3.3	39.6
Russia	3.9	4.5	3.6	4.1	28.7
Tajikistan	4.5	4.6	3.9	4.0	24.5
Ukraine	3.4	4.5	3.2	3.8	31.0
Average	4.0	4.6	3.7	3.7	30.2
Kyrgyzstan rank	105/138	100/138	106/136	134/138	111/138

Source[1]: WEF GCI (2016), Global Competitiveness Index 2016-2017, scale 1-7 in which 1=poor, 7=excellent.
Source[2]: Cornell University, INSEAD, and WIPO (2016): Global Innovation Index 2016. Highest score=69.5

[85] Amabile, T.M. (1998). How to kill creativity. Harvard Business Review, 76(5), 76–87.
[86] Dobni, C.B. (2008). Measuring innovation culture in organizations. The development of a generalized innovation culture construct using exploratory factor analysis. European Journal of Innovation Management, 11(4), 539–559.

It will be important to improve management education to address some of these other issues over the longer term, but there is a nearer-term need to develop proactive, firm-related instruments to improve management quality. One such concept is a management training programme preparing Kyrgyz managers for business relations and economic cooperation with German businesses (Box 5.3).

Box 5.3 Fit for Partnership with Germany

The Manager Training Programme is financed by the German Federal Ministry for Economic Affairs and Energy (BMWi). It establishes business contacts and cooperation with German companies. Kyrgyz managers learn about German business culture and develop their presentation and negotiation skills during visits to German firms in various industries on subjects ranging from executive management and international cooperation to human resources management. During visits, participants obtain practical knowledge from successful German companies, becoming familiar with current best practice in facilities, technology and management. Participants also present their firms and products, and can establish business contacts and close deals – typically import/export deals, business partnerships or joint ventures. The secret of programme's success was the right mix of management training and business practice.

During 2006-2013, around 20 Kyrgyz managers per year took part in the programme, with priority given to SMEs wanting to establish contact with German firms. Following successful interview, participants attended a one month training programme in Germany, under the motto "Fit for Partnership with Germany". During the programme, participants developed their management skills in interactive and practice-oriented training sessions.

148 the managers from Kyrgyzstan took part in the Manager Training Programme. Results have been promising, resulting in a range of concrete cooperation projects. Kyrgyz entrepreneurs improved their human resource management, created new work places and increased profitability by reducing costs and buying new equipment while initiated new business projects.

Partners
Federal Ministry for Economic Affairs and Energy (BMWi)
Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH
Chamber of Commerce and Industry of the Republic of Kyrgyzstan

Source: Fact-finding visit to Bishkek, April 2017
www.managerprogramm.de
Chamber of Commerce and Industry of the Kyrgyz Republic, www.en.cci.kg

Internal innovation landscape by innovator profile

Table 5.12 shows that, while domestic ownership dominates across all profiles, there is variation regarding foreign ownership and female ownership. Foreign ownership is highest among High and Incremental Performers, and lowest among Radical Performers. The share of female ownership is around 50% across all innovator profiles, although the share of firms with

female top managers is much lower – averaging less than a quarter across all firms, with only Radical Innovators being significantly higher, at 47.6% with female top managers. While many firms do define long-term goals, dissemination among employees is weak, as is monitoring of delivery against these goals using formal indicators. While almost 70 per cent of High Performers provide time for employees to innovate, this share is much lower among Incremental and Radical Performers.

Table 5.12 Indicators reflecting internal innovation landscape by innovator profile

	N	Low Performer	Incremental Performer	Radical Performer	High Performer	Total
Diversity of stakeholders						
Domestic ownership[1]	256	92.2%	84.2%	95.2%	74.7%	86.9%
Foreign ownership[1]	256	6.3%	15.6%	4.8%	24.5%	12.1%
Government ownership[1]	256	1.5%	0.1%	0.0%	0.8%	1.0%
Share of firms with female owners	250	53.5%	54.8%	57.1%	48.3%	52.8%
Share of firms with female top manager	253	20.3%	27.9%	47.6%	21.3%	24.1%
Goals and measurement						
Share of firms with long-term targets	56	71.4%	20.0%	50.0%	52.6%	59.0%
Share of firms in which all employees are aware of the targets	53	23.1%	20.0%	0.0%	22.2%	20.8%
Share of firms that use at least 3 indicators to measure performance	51	24.0%	25.0%	25.0%	27.8%	25.5%
Time to innovate						
Share of firms providing time for employees to innovate	253	11.7%	34.9%	28.6%	68.9%	30.8%

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: Mean percentage of ownership

Evidence suggests that improvement to the internal innovation landscape requires both action at the firm-level as well as in policymaking. Some possible policy options to improve the internal innovation landscape are presented in Table 5.13.

Table 5.13 Potential instruments for policy support (internal innovation landscape)

	Firm-oriented approach	System-oriented approach
Reactive approach	Developing sustainability (social, environmental, economic) indicators and measurement practices Developing ethical code of conduct	Improving the quality of management education by combining subject expertise and practical relevance. Improving the knowledge of expressed and latent needs of different kinds of innovators
Proactive approach	Co-operative learning schemes for developing internal innovation culture, strategic planning and customer orientation Integrating sustainability reporting into financial reporting	Integrating sustainability reporting into policy assessment.

5.6 Innovation inputs

Access to finance is a key constraint to Kyrgyz firms. Table 5.14 shows start-up entrepreneurs to have difficulty obtaining both equity and venture capital finance, ranking poorly compared to other FSU countries. Perhaps an even more important barrier knowledge absorption is a weak capacity to retain or attract talent, limited availability of scientists and engineers, and weak ability to adopt new technology among Kyrgyz firms. FDI is also found to bring only limited new technology into the country. Improved knowledge is one factor that may attracts investors, having a positive impact on availability of financial resources.

Table 5.14 Innovation input across FSU countries

	Venture capital availability	Financing through local equity market	Availability of scientist and engineers	Capacity to retain talent	Technology absorption	FDI and technology transfer	Capacity to innovate
Armenia	2.8	2.6	4.2	2.8	4.3	4.3	4.2
Azerbaijan	3.1	3.4	4.4	4.1	4.8	4.8	4.4
Estonia	3.6	4.1	4.3	3.3	5.4	4.8	4.9
Georgia	2.6	2.4	3.3	3.0	4.0	4.0	3.7
Kazakhstan	2.6	3.1	4.0	3.6	4.5	4.0	4.1
Kyrgyzstan	**2.6**	**2.8**	**3.3**	**2.5**	**3.4**	**3.3**	**3.5**
Latvia	2.7	3.2	3.6	2.6	4.4	4.4	4.3
Lithuania	3.0	3.4	4.1	2.9	5.3	5.1	4.9
Moldova	2.0	2.4	2.9	1.9	4.0	3.9	3.5
Russia	2.6	3.1	4.1	3.3	4.3	3.7	4.0
Tajikistan	3.3	3.0	4.3	3.9	4.1	4.0	4.1
Ukraine	2.1	2.5	4.7	2.5	4.4	3.7	4.4
Average	2.8	3.0	3.9	3.0	4.4	4.3	4.2
Kyrgyzstan rank	86/137	110/138	116/138	126/138	133/138	128/138	120/138

Source: WEF GCI EOS (2016), Global Competitiveness Index 2016, scale 1-7 in which 1=poor, 7=excellent.

Only 10.3 per cent of Kyrgyz firms report spending on R&D activities (Table 5.15). Hence, the vast majority of innovators are innovating without having separate resources for innovation. In particular, it is common for small firms (especially service businesses) not to allocate separate resources to innovation activities, which are often integrated into daily business activities. Such firms may develop "hidden and unplanned innovations",[87] e.g. customer collaboration and quality improvements. Such "hidden" innovation activities are difficult to target with policy support. Banks and other funding bodies also commonly assess innovation proposals based on a written project plan and business case. It is necessary to improve the project and process management skills of firms.

More than 90 percent of firms with loans report that collateral such as land and buildings, machinery and equipment or accounts receivable were required. Although many firms reported having no need for external financial resources, between 40 and 50 per cent of Incremental, Radical and High Performers reported high interest rates as the reason for not applying for a

[87] Hansen, P.A. and Serin, G. (1997). Will low technology products disappear? The hidden innovation processes in low technology industries. Technological Forecasting and Social Change, 55(2), 179–191.

loan. Responses indicated interest rates of between 3 and 14.8 per cent. However, during the fact-finding visit to Bishkek in April 2017, entrepreneurs and representatives of intermediary organizations reported interest rates of almost 20 per cent and the majority of granted loans to be secured by collateral. Owners and their families are a significant source of financial resources.

Table 5.15 Indicators reflecting innovation input by innovator profile

	N	Low Performer	Incremental Performer	Radical Performer	High Performer	Total
R&D activities						
Share of firms that have spent on R&D activities[1]	252	3.1%	11.9%	0.0%	27.9%	10.3%
Financial resources						
Owner has financed the business activities[1]	253	10.2%	11.6%	14.3%	14.8%	11.9%
Loan applied during past fiscal year[1]	253	19.5%	18.6%	38.1%	41.0%	26.1%
Why the loan was not applied						
No need	115	74.5%	51.4%	38.5%	44.4%	61.8%
Interest rate	52	16.7%	42.9%	46.2%	38.9%	28.0%
Other reasons	19	8.8%	5.7%	15.3%	16.7%	10.2%
Total	186	100%	100%	100%	100%	100%
Interest rate of most recent loan[2]	68	13.8%	14.8%	10.3%	3.0%	9.9%
The duration of most recent loan (months)[2]	68	34.8	23.2	30.1	16.4	27.1
Most recent loan requires collateral[1]	68	100%	66.7%	71.4%	87.0%	89.7%

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: Percentage of firms
Note[2]: Mean value

While financial constraints are a major issue, lack of skills and knowledge to develop and commercialize innovations are at least as important. Table 5.16 presents a set of potential instruments to ensure adequate resources to innovation.

Table 5.16 Potential instruments for policy support (innovation input)

	Firm-oriented approach	System-oriented approach
Reactive approach	Adapting financial instruments to innovators Designing services to help firms develop project plans and funding proposals	Improving the investment environment and returns for attracting FDI Coordinating co-operative R&D activities Developing tools, techniques and services to assess the required resources
Proactive approach	Improving project management skills Co-operation schemes for funding and sharing costs and risks	Schemes for attracting and retaining talent in Kyrgyzstan

5.7 Innovation process

While innovation processes are often iterative, they commonly flow through the front-end (identifying new opportunities), concept creation and back-end (commercialization) phases. In the front-end, firms often select the sources of ideas and the partners with whom innovation is developed. A high share of Kyrgyz firms has selected a *closed* innovation model as opposed to an *open* one (Table 5.17). Low and Incremental Performers in particular prefer to develop innovations based on their own ideas, while a high share of Incremental Performers develop new products in collaboration with suppliers. Radical Performers tend to develop new products with customers and new processes with suppliers. A common method for acquiring new knowledge is to buy new machinery and adopt its technology to improve processes.

Collaboration between business and R&D institutions is very limited, with only around 5% of even High Performers reporting such collaboration. During an April 2017 fact-finding mission, entrepreneurs compared these institutions to "ivory towers", characterized by inflexible modes of operation and a lack of interest in commercialization. R&D institutions report limited financial and human resources for R&D, and difficulties selecting projects for commercialization.

The diversity and incidence of changes facilitated by innovations tend to grow as the innovator profile shifts from Low Performer to High Performer. Incremental, Radical and High Performers all have a high degree of technical changes, especially regarding product innovations, while changes reflecting how these products are offered to customers are less common. This is a sign of strong product-orientation instead of customer-orientation. Friedman et al. (2012) compared firms in Kyrgyzstan, Georgia and the United States, and found that Kyrgyz firms tended to focus less on customer needs and more on market share and low price. Only High Performers have a high share of activities focused on product design, support services and marketing.

