Progress in Central Asia is being hampered by the low level of investment in research and development.

Nasibakhon Mukhitidinova

A 'flying machine' on display at the Tashkent Innovation Fair in 2014
Photo: © Nasibakhon Mkhitidinova

14 · Central Asia

Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

Nasibakhon Mukhitdinova

INTRODUCTION

A quick recovery from the global financial crisis

The Central Asian economies have emerged relatively unscathed from the global financial crisis of 2008–2009. Uzbekistan has recorded consistently strong growth over the past decade (over 7%) and Turkmenistan[1] even flirted with growth of 15% (14.7%) in 2011. Although Kyrgyzstan's performance has been more erratic, this phenomenon was visible well before 2008 (Figure 14.1).

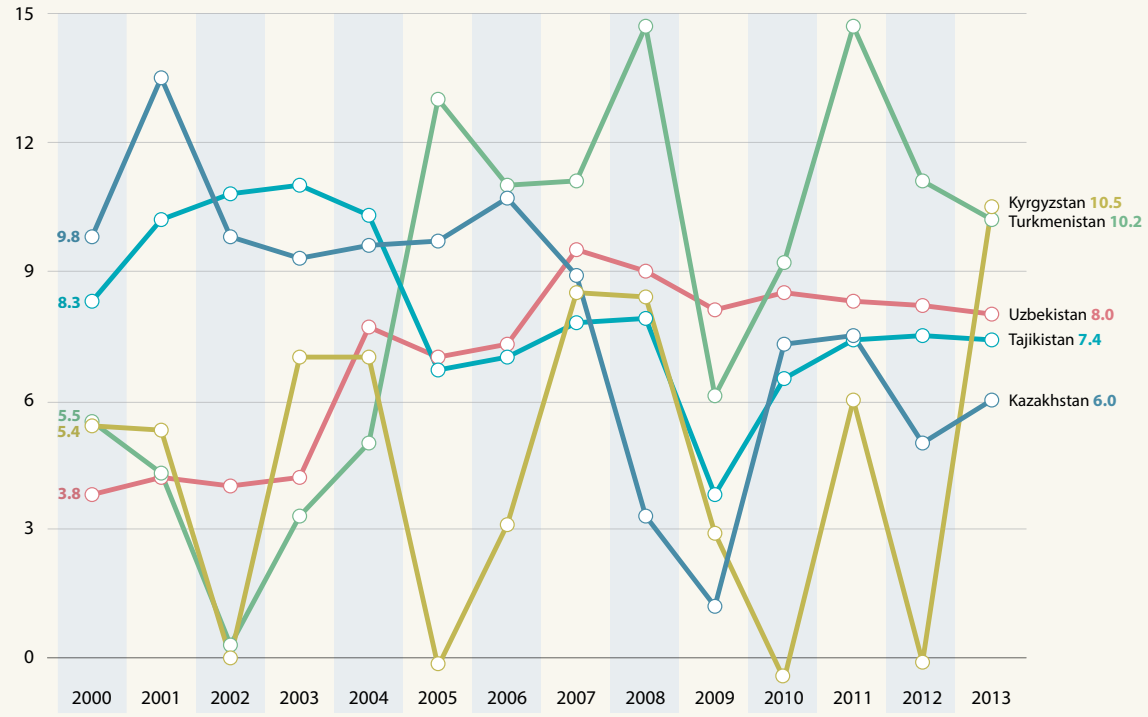
The republics which have fared best have surfed on the wave of the commodities boom. Kazakhstan and Turkmenistan have abundant oil and natural gas reserves and Uzbekistan's own reserves make it more or less self-sufficient. Kyrgyzstan, Tajikistan and Uzbekistan all have gold reserves and Kazakhstan has the world's largest uranium reserves. Fluctuating global demand for cotton, aluminium and other metals (except gold) in recent years has hit Tajikistan hardest, since aluminium and raw cotton are its chief exports – the Tajik Aluminium Company is the country's primary industrial asset. In January 2014, the Minister of Agriculture announced the government's intention to reduce the land cultivated by cotton to make way for other crops. Uzbekistan and Turkmenistan are major cotton exporters themselves, ranking fifth and ninth respectively worldwide for volume.

Although both exports and imports have grown impressively over the past decade, the countries remain vulnerable to economic shocks, owing to their reliance on exports of raw materials, a restricted circle of trading partners and a negligible manufacturing capacity. Kyrgyzstan has the added disadvantage of being considered resource poor, although it does have ample water. Most of its electricity is generated by hydropower.

The Kyrgyz economy was shaken by a series of shocks between 2010 and 2012. In April 2010, President Kurmanbek

1. Turkmenistan had reduced its external debt to just 1.6% of GDP by 2012 (down from 35% in 2002) and Uzbekistan's external debt is just 18.5% of GDP (2012). Kazakhstan's external debt has remained relatively stable at 66% (2012), whereas Tajikistan's external debt has climbed to 51% (up from 36% in 2008) and Kyrgyzstan's remains high at 89%, after dropping to 71% in 2009. Source: Sescric database, accessed July 2014.