Table 5.17 Characteristics of innovation activities across the innovator profiles

	Low Performer	Incremental Performer	Radical Performer	High Performer	Total
Open versus closed innovation development					
Product innovation was developed					
from own ideas	66.7%	38.5%	21.4%	26.4%	30.2%
in collaboration with suppliers	0.0%	30.8%	28.6%	26.4%	27.1%
in collaboration with customers	0.0%	15.4%	50.0%	35.9%	31.3%
in collaboration with R&D institutions	0.0%	0.0%	0.0%	5.7%	3.1%
licenses, supplied by another firm, etc.	33.3%	15.3%	0.0 %	5.7%	7.3%
Total	100%	100%	100%	100%	100%
Process innovation was developed					
from own ideas	0.0%	40.0%	16.7%	28.9%	29.2%
in collaboration with suppliers	0.0%	13.4%	41.7%	28.9%	27.7%
in collaboration with customers	0.0%	13.3%	16.7%	10.6%	12.3%
in collaboration with R&D institutions	0.0%	0.0%	0.0%	5.3%	3.1%
by buying new machinery to adopt technology	0.0%	26.7%	25.0%	18.4%	21.5%
by licensing or supplied by another firm, etc.	0.0%	6.6 %	0.0 %	7.9 %	6.2 %
Total	0.0%	100%	100%	100%	100%
Changes innovation created[1]					
Product innovation changed by					
adding new functions	0.8%	53.5%	47.6%	59.0%	27.7%
making use of new material	0.8%	23.3%	14.3%	31.1%	13.0%
making use of new technology	2.3%	60.5%	66.7%	86.9%	37.9%
looking different	0.8%	14.0%	19.0%	31.1%	11.9%
Process innovation improved					
logistics and distribution	0.0%	16.3%	19.0%	37.7%	13.4%
production methods	0.0%	32.6%	38.1%	55.7%	22.1%
support services	0.0%	20.9%	23.8%	55.7%	19.0%
Process innovation required changes					
in techniques	0.0%	27.9%	42.9%	52.5%	20.9%
in machinery and equipment	0.0%	30.2%	47.6%	50.8%	21.3%
in software	0.0%	14.0%	28.6%	52.5%	17.4%
in management	0.0%	14.0%	33.3%	49.2%	17.0%
Organisational innovation changed					
knowledge management system	0.0%	53.5%	14.3%	72.1%	27.7%
management structure	1.6%	41.9%	4.8%	57.4%	22.1%
ways to collaborate	0.0%	25.6%	4.8%	52.5%	17.4%
ways to outsource or subcontract	0.0%	32.6%	4.8%	44.3%	16.6%
supply chain management	0.8%	67.4%	14.3%	78.7%	32.0%
Marketing innovation changed					
product appearance	3.1%	39.5%	14.3%	63.9%	24.9%
advertising and promotion	3.9%	51.2%	19.0%	75.4%	30.4%
product placement and sales channels	3.9%	48.8%	14.3%	75.4%	26.6%
pricing strategies	4.7%	60.5%	19.0%	78.7%	33.2%

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: Share of firms within the profile

While Kyrgyz firms report a range of innovation activities resulting in incremental and radical changes inside the firms as well as among their customers, international comparisons suggest that the quality of innovation process demands improvement. On use of ICT, Kyrgyzstan ranks below average among FSU countries, at 91st among 129 countries (Cornell University, INSEAD, and WIPO, 2016), while sophistication of production processes is lowest among FSU countries, ranking 118th among 138 countries (WEF GCI, 2016).

Innovation activities among High Performers are spread broadly across business activities - a situation whereby innovation breeds innovation and one innovation output serves as an input to the next. For example, product innovation leads to process innovation, process innovation leads to marketing innovation, marketing innovation leads to management innovation and management innovation leads to organizational innovation (Forsman and Annala, 2011). Incremental and Radical Performers are further behind, while Low Performers may not even have started such a journey. Policymakers should seek to support Low, Incremental and Radical Performers to become High Performers. One way of doing this may be collaborative schemes to create opportunities to share costs and risks with, as well as learn from, other actors. There is also a need to bridge the cultural divide between the business and academic R&D sectors, while increasing financial resources for the research sector while also improving its human resources.

Table 5.18 presents potential instruments to address challenges related to innovation process.

Table 5.18 Potential instruments for policy support (innovation process)

	Firm-oriented approach	**System-oriented approach**
Reactive approach	Developing services for networking Support for designing a partner strategy	Financial resources for public R&D activities Criteria for R&D project selection
Proactive approach	Schemes for improving process and change management skills Schemes for collaborative R&D activities with other firms and R&D institutions	Resources to improve the quality of R&D scientists and engineers

5.8 Internal and external learning process

Firms' learning processes are crucial for innovation success, and can be separated into internal or external processes.[88] The former exploit firms' internal resources and experiences, while external learning depends on interactions with partners. Both are interdependent and mutually reinforcing, although internal learning may be considered a prerequisite for external learning. Innovating Kyrgyz firms often collaborate with customers and suppliers as external sources of new knowledge. However, approximately one third of Kyrgyz firms still innovate in isolation. Another external source of learning are knowledge-intensive business consultancy services, notably for High Performers (Table 5.19), although still more than half of High Performers report no need for such services, with cost not seeming to be the main barrier.

Table 5.19 Sources for internal and external learning

	Low Performer	Incremental Performer	Radical Performer	High Performer	Total
Consultants hired[1]	*15.6%*	*25.6%*	*23.8%*	*42.6%*	*24.5%*
for developing business skills	5.5%	11.6%	19.0%	32.8%	14.2%
for improving business processes	8.6%	23.3%	23.8%	31.1%	17.8%
for sophisticated projects	6.3%	9.3%	19.0%	31.1%	13.8%
Consultants not hired[1]	*84.4%*	*74.4%*	*76.2%*	*57.4%*	*75.5%*
because of no need	75.8%	62.8%	66.7%	54.1%	67.6%
because too expensive	2.3%	9.3%	9.5%	3.3%	4.3%
because of other reason or n.a.	6.3%	2.3%	0.0%	0.0%	3.6%
Other sources for external learning[1]					
formal training offered	36.7%	62.8%	71.4%	77.0%	53.8%
use of external auditor	32.8%	39.5%	14.3%	36.1%	33.2%
quality certifications	20.3%	18.6%	9.5%	44.3%	24.9%
acquisition of external knowledge	13.3%	14.0%	4.8%	31.1%	17.0%
use of licensed technology	6.3%	14.0%	9.5%	13.1%	9.5%
Indicators reflecting existing knowledge base					
management experience in years[2]	17	15	14	15	16
number of competitors[2]	3	3	6	4	3
main market					
local	59.0%	60.4%	38.1%	29.5%	50.4%
national	33.1%	34.9%	61.9%	62.3%	42.9%
international	7.9%	4.7%	0.0%	8.2%	6.7%
total	100%	100%	100%	100%	100%
technology more advanced compared with competitors (N=34) [1]	0.0%	7.0%	4.8%	13.1%	4.7%
share of workforce using computers	43.8%	37.6%	50.0%	51.7%	45.9%

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: Share of firms within the profile
Note[2]: Due to the departure from normality, median is used.

[88] Alegre, J., Sengupta, K. and Lapiedra, R. (2011). Knowledge management and innovation performance in a high-tech SMEs industry. International Small Business Journal, 31(4), 454–470.

During interviews as part of this Review, technology-intensive respondents identified the Internet is their main source of external knowledge, with systematic collaboration and network building seldom reported. There was also an almost exclusive focus by firms and researchers on technical and engineering solutions rather than creative, aesthetic and marketing solutions, suggesting a narrow understanding of innovation.

Internal learning takes place when experiences are shared within a firm – often an employee's idea for an improvement. It requires individual creativity, open communication, risk tolerance and staff autonomy to make decisions. External competition can also be an important driver of innovation, and Radical Performers indeed tended to have the higher number of competitors (Table 19). Penetration of international markets is low across all innovator profiles.

The major source of external knowledge input for Kyrgyz firms is formal training, and there is limited perceived need or value of business consultancy services, tending to be satisfied with incremental improvements and running a risk that their knowledge will become outdated. Only the High Performers show a more diversified partner network.

Instead, the development of gradual improvements improves knowledge only incrementally. The Low and Incremental Performers are in a risk to experience a knowledge gap. They are satisfied with their existing offerings and due to the lack of challenging development activities, these firms are running a risk that their knowledge will become outdated.

Table 5.20 presents potential instruments to address challenges related to learning processes within firms.

Table 5.20 Potential instruments for policy support (learning processes in firms)

	Firm-oriented approach	**System-oriented approach**
Reactive approach	Developing tools to help small firms utilise the services available to support their innovation activities	Enhancing tools to assess the knowledge types needed to develop and commercialise innovations
Proactive approach	Co-operative scheme for expanding the sources for external learning	Enhancing understanding what kinds of learning is needed for becoming a top innovator

5.9 Innovation output

Patent filings are commonly used as a measure of innovation output. However, while patents or utility models may help assess a technology-intensive innovation, they ignore other types of innovations. Hence, trademarks and designs are also considered here to help assess non-technological innovation across innovator profiles.

As part of this Review, visits to universities and R&D institutions revealed technology-intensive institutions with large portfolios of national patents. However, many of these patents are not exploited commercially. Kyrgyzstan's performance is also poor in terms of international patent applications, although stronger when we consider utility models and industrial designs (Table 5.21).

Table 5.21 IPR applications across the FSU countries

	Technology outputs			*Creative outputs*	
	Patent applications by origin	PCT international patent applications by origin	Utility model applications by origin	Trademark applications by origin	Industrial designs by origin
Armenia	28.1	2.7	39.7	55.1	6.7
Belarus	25.6	1.0	44.2	16.3	5.2
Azerbaijan	6.9	0.1	2.3	11.8	1.7
Estonia	12.3	13.3	34.7	42.8	22.5
Georgia	18.1	2.3	27.5	24.8	13.5
Kazakhstan	24.5	0.7	5.7	9.3	1.2
Kyrgyzstan	**40.4**	**0.7**	**7.3**	**10.2**	**13.3**
Latvia	12.9	7.8	n.a.	30.3	16.8
Lithuania	10.3	6.3	n.a.	28.0	10.5
Moldova	21.3	5.5	100.0	100.0	93.8
Russia	38.6	3.2	66.6	27.3	4.6
Tajikistan	0.1	n.a.	58.5	6.1	0.1
Ukraine	37.5	5.7	100.0	37.6	72.0
Median	21.3	3.0	39.7	27.3	10.5
Kyrgyzstan rank	17/119	78/96	35/62	83/109	47/110

Source: Cornell University, INSEAD, and WIPO (2016): The Global Innovation Index 2016. Highest score=100,0

Across innovator profiles, High Performers are found to be most likely to apply for (and be granted) both patents and trademarks (Table 5.22). Radical Performers were most likely to have applied for trademarks only.

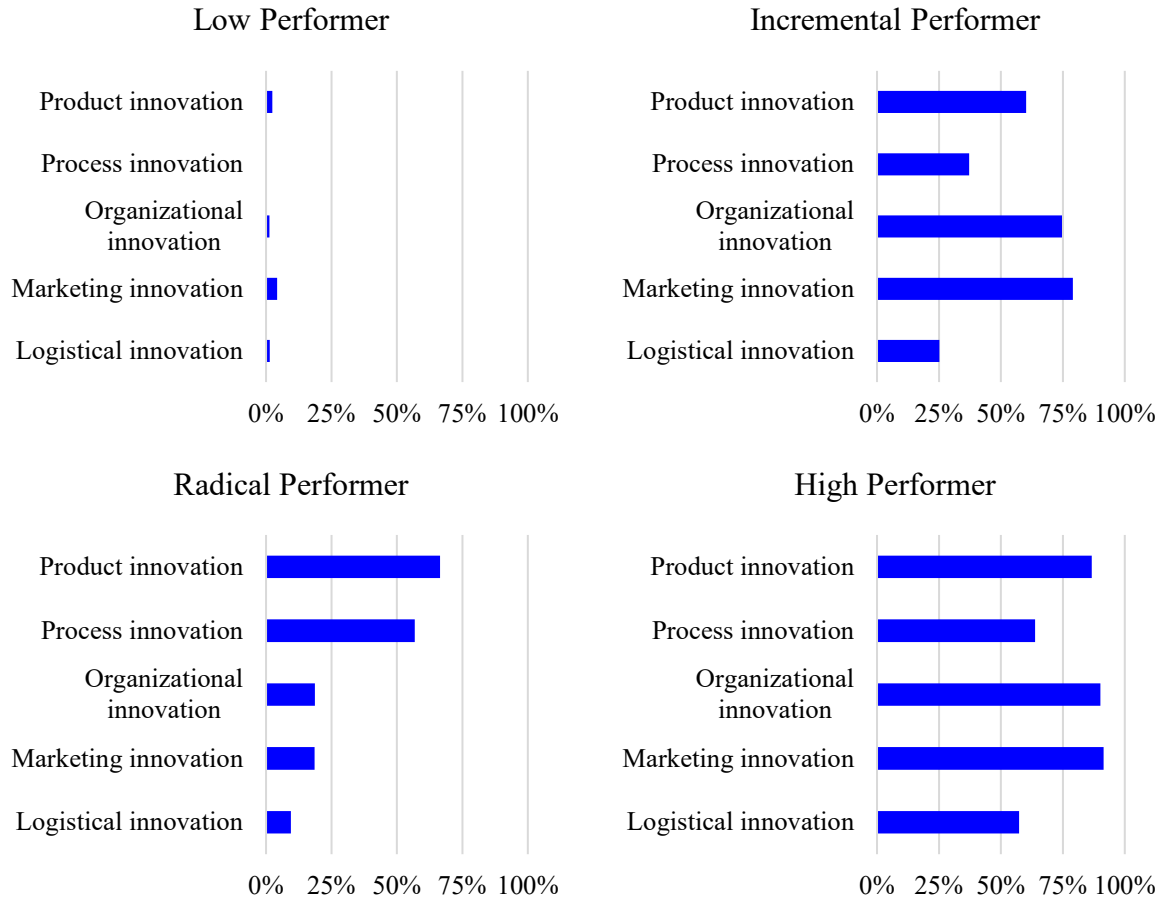
Table 5.22 Applied and granted IPRs by innovator profile

	Low Performer	**Incremental Performer**	**Radical Performer**	**High Performer**	**Total**
IPRs applied during the last three years[1]					
Patent only	3.9%	2.3%	4.8%	4.9%	4.0%
Trademark only	0.8%	4.7%	14.3%	6.6%	4.0%
Both, patent and trademark	0.8%	0.0%	0.0%	13.1%	3.6%
IPRs granted during the last three years[1]					
Patent only	2.3%	2.3%	4.8%	4.9%	3.2%
Trademark Only	0.0%	4.7%	9.5%	6.6%	3.2%
Both, patent and trademark	0.0%	0.0%	0.0%	8.2%	2.0%
Share of firms that hold a patent[1,2]	4.7%	4.7%	9.5%	26.2%	10.3%

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: Share of firms within the profile
Note[2]. Share of firms answering "Yes" to the question of: "*Has a patent ever been granted to your firm?"*

Figure 5.8 presents innovation outputs in terms of developed innovation types, with diversity of innovation output greatest for Incremental and High Performers, combining technical and commercial development. Radical Performers have tended to focus on product and process innovations.

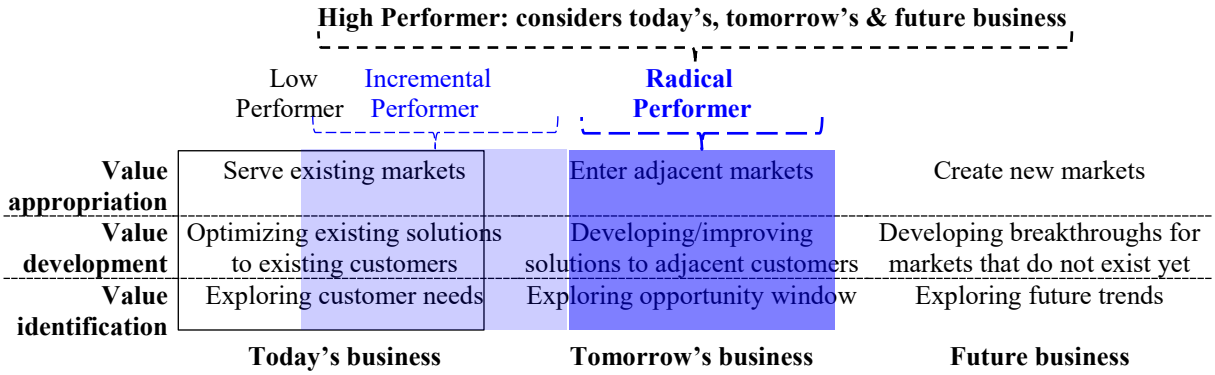
Figure 5.8 Innovation output by innovator profile



Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)

Innovation portfolios are one way to present the balance between risks and returns across innovator profiles, and assess future potential (Figure 5.9). Based on data for Kyrgyz firms (EBRD-World Bank, 2013), more than half (Low Performers and a share of Incremental Performers) focus exclusively on existing business. With the approach often one of "*money making with no investments in innovation*", the future potentiality of these firms is likely to be low, with a risk that the needs of current customers will change or disappear. Approximately 20 per cent of firms (the majority of Incremental Performers and a share of High Performers) focus on today's business but have also allocated some resources for exploring other markets, but with limited risk appetite and mainly minor improvements that are again at risk of being overtaken by disruptive change.

Figure 5.9 Innovation portfolio by innovator profiles



Note: Designed based on Phillips (2006), Nagji and Tuff (2012) and Forsman (2015)

Radical Performers represent approximately ten per cent of Kyrgyz firms, and focus more on future business, with a higher tolerance for risk. They tend to develop radical inventions one after one, but limited market knowledge poses a risk to profitability, and require support to deepen this knowledge. High Performers have more balanced portfolio. They understand both the importance of optimizing existing solutions for current customers and the value of identifying future business opportunities.

In firms, innovation is a commercial phenomenon, and particular attention should be given to creative outputs (e.g. trademarks and industrial designs), which are used also in the service sector to differentiate offerings from those provided by competitors.

Table 5.23 presents potential tools for strengthening the innovation output of firms.

Table 5.23 Potential instruments for policy support (innovation output)

	Firm-oriented approach	**System-oriented approach**
Reactive approach	Designing services to support commercial development Designing services to support the diversification of innovation activities	Developing indicators to measure innovation output including both technical and commercial approaches Developing indicators to measure innovation output from different time perspectives
Proactive approach	Co-operative scheme for improving strategic understanding of innovation (e.g. Innovation portfolio)	Co-operative scheme for understanding and improving abilities to support strategic innovation

5.10 Innovation outcome

Innovation outcomes result from the ability to commercialize innovative outputs, making innovation performance closely related to business performance. High Performers have the highest proportion of exporting firms, but the proportion of exports in sales is low across all profiles. High Performers tend to provide more jobs, with innovative firms of all profiles

tending to provide more female employment, enjoying higher growth rates and paying better salaries (Table 5.24).

Table 5.24 Outcome measures by innovator profile

	Low Performer	Incremental Performer	Radical Performer	High Performer	Total
Sales distribution					
National sales	92.5%	94.9%	94.8%	88.7%	92.1%
Direct exports	4.9%	2.3%	0.0%	7.9%	4.8%
Indirect exports	2.6%	2.8%	5.2%	3.4%	3.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Share of exporting firms (direct and/or indirect)	14.8%	14.0%	9.5%	21.3%	15.8%
Size in terms of					
Sales[1]	5.1	4.3	4.3	7.3	5.5
Jobs – No of employees[1]	5.2	5.0	4.9	6.6	5.5
Jobs – No of female employees[1]	4.8	5.2	6.4	6.7	5.5
Growth in terms of[1]					
Absolute sales growth[1]	4.9	5.5	5.3	6.6	5.5
Relative sales growth[1]	5.0	6.3	6.3	5.6	5.5
Absolute jobs growth[1]	4.8	6.1	6.1	6.5	5.5
Relative jobs growth[1]	4.9	6.0	6.5	6.5	5.5
Employee productivity – Sales per labour costs	5.1	4.8	5.1	7.1	5.5
Salaries per employee[1]	5.1	5.7	4.7	6.7	5.5
Length of employment[1]	6.3	4.7	5.4	4.9	5.5

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)
Note[1]: Due to the departure of normality, all values are classified into 10 equal groups (1-10) in which 1=lowest and 10=highest value. Growth relates to previous three years.

There is a need for policy instruments to support other profiles to become High Performers, while High Performers need support to internationalize their activities. Low Performers need help to acquire the skills for business foresight and to make incremental improvements. Radical Performers need support to diversify and commercialize their innovation outputs. Incremental Performers need stimulus for more radical experimentation. Table 5.25 summarizes some potential options to support innovation outcomes.

Table 5.25 Potential instruments for policy support (innovation outcome)

	Firm-oriented approach	System-oriented approach
Reactive approach	Designing indicators and services to support the measurement of innovation outcome Designing services to support productivity improvements	Designing an instrument toolbox covering support to the different kinds of innovators
Proactive approach	Co-operative scheme to improve customer and market knowledge	Co-operative scheme to learn how to maximise the innovation outcome

5.11 Key obstacles to innovation and growth

The biggest obstacles reported by the Kyrgyz firms are political instability, corruption and high taxes, a large informal sector and lack of skilled workers. While these obstacles have a divergent impact on the four innovator profiles, they are the biggest obstacles reported by all profiles (Figure 5.10). This concurs with earlier recommendations presented by the Asian Development Bank (2013), IMF (2016) and World Bank (2015, 2016[89]) that there is a need to improve the business environment.

Figure 5.10 Obstacles hampering current operations by innovator profile

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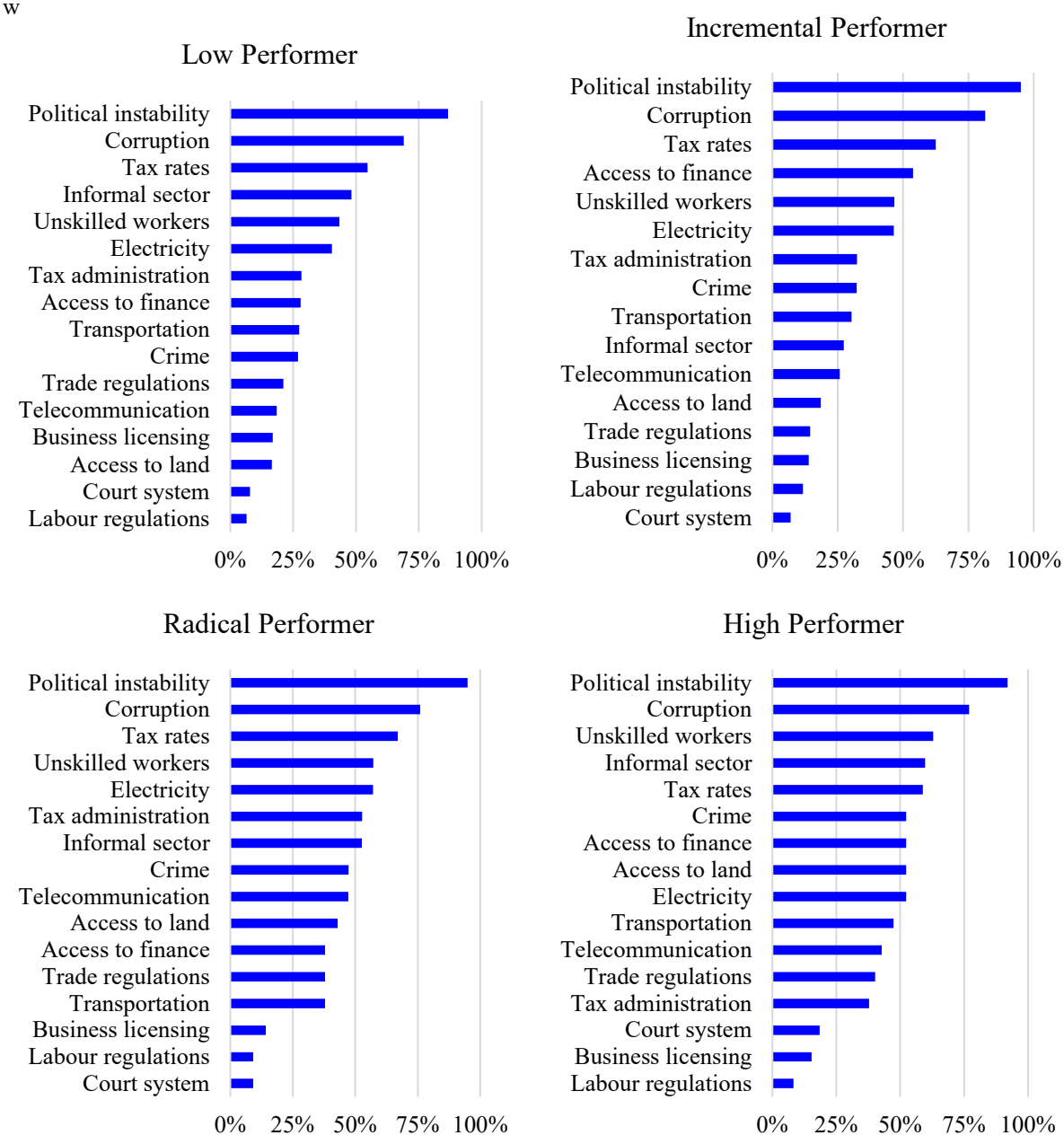

Source: EBRD-World Bank, (2013) Business Environment and Enterprise Performance Survey (BEEPS V)

[89] World Bank (2016). Kyrgyz Republic: A resilient Economy on a Slow Growth Trajectory. Economic Update No. 4, Winter 2016.

5.12 Recommendations

Key problems and potential policy solutions, tailored to the different innovator profiles, are presented at the end of each section. Here, we take a "helicopter perspective" to provide some key recommendations for policymaking.

Recommendation 5.1

In Kyrgyzstan, corruption and informality in both public and private sectors represent significant barriers to innovative firms. Despite significant improvements in starting a business, doing business and trading across borders require attention. eGovernment could help streamline processes and simplify administration, while transport infrastructure and services such as electricity also need urgent action. There should be a mix of actions with short-term and long-term impact with indicators to monitor progress and identification of the responsible authorities.

Recommended actions to improve the business environment in the short term are to:

- Reduce corruption and crime through more efficient enforcement of legislation
- Reduce red tape by streamlining administrative processes, including for cross-border trade
- Improve transportation infrastructure and its maintenance
- Publish regular progress reports on actions taken

Recommended actions to improve the business environment in the long term are to:

- Develop a culture of professional integrity and accountability
- Strengthen public attitudes and demands for anti-corruption
- Implement ethical codes of conduct in both private and public organizations
- Develop business sustainability indicators and monitor progress against them

Recommendation 5.2

Economic development is still significantly factor driven (e.g. gold extraction and agriculture), and sensitive to external factors beyond the control of national policymakers and competitiveness based on low costs of production. Innovation and entrepreneurship will be key vehicles of economic diversification, but require investment in education and skills. The economy is dominated by small businesses and individual entrepreneurs. While informality is a significant distortion to competition, a new generation of entrepreneurs is also emerging. These knowledge-technology intensive entrepreneurs need an environment enabling interaction and entrepreneurial experimentation.

Recommended actions to support knowledge-intensive start-ups in the short term are to:

- Improve incentives to start formal businesses, and regularize informal ones
- Establish business acceleration and incubation activities at universities and other training institutions
- Monitor Government procurement and introduce measures to encourage the participation of SMEs
- Consider eGovernment initiatives as a tool to support a promising local ICT start-up community

- Set up a cooperative scheme to support emerging entrepreneurial communities and knowledge-technology intensive sectors

Recommended actions to support knowledge-intensive start-ups in the long term are to:

- Develop cooperation schemes for funding and sharing costs and risks between enterprises and research institutions
- Facilitate university-industry collaboration to expose students to entrepreneurial opportunities
- Integrate entrepreneurship into education at all stages to strengthen entrepreneurial attitudes, knowledge and skills

Recommendation 5.3

Kyrgyz firms emerge across four "innovator profiles", each with specific policy needs: Low Performers, Incremental Performers, Radical Performers and High Performers. High Performers are important to improve technological sophistication and productivity, while Incremental, Radical and High Performers are all important for job creation. Radical Innovators tend to be especially important to create ownership and job opportunities, including at the managerial level, for women. Across all profiles, the share of firms with senior female management is low, although in terms of ownership performance is better. Low Performers may represent an important source of new talent, and should be supported to become Incremental or Radical Performers, while Incremental Performers should be supported to implement more radical changes. Radical Performers should be supported to commercialize their innovations. High Performers need support to access international markets and networks. Many Kyrgyz firms have selected a closed innovation model driven by short-term business needs where innovations are developed in isolation and collaborators, if any, are local or national customers and suppliers. A linear view of innovation policy tends to emphasize inputs (scientific knowledge and finance) and technological outputs (patents).

Recommended actions to enhance innovation in enterprises in the short term are to:

- Increase awareness of policymakers and implementers of the range of innovations and innovators
- Develop instruments for identifying potential innovators and their specific problems
- Develop a collection of policy instruments to respond to these problems
- Identify the systemic impact of different kinds of innovations and innovators
- Raise awareness of positive case studies to serve as role models, particularly for future female managers and innovators
- Establish cooperative schemes for business foresight activities and to develop internal innovation cultures in enterprises, strategic planning and client orientation

Recommended actions to enhance innovation in enterprises in the long term are to:

- Improve strategic understanding of innovation in both private and public organizations
- Increase awareness of the systemic view of innovation policy
- Develop a comprehensive toolbox of policy instruments with support targeted to each profile of innovator

Chapter 6

INNOVATION FOR SUSTAINABLE DEVELOPMENT

Kyrgyzstan, like all other member States of the United Nations, has signed up to the 2030 Agenda for Sustainable Development. Through this agenda, the countries of the world have committed themselves to achieving, by 2030, 17 sustainable development goals that will result in economic prosperity, within planetary boundaries, for all. Fostering innovation is one of these goals. Innovation is also recognized as a key means of implementation for achieving the 2030 Agenda as a whole.

Within this overall framework, each country sets its own priorities depending on its own national circumstances. The international community has created processes for monitoring progress at the regional and global levels, and for countries to exchange policy experiences, to learn from each other, and to coordiante their policies where appropriate. The present chapter contributes to this effort by analyzing how the current innovation policies of Kyrgyzstan contribute to the country's national sustainable development priorities, comparing current policies to international good practice, and recommending policy reforms that could further encourage innovations contributing to sustainable development.

The previous chapters have covered the role of innovation policies in promoting economic development. The present chapter focuses on the other two pillars of sustainable development, i.e. environmental sustainability and social inclusiveness. However, it should be noted that failures to address unsustainable practices has a very real economic cost. While no estimates of this cost are available for Kyrgyzstan at present, the World Bank has for instance estimated that for neighboring Tajikistan the direct and indirect economic damage caused by environmental degradation may be as high as 8 percent of GDP.[90] Thus the key to sustainable development is to achieve all three dimensions together, rather than achieving one at the expense of the others. In fact, innovation is critical for sustainable development precisely because it is our best chance to mitigate and even eliminate tradeoffs between economic prosperity, environmental sustainability and social inclusiveness.

The global market potential for sustainable innovations is significant. For instance, the global market in sustainable materials and energy efficiency, pollution prevention and various consumptive uses of environmental qualities constitutes about 2.9 trillion US Dollars a year. This market for sustainable innovations grows faster than the global economy as a whole with renewable energy being among the fastest growing market segments (even outpacing growth in the ICT sector).

In this spirit, the present chapter discusses what can be done to promote innovation for sustainable development,[91] i.e. innovation which ideally generates a triple dividend by

[90] The World Bank, Inclusive Green Growth, Pathway to Sustainable Development, Washington D.S. 2012, p.12
[91] UNECE, 2013, Promoting Green Innovation, Policy Assessment and recommendations, United Nations, Geneva.

advancing environmental sustainability and social inclusiveness, while also driving economic progress. [92] [93]

As argued in the previous chapters, innovation needs policy support to flourish. The main rationales for supporting innovation policies from a purely economic development perspective are market and coordination or systems failures. Knowledge, research and development have public good properties and create positive externalities at the macroeconomic level. Moreover, innovation can flourish at scale only when the different elements of the National Innovation System are well development and strongly connected with eachother. Therefore society has an interest in promoting innovation beyond what innovators would be able to do in the absence of policy support.

When it comes to innovation for sustainable development, an additional policy dimension arises. The challenge is not only to encourage innovation in general, but to steer the efforts and investments of innovators into fields of endeavor that are particularly critical for sustainable development. The above market and coordination failures are typically exacerbated in these fields because many of the goods and benefits to be generated by innovation have public good properties and generate positive externalities themselves. This means that the private incentives for engaging in innovation in these fields are attenuated even more than when innovation is applied to goods and services without sustainability attributes [94]. Moreover, because some of the benefits of innovations in fields critical for sustainable development will accrue to society at large rather than to the buyers of the respective products and services, innovations in these fields are also likely to be taken up more slowly by customers. Encouraging the rapid and broad-based adoption of innovations by customers must therefore be therefore another goal of policies supporting innovation for sustainable development.

In keeping with the previous chapters and the current level of economic development of Kyrgyzstan, the main focus will be placed on the adoption and adaptation of innovations that have already been proven to be effective abroad. By the same token, we will not restrict ourselves to technological innovations but also consider non-technological innovations, for instance in business models, services, or marketing.

The first section of this chapter discusses the current state of sustainable development in Kyrgyzstan, including the major gaps and priorities. The second section analyses challenges and opportunities for innovation-led sustainable development, focusing mainly on initiatives that could open up new economic opportunities with higher value-added by greening established sectors. The third section sets out the policy challenges, discusses good practices and then describes and assesses the current policy environment. The fourth section provides policy recommendations.

[92] John Elkington, 1998, Cannibals with forks: the triple bottom line for the 21st century, Gabriola Island, BC ; Stony Creek, CT : New Society Publishers, ©1998.
[93] http://www.wbcsd.org/
[94] Krozer Y, 2015, Theories and Practices on Innovating for Sustainable Development, Springer, Dordrecht-Heidelberg

6.1 Sustainable development in Kyrgyzstan – gaps and priorities

The only comprehensive study available today that assesses progress towards sustainable development in a comparative perspective is the SDG Index and Dashboard Report[95] published every year by the Sustainable Development Solutions Network and the Bertelsmann Foundation. It should be noted that this Report is not compiled by the United Nations and therefore should not be construed as representing the official position of the United Nations on any aggregate, or national, sustainable development achievements or lack thereof. In fact, the Report's ambition of covering as many countries as possible comes at the cost of not always being able to do sufficient justice to national particularities. With these caveats in mind, the report's findings for Kyrgyzstan still provide a useful starting point for discussing the role which innovation can play in achieving the country's national development priorities.

Table 6.1. Current levels of achievement of Sustainable Development Goals for selected transition economies (2018)

	Sustainable development goals	Kyrgyzstan	Armenia	Belarus	Kazakhstan	Tajikistan	Ukraine
1	End poverty						
2	Food security, sustainable agriculture						
3	Healthy lives and wellbeing						
4	Inclusive education, lifelong learning						
5	Gender equality, women empowerment						
6	Sustainable water and sanitation			n.a.			
7	Sustainable and modern energy						
8	Inclusive and sustainable growth, full employment						
9	Sustainable infrastructure and industrialisation, innovation						
10	Reduce inequality within and among countries						
11	Smart and sustainable cities						
12	Sustainable consumption and production						
13	Combat climate change and its impacts						
14	Sustainable use of oceans, seas and marine resources	n.a.	n.a.	n.a.	n.a.	n.a.	
15	Sustainable use of ecosystems and forests						
16	Peaceful, inclusive societies for sustainable development						
17	Global partnership for sustainable development						

Source: SDG Index and Dashboards Report 2018, Bertelsmann Foundation and Sustainable Development Solutions Network.
Note: Green means all indicators under goal are met; while yellow (least distant), amber and red (most distant) indicate increasing distance from achievement of indicators under the relevant goal.

[95] http://www.sdgindex.org/reports/2018/ <

Table 6.1 shows current gaps for all 17 Goals in Kyrgyzstan, and in the other countries whose innovation policies UNECE has reviewed. Leaving aside Goal 14, which is obviously irrelevant for a landlocked country, Kyrgyzstan, like most of the countries UNECE has reviewed before, faces considerable gaps, although not in all Goals. Most notably, as is the case in most of these other countries, the goal of ending absolute poverty, as measured by daily per capita incomes of the purchasing power parity equivalent of USD 1.90, is met in Kyrgyzstan. Nevertheless, the Government aims to further reduce relative poverty, i.e. the fraction of the population with incomes below one half of the national median.

Among the other 15 SDGs, the SDG Index Report identifies the biggest gaps in Kyrgyzstan as existing on SDG 3 "Healthy lives and population well-being", SDG 8 "Inclusive and sustainable economic growth and full employment", SDG 9, which is not only about promoting innovation, but also about sustainable infrastructure and industrialization, and SDG 16 "Peaceful and inclusive societies" (an issue which is not at the core of UNECE's mandate and therefore will not be explored in this chapter). These are generally areas in which the other transition economies reviewed by UNECE also struggle to varying degrees.

Considerable gaps also exist on SDG 2 "Food security and sustainable agriculture", SDG 4 "Inclusive education and life-long learning", SDG 5 "Gender equality and women's empowerment", SDG 12 "Sustainable consumption and production", SDG 15, "Sustainable use of terrestrial eco-systems and forests", and SDG 17 "Global partnerships for sustainable development" (a goal which is about the means of implementing the other 16 goals).

Nevertheless, the trends look mostly positive for those SDGs for which the data used in the SDG Index were available (Table 6.2), including for three of the four SDGs where gaps are greatest.

Table 6.2. Trends in SDG gaps in Kyrgyzstan (2018)

	Sustainable development goals	Status
1	End poverty	
2	Food security, sustainable agriculture	
3	Healthy lives and wellbeing	
4	Inclusive education, lifelong learning	
5	Gender equality, women empowerment	
6	Sustainable water and sanitation	n.a.
7	Sustainable and modern energy	

8	Inclusive and sustainable growth, full employment	
9	Sustainable infrastructure and industrialisation, innovation	
10	Reduce inequality within and among countries	**n.a.**
11	Smart and sustainable cities	
12	Sustainable consumption and production	**n.a.**
13	Combat climate change and its impacts	
14	Sustainable use of oceans, seas and marine resources	**n.a.**
15	Sustainable use of ecosystems and forests	
16	Peaceful, inclusive societies for sustainable development	
17	Global partnership for sustainable development	**n.a.**

Source: SDG Index and Dashboards Report 2018, Bertelsmann Foundation and Sustainable Development Solutions Network.

Note:

	Maintaining SDG achievement
	On track to meet the SDG by 2030
	Indicator score is increasing at more than 50 pct of the rate required to achieve the SDG by 2030, but not sufficiently to meet the SDG by that time
	Indicator score is stagnant or increases at less than half the rate necessary to achieve the SDG by 2030
	Indicator score is decreasing, i.e. the country is moving away from achieving the SDG

The negative trend in gender equality and women's empowerment was due mainly to declining participation rates of women in the labour market and in parliament. While the latter development is beyond the scope of the present analysis, the former suggests that innovation policy makers should pay attention to the effects of innovation on employment opportunities for women. The stagnation on SDG 15 reflects a lack of progress on protecting land and freshwater bodies with significance for biodiversity.

It is noteworthy that the SDG Index and Dashboard Report finds that Kyrgyzstan has relatively small gaps in SDG 6 (Water), 7 (Energy) and 13 (Climate Change), and in particular that the country is on track of meeting SDGs 7 and 13 fully by 2030. These findings are not fully in line with the assessments provided by Government representatives and other experts who shared their perspectives for the present Review. As indidcated above, this discrepancy may reflect methodological limitations in the Index and Dashboard Report.

Stated policy priorities

Accordingly, the stated national Sustainable Development priorities of the Government also do not fully align with the gaps and trends identified in the Index and Dashboard Report. Kyrgyzstan has expressed its commitment to the 2030 Agenda for Sustainable Development on numerous occasions.

In a recent speech in November 2017, the President of Kyrgyzstan identified the following seven sustainable development goals as national priorities

- SDG 1 Poverty reduction (although he reports a lot of progress has already been made)
- SDG 7 Energy
- SDG 8 Job creation, social wellbeing, raising living standards
- SDG 9 Infrastructure and innovation
- SDG 13 Climate change
- SDG 15 Sustainable terrestrial eco-systems and forests and
- SDG 16 Peaceful and inclusive society

In May 2017, Kyrgyzstan signed a new United Nations Development Assistance Framework (UNDAF) with the United Nations system for the period 2018-2022. This framework defines the following four priorities with intended outcomes (Table 6.1).

Table 6.3. Priorities and Outcomes under the 2018-2022 UNDAF

Priority	Outcome
I. Sustainable and inclusive economic growth, industrial, rural and agricultural development, food security and nutrition	1. By 2022, inclusive and sustainable economic growth is increased through agricultural, industrial and rural development, decent work, improved livelihoods, food security and nutrition
II. Good Governance, rule of law, human rights and gender equality	2. By 2022, institutions at all levels are more accountable and inclusive ensuring justice, human rights, gender equality and sustainable peace for all
III. Environment, climate change, and disaster risk management	3. By 2022, communities are more resilient to climate and disaster risks and are engaged in sustainable and inclusive natural resource management and risk-informed development
IV. Social Protection, Health and Education	4. By 2022, social protection, health and education systems are more effective and inclusive, and provide quality services

Source: United Nations Development Assistance Framework Kyrgyzstan 2018-2022, New York, 2017, https://www.unece.org/fileadmin/DAM/operact/Technical_Cooperation/Delivering_as_One/UNDAF_country_files/UNDAF_files_2015-2020/UNDAF_Kyrgyzstan_18052017_eng_fin.pdf

According to the UNDAF document, the four priorities above address (parts of) 16 out of the 17 Sustainable Development Goals, the lone exception being SDG 14, “Sustainable use of oceans, seas and marine resources”, for obvious reasons. Clearly, even though not all of the targets under each of these SDGs are covered, attempting to pursue virtually all the Goals is the opposite of prioritizing.

Given this apparent lack of focus, there is a danger that the limited fiscal, financial and human resources available to tackle sustainable development would be spread too thinly, and the overall impact would remain small. Going forward, it will therefore be critical to establish a limited number of clear priorities, including in light of current levels of achievement, and to then act decisively on these.

6.2 Challenges and opportunities for innovation-led sustainable development

The environment is a major asset of Kyrgyzstan due to unique nature qualities and low population density. Kyrgyzstan is rich in water resources, mainly located in the mountainous areas. The per capita greenhouse gas emissions are quite low by international standards due to the extensive use of hydro-resources in providing environmentally friendly electric power. Moreover, Kyrgyz citizens consume only about one third of the world average of energy per person. However, energy consumption is growing fast, and energy efficiency should therefore be improved.

The country faces challenges from climate change, irrational use of land and unsustainable mining practices, including air pollution from the coal-based district heating power plants and outdated enery-inefficient residential buildings in major cities, unsustainable water management (Table 6.4), degradation of land deforestation and decreased biodiversity in rural areas. Particle emissions, of all compounds, have been increasing fast. More than half of the emissions originate in the energy sector. The annual water use of nearly 880 m^3 per capita is high, with over 90 percent used for irrigation. About half of all effluent from households and industries is being disposed untreated, and the untreated volume appears to be growing. Soil degradation and lack of natural fertilizers are also challenges for the rural population.

Table 6.4. Indicators of environmental performance and water management

	2011	2012	2013	2014	2015
Particulate matter emissions 1000 t	42.5	43.5	45.1	60.5	61
Of which by the energy sector %	56%	56%	49%	52%	60%
Water collection mln m3 a year	4,519	4,869	5,114	4,768	5,224
Of which used for irrigation%	94%	94%	89%	95%	94%
Sewage collection mln m3	146	124	123	113	111

Climate change is already having an impact on Kyrgyzstan's natural resources. Mountain ecosystems are threatened by shifts in temperatures and extreme weather events, with consequent erosion of forest soil. Also, the melting of glacial areas is already deteriorating the quality of mountain and lowland ecosystems.

At the same time, the country has significant potential for low-carbon development[96]. If used in a sustainable way, natural resources and ecosystem services can support the livelihoods of local communities, while absorbing greenhouse gas emissions and mitigating climate change. Integrated water resources management and sustainable forest management are the green

[96] UN Development Program (2012), "The Prospects for Green Economy in the Kyrgyz Republic", Bishkek.

approaches that would foster the development of new green businesses, the generation of employment and the reduction of poverty.

Close to half of Kyrgyzstan's GDP is generated by the services sector. However, the major negative environmental impact of current economic activity is generated by agriculture, industry, construction and the built environment, and the energy sector. The latter sector is of particular significance because it supplies the other sectors and therefore has a major impact on their environmental performance, and because of its impact through household energy consumption.

Agriculture

Kyrgyzstan has a large agricultural sector, with about two thirds of all people living in rural areas and 34% of all land used for agriculture, mainly animal husbandry. Forestry covers 13% of land. The agricultural and forestry areas have increased in the last five years.

Farms use mainly organic fertilizers, while the use of chemical fertilizers is 10 - 50 times lower than in advanced countries. In this sense, Kyrgyz agriculture is actually already relatively "green". However, this is essentially because agricultural production is extensive rather than intensive, and much agricultural land is distributed among smallholders. The flip side of the coin is that agricultural productivity has remained low.

Moreover, the sustainability of agriculture is being threatened by soil degradation and unsustainable water use, including inefficient irrigation systems. Wood extraction from forests and irrational use of water reservoirs, together with transformation of natural habitats into arable lands, mining areas or infrastructure, are all contributing factors to the progressive depletion of natural resources. The ongoing degradation of land causes mud flows, land slides, avalanches, water scarcity because of logging, man-made hazards, fires and infections, which reinforce emigration to urban areas and abroad.[97] Significant areas are degraded, including about 7.2 mln m3 radioactive materials on 31 radioactive tailing-fields, 5.2 mln m3 hazardous waste on 5 tailing-fields and 3.3 mln m3 ores residues on 25 uncovered mountain pits of ores. Economic use of this land and its direct surroundings is not possible, and neighboring water sources are threatened.[98]

The Ministry of Agriculture is promoting intensification of agricultural production in order to address the problem of low productivity. The challenge will be to do this without inflicting more damange on the environment.

One option are innovations that enable farmers to move up the value chain into produce certified as organic, ecological, or fair. Global markets for this are large and growing. For example solely the certified organic food constituted in 2017 a global market of USD 46 billion. Sustainable innovations in food provide opportunities in principle to Kyrgyz farmers not least

[97] Chandonnet A, Mamadalieva Z., Orolbayeva L., Sagynbekova L., Tursunaliev U., Umetbaeva D., Mambetaliev E., Pugachev A., Ryspaeva A., 2016, Environment Climate Change and Migration in the Kyrgyz Republic, International Migration Organization, Bishkek.

[98] Nasritdinov E., Ablezova M., Abarikova J., Abdoubaetova A., Environmental Migration, 2008, Case of Kyrgystan, Environment, Forced Migration & Social Vulnerability, Conference 9-11 October 2008, Bonn, Germany.

because there is short supply within high-income countries were costs of labour and land are high. Some non-governmental organizations have introduced experiments with organic farming. The supply of organic agricultural products generates about 50% higher prices than the conventional ones at lower costs because mineral and chemical inputs are not used,[99] but this type of farming is labour intensive and needs know-how.

Another significant challenge are the costs of shipping from Kyrgyzstan to high-income markets. Moreover, in order to have a chance to penetrate foreign markets for organically grown foods, Kyrgyz farmers will have to be able to get credible certification meeting international standards for their products. This is promoted by the EU – ACA programme for the Kyrgyz Republic, which supports state-of-the-art laboratories with phyto-sanitary equipment that will allow certifying national products as exportable to the EU.[100] The Russian-Kyrgyz Fund also prioritizes organic agriculture and provides loans for this development to the Kyrgyz farmers.

A third major area where innovation can contribute to making agriculture both more sustainable and more producive is irrigation. Water scarcity for farming becomes a major issue as glaciers pull back due to global warming. The Ministry of Agriculture promotes drip irrigation as a tool for more efficient water management, and some local technological development exists in this area (Box 6.1).

Box 6.1 Gidropulse – sustainable irrigation in agriculture

An interesting local sustainable innovation for irrigation in agriculture has been developed by the firm Gidropulse, a subsidiary of the Kazakh firm Gidrotaran. This innovation, developed by a scholar of the Kyrgyz National University, uses a water pulse for pumping water. After the pulse, no additional energy is needed, which saves energy and maintenance costs, although it does not economize on water use per se. The maximum height for pumping water from a reservour is 200 metres. Over a period of 25 years, about 500 units have been sold on the domestic market and abroad.

Despite this, water use remains high, in part because of its low cost. Correspondingly, farmers have little incentive to invest in water saving technologies, a fact which holds back the demand for innovation in this area, and thereby also undermines the incentives for innovators to search for better solutions. Full cost pricing of water could foster water saving practices, recycling technologies, and introduction of crops that need less water,[101] although it would also put pressures on the farmers' incomes in the short term.

Another innovative way of increasing both productivity and sustainability in agriculture is the use of decentralized installations that convert biomass into energy and organic fertilizer (Box 6.2).

[99] Federation of Organic Development BIO-KG, Participatory Guarantee System, undated and BIO-KG presentation 30-03-2017.
[100] The European Union's ACA – Asia and Central Asia programme for Kyrgyzstan, GSP+, 28/02/2017; PBLH International Consulting CONSORTIUM: POHL CONSULTING & ASSOCIATES GMBH
[101] https://www.unce.unr.edu/publications/files/ag/2010/cm1003.pdf

Box 6.2 Biogas: the Fluid Public Foundation

An example is the biogas system developed by the "Fluid Public Foundation", a Kyrgyz non-governmental organisation established in 2002. Its main product is a biodigestor for manure with a ceramic heater (it also provides photovoltaic and solar heat systems and consultancy). About 60 biogas systems operate on domestic markets and abroad. This system can use all kinds of manure up to one tonne per day to produce up 30 m^3 biogas with an energy value of 20 - 25 MJ (4.5 – 5 kWh) per m^3 and organic fertilizers certified by the Kyrgyz authorities for use in agriculture; the fertilizers are usually more valuable than biogas. The costs of installation and operations are low when compared to international competitors and the payback period is short (less than one year).

A fifth option for a more sustainable use of land is diversification of agriculture into tourism. Rural communities possess traditional knowledge which, if revived and infused with modern know-how, design and marketing techniques, could become the foundation for growth in eco-tourism, including trekking, horse riding and other traditions of nomadic life. An example of tourism based on traditional knowledge is under development by "Artasian", a Kyrgyz business start-up aiming at supplies of modernized crafts, with particular attention to traditional textiles.

A barrier for such diversification is that the Kyrgyz traditional knowledge slowly dissolves under pressures of modernity and lack of interest from policies and business.[102] There is little policy attention to assets of the traditional know-how and crafts. For instance, development of rural crafts is neglected in the current FAO program of USD 34.2 million aiming at improvement of land management and the EU program of €71.76 million aiming at the rural development during the period 2014 - 2020.[103] Both programs are narrowly focused on the intensification of agriculture rather than on adding value, which can cause a low-benefit lock-in of Kyrgyz agriculture. Sustainable modernization could be fostered with policy instruments such as guarantees for investments in innovative crafts, promotional support of the rural tourism, or exempting of agro-tourism from regulatory pressures and taxes during a number of.

Industry

Gold mining is a major contributor to GDP and a major source of tax income for the Government. However, it is also a major source of environmental damages, such as health impacts of hazardous compounds, water pollution downsstream, distortion of the mountainous environment. [104] The environmental damage of mining could in principle be reduced consderably by implementing state-of-art, cleaner technologies and updating with cleaner production expertise.[105]

[102] Ibraeva G., Elias M., Ablezova M., Danshina A., 2016, Enabling Gender Equality in Agricultural and Environmental Innovations in Southwestern Kygyzstan, Biodiversity International, Rome.
[103] FAO, Country Programming Framework in the Kyrgyz Republic 2015-2017; European Commission – European External Action Service, Multiannual Indicative Programme (MIP) for Kyrgyz Republic 2014-2020, MIP 2014-2020.
[104] https://www.earthworksaction.org/voices/detail/lake_issyk_kul#.WPixfE05Xm6; http://www.etd.ceu.hu/2013/isaeva_nurila.pdf;
[105] Hilson G, Murck B., 2001, Progress toward pollution prevention and waste minimization in the North American gold mining industry, Journal of Cleaner Production, 9 (5), p. 405-415

The Kyrgyz textile and clothes industries generate about USD 375 million turnover, which is about one third of the total Kyrgyz industry's turnover. There is considerabel potential there for simultaneously improving environmental sustainability and increasing productivity by entering global value chains for sustainable textiles.

The fashion industry has grown very rapidly in the early 21st century at the global level. It is now valued at more than 2.5 trillion USD and employs over 75 million people worldwide. Between 2000 and 2014, clothing production doubled with the average consumer buying 60 percent more pieces of garment compared to 15 years ago. Yet, each clothing item is now kept half as long. The industry has truly entered the era of "fast fashion". Yet only 13% of clothing is recycled after its use, cascading mainly into less-value uses, when merely 1% is recycled in a closed-loop into new clothing.

Despite an increase in jobs, this development comes at a price. Nearly 20 percent of global waste water is produced by the fashion industry, which also emits about ten percent of global carbon emissions. In addition, the textiles industry has been identified in recent years as a major contributor to plastic entering the ocean, which is a growing concern because of the associated negative environmental and health implications. Fast fashion is also linked to dangerous working conditions due to unsafe processes and hazardous substances used in production. Costs reductions and time pressures are often imposed on all parts of the supply chain, leading to workers suffering from long working hours and low pay.

The UN is committed to changing the path of fashion, reducing its negative social, economic and environmental impact and turning it into a driver for the implementation of the Sustainable Development Goals (SDGs). In 2018 10 different UN organizations agreed to establish a UN Alliance on Sustainable Fashion.

Global and complex value chains, with production facilities scattered all over the world and widespread practices of illegitimate subcontracting and undeclared informal work, make it very hard to gain accurate information about how and where such impacts occur. In order to increase the industry's ability to manage its value chain more sustainably, both consumers and businesses must first be aware of the nature and magnitude of these risks. Improving both traceability and transparency of value chains has therefore become a priority. In 2017, UNECE launched a project for an international framework initiative on transparency and traceability for sustainability in the textile and leather sector. This initiative provides an opportunity for the Kyrgyz textile industry to improve its access to high-value European markets for so called "clean clothes" because it prepares the ground for verifiable enforcement of of environmental regulations. In this vein, competition assessments were made recently with recommendation for export promotion, capacity building, and tariff reductons for the Kyrgyz textile industry.[106] The European Union has funded € 0.587 mln for the improvement of enviromental standards in the textile industries in Kyrgyzstan[107].

[106] OECD, 2014, Expanding the Garment Industry in Kyrgyz Republic, Paris. Birkman L. Kaloshkina M. Khan M., Shavurov U., Smallhouse S. Textile and Apparel Cluster in Kyrgyzstan, Harvard Kennedy School, Harvard Business School, 2012.

[107] European Commission, International Development and Cooperation, Central Asia – Private Sector, 4/12/2017

Energy

As mentioned above, the energy sector is particularly critical for sustainable development because energy serves all social and economic activities and has major environmental impacts. Making energy more sustainable therefore will have a positive effect throughout the economy and society. Appropriate policies could generate various sustainable innovations based on large and small hydropower, communal afforestation, electric mobility, air conditioning, energy smart distribution and storage, and other technologies entailing frontrunning business position in this area.

This energy transition requires improved governance and effective legislation for the introduction of innovative green technologies, and integrated environmental and economic thinking. It also requires extensive consultations with all agents and stakeholders, involving government authorities, business community, civil society, NGOs, community organizations, academics, engineers, law makers, financial institutions and international organizations.

Due to its existing hydropower resources, Kyrgyzstan already enjoys a relatively high share of renewables in its energy mix. Hydropower covers about 31% of the Kyrgyz energy production and 80% of electricity generation, which makes the Kyrgyz Republic a global champion of renewable energy. Coal, about 31% all energy resources, is used for heating and oil, also about 31%, for transport.[108] However, many hydropower installations are obsolete, and development of new capacities stagnates.

Small-scale decentralized hydropower plants could help solve this problem, particularly for rural areas. This sustainable innovation is a national priority. The potential for the small hydropower stations is estimated to be 840 mln ton oil equivalent (nearly 10 million GWh) but only 1% of the potential is used.[109] Donor institutions have allocated USD 1.6 million for development of expertise in this business, in particular into an expertise centre. The Kyrgyz government envisages USD 150 million investments during the period 2016 - 2030 for development of 13 facility with total capacity 160 MW.[110] Small scale hydropower cannot satisfy all national demand for electricity but it can enhance the regional economy. This development is also promoted in the EU– ACA programme for the Kyrgyz Republic.[111] There is also potential in solar energy, and some limited local innovation has occurred in this area (Box 6.3).

[108] International Energy Agency
http://www.iea.org/statistics/statisticssearch/report/?year=2014&country=KYRGYZSTAN&product=Balances
[109] http://www.kg.undp.org/content/kyrgyzstan/en/home/presscenter/pressreleases/2015/02/17/kyrgyzstan-is-working-on-a-concept-to-develop-small-hydro-energy.html
[110] http://voiceofrenewables.com/hydro/150-million-usd-for-small-hydro-until-2030-in-kyrgyzstan/
[111] The European Union's ACA – Asia & Central Asia programme for Kyrgyzstan, GSP+ Support Measures: state of play of laboratories and phyto-sanitary equipment certifying national products as exportable to the EU, 28/02/2017; PBLH International Consulting Consortium: Pohl Consulting & Associates GmbH

Box 6.3 Solar energy

One German solar energy firm has invested in Kyrgyz Republic, but there are also domestic firms for solar based systems. For example, the Bishkek Heavy Machinery Industry ("Baytur") has patented a method for operations with dry battery, which reduces heat in solar cells. It has also developed sensors with mechanism for turning solar panels with use of heat from a dry accumulator. This system reduces the heating effect by 25% and helps prevent freezing or over-heating. This could be an interesting export product once proven on the domestic market.

However in the meantime, the use of fossil fuels, particular coal, is increasing and even displacing hydropower in electricity generation. Fossil fuels have supplied about 20% of all electricity consumption in 2015 compared to only 9% in 2011. The move towards relying more on fossil fuels will be further reinforced by investment of USD 385 million in the Bishkek fuel thermal power plant; the second phase of the heating project is in discussion with GIZ. This policy would constrain sustainable innovations because large investments are locked into the fossil fuels technologies rather than renewable energy.

The rise in fossil fuel consumption runs counter to the global energy decarbonization trend driven by rapid improvements in the cost-effectiveness of low-carbon fuels[112] [113].

The growth in fossil fuels use also runs counter to Government attempts to prioritize renewable energy, as mentioned by the State Committee on Industry, Energy and Mining and the governmental green growth strategy. The present energy policy has incentives for renewable energy production: small scale hydropower has a feed-in tariff coefficient of 2.1 of the maximum electricity tariff, i.e. 6.3 dollar cent per kWh, wind power has a coefficient of 3 and solar power of 6.[114]

However, so far these preferential feed-in tariffs for renewably generated electricity have not had much effect. The main reason is that electricity continues to be sold to households and businesses at significant discounts from generation costs. Electricity distribution is operated by the Energoholding (80% state-owned). Its delivery cost across all energy sources is about 5 dollar cent per kWh. But residents pay only about 1 dollar cent per kWh and industries about 3 dollars cent.

The resulting deficit in electricity generation is estimated as high as USD 2 billion a year (USD 0.03 – 0.01 x 100 mln kWh). To this would have to be added the costs of power transmission and delivery, which would add USD 0.03 - 0.05 per kWh, and the costs of social and environment protection, expressed as taxes. All together, the full-cost tariff which would eliminate the deficit would need to be about USD 0.10 per kWh, i.e. about ten times the residential tariff (comparable to the lowest tariffs for citizens in the EU and US though the industry tariffs are often lower).

[112] Grubler A., 2012, Energy Transition research, Insight and cautionary tales, *Energy Policy*, 50:, p. 8-16.
[113] Rubin E.S., Azevedo I.M.L., Jaramillo P., Yeh S., 2015, A review of learning rates for electricity supply technologies, Energy Policy, 86, p. 198-218.
[114] The average feed-in according to the Ministry of Economy is 13 KGS (USD 0.17) per kWh compared to KGS 2.24 (USD 0.029) per kWh purchase tariff.

Energy price reform to stimulate innovations for energy savings and renewable energy

Electricity price reforms aiming at full cost are necessary and presumably unavoidable by 2022, when the loans taken out to finance the deficit will begin to have to be repaid. The Kyrgyz strategy on the energy sector development is in preparation.

The question is whether Kyrgyz citizens could bear the full costs of energy and electricity. The present cost of energy consumption paid by Kyrgyz citizens fluctuate yearly between 6% to 8% of their average income, 35% to 40% of these costs are for electricity which means 2.2% to 2.9% of the average income. This share of electricity costs in the citizens' income matches the share of the high and medium income citizens in the high-income countries in the EU. The Kyrgyz citizens, therefore, are generally better off than many EU citizens in relative terms, in praticular ones in the EU low income countries. However, attempts to raise electricity prices for residents had led to political unrest in 2010.

At the same time, it should be understood that the costs of electricity and energy production and distribution are being born by citizens in some way in any case. Under the current policy of subsidized prices, the deficit of the electricity company has to be covered from tax revenues or through borrowing, which creates liabilities against future tax revenues. Since at the end of the day, taxes are paid by citizens, the issue is not so much whether citizens collectively can afford to pay for the cost of energy, but how these costs should be distributed among citizens, and which system of pricing creates the right incentives for sustainable production and consumption of energy.

International studies show that energy subsidies are a wasteful allocation of fiscal resources because the largest part of the subsidies supports energy-intensive practices rather than energy efficiency. Moreover, most of the benefits accrue to citizens with high and middle incomes who use much more energy per person than the poor. Thus this type of subsidies is also a relatively ineffective and expensive way of supporting or protecting the poor.[115]

The current policy also undermines electricity production because revenues fell from USD 0.89 mln in 2011 to USD 0.50 mln in 2014, which is insufficient even to maintain equipment. And most significantly for the purposes of the present analysis, it also impedes sustainable innovations based on the Kyrgyz leadership in the hydropower production because investments in energy-efficiency and renewable energy are unrewarding.

This is why the European Union, for example, prescribes full cost pricing including taxes on energy products though it allows tax exemptions. For example, it allows tax exemptions with regard to the international competition and for citizens who spend more than 20% of income on energy (considered the "energy poverty line").

The challenge for the Kyrgyz Republic is to reduce energy subsidies without social disruption. There are examples of how this can be done. In Morocco, for example, the prices of transport fuels are based on full cost, whereas the electricity subsidies are gradully reduced. In parallel,

[115] Barnes D.F., Halper, J. The role of energy subsidies, World Bank, Energy and Development Report, 60-66. http://regulationbodyofknowledge.org/wp-content/uploads/2013/03/Barnes_The_role_of.pdf

income transfers to the poor citizens are enlarged.[116] In Romania, all energy prices have gradually been increased as subsidies are cut. The prices evolve toward full cost along with the EU support for energy infrastructure and low "social tariffs" for small users and for citizens with income below the national average.[117] Iran has shifted subsidies for energy and bread into cash transfers as a basic income (up to 29% of the family income) entailing positive productivity effects in the services business.[118] Such experiences can be used for designing Kyrgyz policies that promote sustainable energy without subsidization, while preserving socio-economic stability and a fair income distribution.

Energy efficiency in buildings

One of the fastest growing sectors in the Kyrgyz economy has been construction. Poor energy efficiency of the housing stock and of buildings in general has been a key problem in Kyrgyzstan.[119] This is a long-term challenge, as the experience from other countries shows.[120]

Innovation has generated technologies that substantially reduce energy consumption in all aspects of the operation of buildings, including insulation, ventilation, heating and cooling, water heating, and lighting and appliances. For instance the energy efficiency of gas furnaces has improved from 63% to as high as 97% since the 1970s. Latest technology windows are eight times better insulated than older specifications. There are also innovations that impact several or even all aspects of a building's operations, in particular smart metering and smart building systems, and smart design. These computerized monitoring and control systems can cut commercial building energy use by 10% to 20%, and improved design can reduce both energy use and construction costs in large office buildings.

Despite these innovations, even advanced countries have been making only slow progress towards improving the average energy efficiency of their building stock. This is because these innovations are being taken up only slowly. The policy challenge therefore is to accelerate the broad-based adoption of these innovations.

The main policy tools that are deployed in leading countries for this purpose are mandatory legal requirements such as building standards, financial incentives such as rebates, mortgage rate reductions or tax breaks, and awareness raising programs, such as energy efficiency labels or eco-design standards.

In 2012, Kyrgyzstan was one of the first countries in the CIS to adopted a law on energy efficiency of buildings. Energy efficiency regulations that set requirements for thermal protection of buildings to ensure energy saving have also been adopted. However, more could be done.

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[116] https://energypedia.info/wiki/Morocco_Energy_Situation
[117] Diaconu O, Oprescu G. Pittman R, Electricity Reform in Romania, paper 08-11, http://aquavalens.org/documents/107435/107587/ccp08-11.pdf
[118] Saheli-Isfahani D., Mostafani- Dehzooei, M.H. 2017, Cash Transfer and Labour Supply: evidence from a large scale program in Iran, Economic Research Forum, working paper, no.1090.
[119] United Nations Economic Commission for Europe, Assessment on the Innovation Policies for Adoption and Adaptation of Green Technologies – Krygyzstan. Geneva 2013.
[120] United Nations Economic Commission for Europe, Mapping of Existing Technologies to Enhance Energy Efficiency in Buildings in the UNECE Region, http://www.unece.org/fileadmin/DAM/hlm/Meetings/2018/10_03_Geneva/1_Study_on_Mapping_of_EE_technologies_v2.pdf

6.3 Policies promoting innovation for sustainable development

To fully realize the potential of innovation for sustainable development, it is necessary to encourage rapid and broad-based adoption and diffusion of innovations in fields critical for sustainable development. This pertains to acquiring such innovations from abroad, but in particular also to absorbing them into the national economy.

However, there is growing evidence that aggregate performance is often far from what would be possible based on the use of current state-of-the-art technology, because the latest available technologies are adopted only by a minority of firms and households. Significant progress in terms of productivity and sustainability could often be made if the latest technologies were adopted more widely and more quickly. This is especially the case in areas critical for sustainable development.

Of equal importance is the fact that the direction and pace of local innovation efforts will depend critically on the prospects of innovations being adopted rapidly and broadly. If innovative companies see no prospect of innovations in areas critical for sustainable development being adopted at scale and within reasonable time frames, they will turn their attention and resources to other areas of innovation.

Without policy interventions which actively steer innovation efforts into areas critical for sustainable development, progress may not occur because innovation in sustainable technologies and products may not advance more rapidly than innovation in conventional technologies and products.[121] There is therefore a growing interest in understanding the causes of such gaps and in policies that may reduce them.

There are barriers that may impede the rapid adoption of innovations which can have a sizeable positive impact on sustainability. It is important to identify these barriers in order to design effective policies to close adoption gaps.

These barriers fall in the following categories:

- Externalities which distort market prices;
- Lack of salience of sustainability advantages (inattention);
- Credit constraints and other financial market imperfections;
- Information asymmetries between parties who must share costs and benefits of technology adoption; and
- Coordination failures (“chicken and egg” problems).

[121]For instance, the historical record shows that the pace of innovation in exploration and drilling techniques has been rapid enough to keep increasing the level of proven fossil fuel reserves relative to demand, and to also keep the costs of exploitation from rising and the success rates of exploration from falling. Therefore, there is no evidence to suggest that supply will be outstripped by demand, and that prices will be pushed up “naturally”, thereby encouraging a shift towards renewables/alternative fuels. Similarly, innovation in electric vehicles will not automatically lead to a market breakthrough. A breakthrough will happen only if innovation in electric vehicles is more rapid than innovation in internal combustion engine vehicles (Covert, Thomas, Michael Greenstone and Christopher R. Knittel. 2016. "Will We Ever Stop Using Fossil Fuels?." Journal of Economic Perspectives, 30(1): 117-38).

Distortions in market prices can negatively affect not only choices to invest in acquiring new technologies, but also choices on how to use them, as well as decisions to invest in innovation in the first place. These distortions arise from externalities, i.e. situations where decision makers (consumers or companies) do not bear the full costs or do not reap the full benefits of their choices, and where their choices therefore lead to excessively high costs or inefficiently low benefits for society as a whole. A classic example is a fuel price which reflects the costs of mining, refining and distributing the fuel, but not the cost of environmental pollution caused by burning it. In this situation, a consumer buying a car with a new more fuel efficient engine would bear the full cost of this investment, and would benefit from lower expenditures on fuel. However, if the price of fuel does not capture the cost of pollution, the owner of the more fuel efficient car will not reap the benefit of lower pollution. As a result, the demand for new cars may remain too low.

Even if externalities have been internalized and market prices are not distorted, innovations may still not be adopted as rapidly as would be desirable. One reason is that information on the sustainability properties of different products may be less salient to customers than other product features which then guide their purchase choices.

For instance the purchase prices of two alternative products can be compared easily, and will typically have a significant influence on the purchase decision. By contrast, whether an innovative product has lower usage costs may be much more difficult to assess, given that this depends on the technical properties of the product in conjunction with individual usage patterns. Future usage costs may thus receive less attention in purchase decisions.

Relatedly, adopting innovative sustainable technologies or products may require significant upfront investments. This is true for durable consumer goods, and even more so for innovative solutions in reducing the ecological impact of housing, or for investments in innovative sustainable production processes. The costs of adopting such innovations have to be incurred immediately, whereas the benefits in terms of reduced usage costs, lower environmental impact or higher revenues will materialize only over time. Such investments may therefore depend on the ability of consumers or companies to obtain credit.

There is ample evidence that consumers and companies, particularly small and medium-sized enterprises, are often constrained in their access to credit by a lack of collateral and by information asymmetries which discourage banks from lending. Such information asymmetries may be particularly relevant in the case of investments in innovative technologies where the return depends on product characteristics and future usage patterns that are difficult for creditors to verify.

Kyrgyz consumers express positive opinions about waste recycling of, energy saving, healthy food as, and they also show ambiguity in behavior when costs are involved, similarly to other countries.[122],[123].

[122] Shadymova, J, Wahlen S., 2014, 'Nobody cares about the environment': Kyrgyz' perspectives on enhancing environmental sustainable consumption practices when facing limited sustainability awareness, International Journal of Consumer Studies, Volume 38, Issue 6, Pages 678–683.
[123] Liu, M.F.M., Pistorius T., 2012, Coping with the crisis: Impact assessment and potentials for non-traditional renewable energy in rural Kyrgyzstan, Energy Policy 44, p. 130-139.

Another possible barrier to the efficient adoption of innovations are information asymmetries between parties which must share the costs and benefits of the investment. An example is the decision by a landlord whether or not to use innovative materials to improve the insulation of a block of rental apartments. The landlord would do so if he could recover the costs through higher rents. The tenants would benefit through lower heating bills. However, it may be difficult for the two parties to agree on the appropriate size of a possible rent increase because the benefits will depend on the properties of the materials which the landlord installs, which the tenants do not control, and the heating habits of the tenants, which the landlord has no control over.

A fifth possible barrier can arise from coordination failures between the adoption of innovations and the development of complementary infrastructure ("chicken and egg problems"). For instance, consumers may be reluctant to purchase electrical cars or cars running on alternative fuels if there is a lack of charging stations, while the energy industry may be reluctant to build charging stations if there are few vehicles to be charged.

There are a range of policy options available to address the above barriers to the adoption of critical innovations, such as

- taxes and markets to internalize externalities
- standards
- regulations
- product labelling
- awareness-raising campaigns
- subsidies
- tax incentives
- public procurement

These policies may be used individually to address specific barriers, or they may be used in combination to address barriers arising from the inter-connectedness of adoption decisions in different areas.

Pigouvian taxes and, in the case of pollution externalities, markets for tradable permits, are generally considered the preferred policy instruments for internalizing negative externalities and correcting price distortions. The advantage of these instruments is that they are cost-effective because they do not discriminate between alternative technological solutions to sustainability problems and because they are generally well-targeted, i.e. they provide incentives for behavioural change primarily to those whose decisions are most distorted by market failures.

Where these options meet with political resistance, alternative policies that may be considered include subsidies for buyers or investors and mandatory quality or performance standards. These policies are generally considered second-best because they are less well targeted (subsidies) and may be subject to regulatory capture (standards).

Awareness raising campaigns, the introduction of product labelling and standards are examples of policies that can overcome the problem of lack of salience. Good practices include for instance offering free-of-charge energy audits which inform consumers of the specific usage patterns and costs of consumer durables and homes.

In this regard, information has a key role to play, and advances in information and communication technologies, such as the move towards the Internet of Things, hold a lot of promise. This move will generate large quantities of data, for instance about how household appliances are being used, and these data can in turn be used to inform consumers about the true costs of their consumption choices, and to create pricing schedules which provide incentives for a more efficient use of resources.

Incidentally, these policies can also address the problem of excessive obsolescence alluded to in the section on fast fashion above, i.e. excessively short life cycles of products in some areas. Furthermore, innovative service models of manufacturers, minimum requirements for software compatibility over time, and regulations and standards on improved reparability of products can be part of the solution here.

Awareness raising campaigns can also affect positive change in consumption patterns by changing behaviours through changing perceptions and aspirations. A case in point is the move to a "sharing economy" where people aspire less to owning durable consumption goods, such as cars, and focus more on being able to use them when they need them. This provides examples of innovations which, although often enabled by technology, are essentially new business models enabling new modes of consumption.

Credit constraints and other financial market imperfections can be addressed through investment tax incentives and different forms of investment subsidies. But minimising the risk of inefficient public spending requires detailed understanding of technologies and markets.[124]

It also requires careful targeting. There is evidence that some subsidies, while intended to encourage investments of poorer, more credit-constrained households, have instead been taken up mostly by wealthier, less constrained households. "Tagging", i.e. restricting eligibility for subsidies based on observable characteristics such as income level can improve outcomes significantly.[125]

Financial incentives can also be combined with product labelling or standards, as when subsidized mortgages are made available to home owners who build to certain minimum energy efficiency standards. There is also scope for providing additional incentives in areas such as green financing through changes in the regulatory environment for institutional investors.[126]

Information asymmetries between parties sharing the costs and benefits of adopting an innovation, and coordination failures between entities that need to make complementary investments can be mitigated through regulations and standards.

Barriers to the adoption of innovations often constrain the demand for innovation, even though, as indicated above, a lack of demand will also negatively affect supply. To address innovation

[124] Karol Kempa and Ulf Moslener (2015), Climate Policy with the Chequebook – An Economic Analysis of Climate Investment Support. Frankfurt School of Finance and Management, Working Paper Series no. 219.
[125] Allcott, Hunt, Christopher Knittel and Dmitry Taubinsky. 2015. "Tagging and Targeting of Energy Efficiency Subsidies." American Economic Review, 105(5): 187-91.
[126] European Commission (EC) (2015), Shifting Private Finance towards Climate Friendly Investments - Policy options for mobilising institutional investors' capital for climate-friendly investment.

adoption gaps, therefore, requires complementing supply-side policies with appropriate demand-side policies.

In addition to the policies discussed above, the state can be an important source of demand for innovation for sustainable development, notably through public procurement. For example, in the EU market, procurement accounts for about 19% of gross domestic product. More generally, demand for innovation in areas critical for sustainability can be boosted by increasing the innovative capacity of the public sector to meet societal challenges.[127]

Beyond the specific policy options outlined above, there are a number of general good practices and principles which can be identified for the design of policies promoting the adoption and diffusion of innovations critical for sustainable development.

When designing policies or choosing among alternative policy options, especially also in the context of limited public budgets, policy makers may wish to consider the following criteria:

- significant impact;
- complementarity with other existing policies at the national and international levels;
- political feasibility;
- economic feasibility; and
- capacity of the public sector to implement the chosen policies.

Technology-neutral policies, which aim to promote certain outcomes (e.g. maximum emissions standards for vehicles), are generally preferable to policies which promote the adoption of specific technologies (e.g. subsidies for electrical vehicles), and which may result in missed opportunities from alternative technologies which may turn out to be superior.

Policy coherence and consistency is a challenge, particularly in areas where the goals of sustainability and social inclusion may conflict. One example would be where policies encouraging the adoption of innovative energy efficiency solutions for consumers coexist with policies subsidizing energy for households for social reasons. 128 Overcoming policy incoherence requires a coordinated approach across different government ministries. This will require investments in expertise and staff of relevant Government ministries and agencies[129],[130].

Overcoming resistance to change by legacy industries to the removal of subsidies and the adoption of innovations may also be a challenge in this regard.

Because the impact of the broader adoption of innovations in one area may depend on the state of technology in another area, such as in the case of electrical vehicles and the sources of power

[127] See the Committee's document on good practices and policy recommendations on Innovation in the Public Sector ECE/CECI/2015/5 and Organization for Economic Cooperation and Development (2011), Demand-Side Innovation Policies.
[128] For instance, global road sector subsidies for gasoline and diesel totaled USD110 billion in 2012. These subsidies tend to support demand for these fuels and thereby reduce the demand for alternatives, which in turn is likely to reduce incentives for innovation in this area.
[129] World Bank, 2013, Kyrgyz Republic, Overview of Climate Change Activities, report 85561.
[130] Asian Development Bank, 2015, Improving the Implementation of Environmental Safeguard Capacity and Capacity Development Plan, ADB, Project number 4333.

for electricity generation, it may be necessary to coordinate and possibly sequence policies aimed at speeding up the adoption of innovative technologies in several connected fields.

Overcoming policy uncertainty is another key challenge, i.e. ensuring that investors (both customers adopting innovative products or technologies and innovators embarking on the development of such products and technologies) have confidence in the stability of the regulatory and policy framework. Without this confidence, current regulations, standards, subsidies, taxes and tax breaks can only exert a very limited influence on purchase and investment decisions with a medium to long payback period.

When designing policies to promote the adoption of innovations critical for sustainable development, it is important to take into account their potential impact on international trade and investment. Among these policies are regulatory standards, carbon labelling, voluntary supply chain measures (if implemented by large players with market power, they become de facto mandatory), charges on embodied carbon, subsidies and product tax incentives, preferential finance terms, government procurement, and approved technology lists.

On the one hand, care needs to be taken that such policy measures comply with international trade rules and they do not become technical barriers to trade. On the other hand, product certification and traceability remain key challenges in order to ensure that policies such as the above do not lead to distorted trade flows. An example would be when products which comply with a domestic standard and are, therefore, more expensive are replaced by cheaper imports, which may not comply with the standard.

In this regard, there is also a need for more information about the large number of national standards, labels and certification schemes, such as for instance the UNECE Committee on Housing and Land Management is compiling for energy efficiency in housing.

Current policy environment

The Kyrgyz government has introduced a legal framework to improve environmental performance. This framework covers among others environmental regulations in the Law on Environment Protection (1999) and Law on Environmental Expertise (1999), as well as in decrees on the State Environmental Examination (in May,7, 2014 No 248), and Regulations on the Order of Environmental Impact Assessment (February, 13, 2015, No 60). Regulations on monitoring and enforcement are defined in the General Technical Regulation on Environmental Safety (2009) and executed by the State Inspectorate on Technical and Environmental Safety. In line with findings of the UNECE mission about the state of the environment in Kyrgyzstan,[131] the Kyrgyz government has re-structured its system for measuring environmental quality.[132]

The Kyrgyz policy has also embraced sustainable development based on the rule of law, principle of democracy and participation of civil society in the governmental strategy for the period 2013 - 2017.

[131] United Nations Economic Commission for Europe, 2009, Environmental Performance Review of Kyrgyzstan, Second Review, New York and Geneva.
[132] State Agency on Environment Protection and Forestry under the Government of Kyrgyz Republic and UNDP-UNEP Poverty and Environment Initiative in the Kyrgyz Republic, 2012, The National Report on the State of the Environment of the Kyrgyz Republic for 2006 – 2011, UNEP, Kyrgyz Government, UNDP

With respect to natural resources and environment it aims at sustainable innovations when it advocates "… promoting new technologies to improve the energy and resource efficiencies of both the production and consumption, reduce emissions and pollution of the environment, and prevent the loss of biodiversity." [133]

However, the intentions and aspirations formulated in the above legal documents have been insufficiently supported with implementing regulations and – the most glaring weakness – funding. This echoes a similar finding made in the preceedng chapters for innovation policy in general. In fact, some policies, such as the subsidies for non-sustainable energy discussed above, actually counter-act the goal of sustainable development.

Cleaner technologies do not receive specific policy support at present, although the Ministry of Economy envisages tax exemptions in the new tax code. Urgency for sustainable innovations is not reflected in current expenditures on environment protection. Total expenditures hover around one percent of all investment in the economy, and are equivalent to less than 0.5 percent of GDP, out of which more than half is spent on water protection. The percentage in European countries is typically two to four times higher and is increasing over time, whereas it has been decreasing in the Kyrgyz Republic.

There is also a mismatch between high aspirations and low budget in the governmental science strategy toward 2022.[134] Seven priorities are envisaged, most of which have a sustainability dimension in principle: rational use of natural resources, food security, ICT, health and quality of life, new technologies in energy, tourism and transport, social and humanity issues. The Ministry on Education and Science provides about USD 10 million a year for these priorities, which are divided among 46 research institutes. This budget means USD 1.4 million per priority. Given the average scholars' salary, the annual budget is sufficient for 2 – 3 researchers per institute, i.e. about one project team in a European country. This budget is barely sufficient to keep knowledge up to date and it is certainly insufficient for research and development aiming at innovations. A more effective policy would define a more limited number of priorities to avoid spreading small funds too thinly.

Enforcement of existing regulations

The Ministry of Environment aims to ensure enviromental quality by enforcing existing national standards. This enforcement is based on the experts' assessment, as is standard practice in many countries. Enforcing standards for waste management has been uneven as waste is managed decentrally by municipalities in a sometimes informal and uncontrolled way. Inspections and enforcement of environmental standards are done by the State Inspectorate on Ecological and Technical Safety as prescribed by the government decision on the national governance from 12 January 2012. Environmental performance is reviewed every three years[135] based on the Kyrgyz expertise and statistical data. The Polluter Pays Principle prevails. The inspectors have the right to take decisions, assess situations and propose improvements. Table 6.5 presents data on emissions, compliance and penalties for non-compliance.

[133] National Council for Sustainable Development of the Kyrgyz Republic, National Sustainable Development Strategy for the Kyrgyz Republic For the period of 2013-2017, undated, p.49
[134] Resolution of the Kyrgyz Government, Concept of scientific and innovative development of the Kyrgyz Republic up to 2022, 15-02-2017.
[135] www.aarhus.kg

Table 6.5. Indicators of enforcement of existing regulations

	2011	2012	2013	2014	2015
Number emittors of fine particles	1,111	454	300	161	127
percent found non-compliant	90%	74%	48%	98%	98%
Average penalty USD	7	15	22	58	52
Number of inspected water users and treatment plants	681	445	552	175	198
percent found non-compliant	69%	32%	26%	73%	n.a.
average penalty USD	8	8	16	53	46

The number of controls of installations has decreased. Where controls have been performed, compliance with emission limits has been found to be generally weak. However, the average penalty for non-compliance has been increased sharply in recent years, although even at the increased levels, they do not seem to have a significant deterrence effect.

The State Inspectorate has specified the number of administrative penalties and compensation payments for environmental damages in 2016. This is summarized in Table 6.6.

Table 6.6. Administrative penalties and compensation payments for environmental damage, 2016

	Administrative penalties			Compensation payments for environmental damage		
	handed down	payments received w/in one year	effectiveness	handed down	payments received w/in one year	effectiveness
Number	1,558	1,398	90%	712	625	88%
USD	58,343	51,925	89%	58,343	51,925	89%
Cost per issue	37	37		82	83	

Source: Gosudarstwiennaia sluzhba intellektualnoi cobstwienosti i innowacii pri Prawitielstwie Kirgijskoj Republiki, 07/1516.

The number of administrative penalties and compensation payments for environmental damages has increased along with higher penalties and compensation payments. The costs per issue remain low at an average of USD 37 respectively USD 83 per issue. But close to 90 percent of all penalties and compensation payments are received within one year, which is a good performance by international standards.

International cooperation on environmental sustainability

Kyrgyzstan is being supported by a few foreign economic cooperation agencies in its efforts to improve environmental sustainability. The Swiss Development Agency supports some projects on climate change resilience, energy efficiency and solar water boilers because heat is more expensive than electricity, e.g. for barber shops. Together with the German Development Bank

KfW it has introduced grants schemes, support of credits for green farms, water and waste services. The German Development Corporation GIZ cooperates mainly with the state agencies and increasingly with business associations. It has recently started with capacity building in cleaner technologies, although it has been operating for about fifteen years in the Kyrgyz Republic. The European Bank on Reconstruction and Development approved a Green Strategy in 2015, which envisaged 40% of its portfolio in projects aiming at green growth - it is already above 60% - and each investment project must pass the environmental due diligence and if necessary, experts assess what improvement should be demanded.

6.4 Recommendations

Kyrgyzstan, like other transition economies, faces significant gaps in the pursuit of sustainable development. Given the available fiscal and human resources, it will be necessary to prioritize among the various Goals in the UN 2030 Agenda for Sustainable Development. At the same time, it is clear that the cost of inaction would be high. Fortunately, the country has considerable potential for sustainable development based in particular on relatively large sources of renewable energy, as well as on relatively skilled and affordable labor. But this potential is under threat from inefficient and unsustainable practices in both industry and agriculture. Proven innovative solutions exist, but the international experience shows that businesses and consumers are unlikely to develop and adopt them rapidly and at scale, unless Government provides the right enabling framework, incentives and support.

Recommendation 6.1

Businesses will not incur the financial expense and the risk of innovation in areas critical for sustainable development if there is no market demand for the resulting sustainable products, services and production processes. Government policy can play a key role in stimulating demand from domestic businesses and consumers. Government can also be a direct source of demand in its role as a customer procuring innovative sustainable goods and services from the business sector. This market shaping or market creating role of Government is critical to provide a clear medium-term frame of reference for innovators and investors. The authorities could consider the following measures:

- Mainstream sustainability into primary, secondary and higher education in order to raise the awareness of the population about sustainability issues, thereby preparing the ground for consumer demand for innovative sustainable products. The United Nations Economic Commission for Europe for instance has a programme on Education for Sustainable Development which develops and disseminates international good practices in this regard. This requires training of teachers on sustainable development issues and the development and updating of relevant teaching materials.
- Define sector-specific targets for environmental performance to be reached within e.g. ten years. Different targets should be set for different sectors, including industry, construction - including commercial and residential buildings - agriculture, mining, tourism, and transport – including public and private individual transport.
- The targets should cover efficient resource use and reductions of negative environmental impacts.
- Create a nation-wide system of monitoring of progress towards these targets using key performance indicators. The results of the monitoring should be used to adjust targets and supporting policies as necessary over time.

- Promote the development and adoption of voluntary standards and labels for energy efficiency, emissions of pollutants, and recycling. These standards and labels could be developed in cooperation between the Government and producer and professional associations. This should also include the development of independent certification processes for Kyrgyz producers.
- Where necessary, complement targets and standards with mandatory regulations, including monetary penalties for non-compliance and liabilities for damages to the environment.
- Integrate these standards and targets in all Government procurement programs. Sustainability should be made a criterion used alongside more traditional criteria such as price and quality to select vendors.

Recommendation 6.2

The domestic market of Kyrgyzstan is relatively small. Moreover, domestic demand for sustainable products and services may also be limited by the current level of economic development and per-capita incomes. In order to stimulate investments in innovative sustainable production processes, it is therefore also important to target demand from international markets. Government can play a key role in facilitating this. The authorities could consider the following measures:

- Facilitate the adoption by Kyrgyz producers of existing international standards and eco-labels. As in the case of voluntary national standards, the Governments can support compliance by facilitating the access of Kyrgyz producers to internationally recognized testing and certification services.
- Create international promotion campaigns raising awareness abroad about sustainable products from Kyrgyzstan on the basis of internationally recognized standards and labels.
- Work with the nascent tourism industry to develop eco-branding and to promote Kyrgyzstan as a destination for sustainable tourism.
- Facilitate the participation of Kyrgyz companies with sustainable products and production processes in foreign trade fairs.

Recommendation 6.3

Shaping and creating markets for innovative sustainable products, services and production processes also requires innovative approaches to policy making. Moreover, it places additional demands on the capabilities of Government agencies to implement these policies. It is therefore necessary to invest in the skills of civil servants tasked with developing and implementing policies in this area. The authorities may want to consider:

- Further mainstreaming sustainable development into the curricula of the Academy for Public Administration.
- Creating programmes for civil servants and policy makers to participate in international exchanges of experience with their peers on policies, laws, and regulations promoting innovation for sustainable development and their implementation.
- Creating platforms for dialogue between Government implementing agencies and producers and consumers affected by policies and regulations aiming to facilitate the

development and adoption of sustainable innovative products, services and production processes.

- This kind of dialogue can be used both during the phase of developing policies and during the implementation phase. It can greatly enhance the quality and effectiveness of policies and their implementation by enhancing transparency and by creating a feedback mechanism through which policies and regulations can be improved over time in light of experience.

Recommendation 6.4

In addition to stimulating the demand for sustainable products and services, the Government also has an important role to play in supporting the supply of innovative solutions to sustainability challenges. Government policy should be calibrated to the level of economic development of the country and should focus on the priority areas which the Kyrgyz Republic has set for itself in its sustainable development strategy. It should support both the development of innovative sustainable products and processes domestically and the adoption and adaptation of innovative solutions from abroad. The authorities may consider the following options:

- Define priority areas for research with potential applications in fields relevant for the national sustainable development strategy of Kyrgyzstan.
- Provide additional dedicated funding for research projects in these areas.
- Encourage the transfer of research results in these areas to industry and their translation into new sustainable products and processes by providing dedicated research funding to universities and academic institutes conditional on co-financing from the private sector.
- Further encourage the participation of Kyrgyz researchers and research institutes in international research networks focused on solving sustainability problems.
- Provide funding for research and development aiming to modernize the traditional know-how in foods, forestry, personal care, textiles, housing.
- Mainstream national sustainable development priorities into foreign direct investment policies by systematically considering the impact of foreign direct investment projects on the sustainable development of the Kyrgyz Republic and facilitating the diffusion of foreign knowledge about new sustainable practices to domestic businesses and workers.

Recommendation 6.5

In order to create appropriate incentives for businesses to invest in the creation of innovative sustainable products, services and business practices, and for consumers and customers to adopt these innovations rapidly and on a broad scale, it is critical for supporting policies to be consistent and for them to reinforce rather than to counteract each other. Policy consistency is especially important because the goal of sustainable development is to achieve several policy goals simultaneously, including economic growth, environmental sustainability and social inclusiveness. This will require policies in very different spheres to be coordinated, including in the social sphere. To enhance policy consistency, the authorities may wish to consider to:

- Gradually remove consumer and producer subsidies for fossil fuels and water use and move towards market prices which reflect the full cost of using these resources, including the negative effects their use may have on the environment and the long-term sustainable development of Kyrgyzstan. By artificially lowering the prices of these resources, these subsidies reduce the incentives for consumers and producers to adopt

more sustainable alternatives. By extension, this reduces the incentives of potential innovators to invest in innovations that would provide these sustainable alternatives.

- Provide additional financial support to poor citizens to cushion the impact of price increases for fuel and utilities. Lessons can be learned in this regard from other countries.
- Review existing subsidies for the introduction of sustainable technologies and products in step with the removal of the above subsidies for non-sustainable ones. As subsidies for non-sustainable products and practices are phased out, and thus counter-productive incentives are diminished, it may become possible to achieve sustainability goals at lower cost by reducing the subsidies for sustainable practices.