Figure 14.1: **GDP growth trends in Central Asia, 2000–2013** (%)



Source: World Bank (2014) *Global Economic Prospects,* Table A1.1, p. 100

Bakiyev was deposed by a popular uprising, with former minister of foreign affairs Roza Otunbayeva assuring the interim presidency until the election of Almazbek Atambayev in November 2011. Food prices rose two years in a row and, in 2012, production at the major Kumtor gold mine fell by 60% after the site was perturbed by geological movements. According to the World Bank, 33.7% of the population was living in absolute poverty in 2010 and 36.8% a year later.

A region of growing strategic importance

Former Soviet states, the Central Asian republics share a common history and culture. Situated at the crossroads of Europe and Asia, rich in mineral resources, they are of growing strategic importance. All five are members of several international bodies, including the Organization for Security and Co-operation in Europe, the Economic Cooperation Organization and the Shanghai Cooperation Organisation.[2]

Moreover, all five republics are members of the Central Asia Regional Economic Cooperation (CAREC) Program, which also includes Afghanistan, Azerbaijan, China, Mongolia and Pakistan. In November 2011, the 10 member countries adopted the *CAREC 2020 Strategy*, a blueprint for furthering regional co-operation. Over the next decade, US$ 50 billion is being invested in priority projects in transport, trade and energy to improve members' competitiveness.[3] The landlocked Central Asian republics are conscious of the need to co-operate in order to maintain and develop their transport networks and energy, communication and irrigation systems. Only Kazakhstan and Turkmenistan border the Caspian Sea and none of the republics has direct access to an ocean, complicating the transport of hydrocarbons, in particular, to world markets.

Kyrgyzstan and Tajikistan have been members of the World Trade Organization since 1998 and 2013 respectively, which Kazakhstan is also keen to join. Uzbekistan and Turkmenistan, on the other hand, have adopted a policy of self-reliance. Symptomatic of this policy is the lesser role played by foreign direct investment. In Uzbekistan, the state controls virtually all strategic sectors of the economy, including agriculture, manufacturing and finance, foreign investors being relegated to less vital sectors like tourism (Stark and Ahrens, 2012).

On 29 May 2014, Kazakhstan signed an agreement with Belarus and the Russian Federation creating the Eurasian Economic Union. They were joined by Armenia in October 2014 and by Kyrgyzstan in December 2014. The Union came into effect on 1 January 2015, four years after the initial Customs Union had removed trade barriers between the three founding countries. Although the agreement focuses on economic co-operation, it includes provision for the free circulation of labour and unified patent regulations, two dispositions which may benefit scientists.[4]

Central Asian snow leopards not for tomorrow

Since gaining independence two decades ago, the republics have gradually been moving from a state-controlled economy to a market economy. The ultimate aim is to emulate the Asian Tigers by becoming the local equivalent, Central Asian snow leopards. However, reform has been deliberately gradual and selective, as governments strive to limit the social cost and ameliorate living standards in a region with a population growing by 1.4% per year on average.

All five countries are implementing structural reforms to improve competitiveness. In particular, they have been modernizing the industrial sector and fostering the development of service industries through business-friendly fiscal policies and other measures, to reduce the share of agriculture in GDP (Figure 14.2). Between 2005 and 2013, the share of agriculture dropped in all but Tajikistan, where it progressed to the detriment of industry. The fastest growth in industry was observed in Turkmenistan, whereas the services sector progressed most in the other four countries.

Public policies pursued by Central Asian governments focus on buffering the political and economic spheres from external shocks. This includes maintaining a trade balance, minimizing public debt and accumulating national reserves. They cannot totally insulate themselves from negative exterior forces, however, such as the persistently weak recovery of global industrial production and international trade since 2008.

According to Spechler (2008), privatization has proceeded fastest in Kazakhstan, with two-thirds of all firms being privately owned by 2006. Prices are almost completely market-based and banking and other financial institutions are much better established than elsewhere in the region. The government can dialogue with private enterprises through Atameken, an association of more than 1 000 enterprises from different sectors, and with foreign investors through the Foreign Investors' Council, set up in 1998. Kazakhstan nevertheless remains attached to state-led capitalism, with state-owned companies remaining dominant in strategic industries. When the global financial crisis hit in 2008, the Kazakh government reacted by stepping up its involvement in the economy, even though it had created a wealth fund, Samruk–Kazyna, the same year to further the privatization of state-controlled businesses (Stark and Ahrens, 2012).

2. See Annex 1 for the membership of international bodies mentioned here, p. 736.

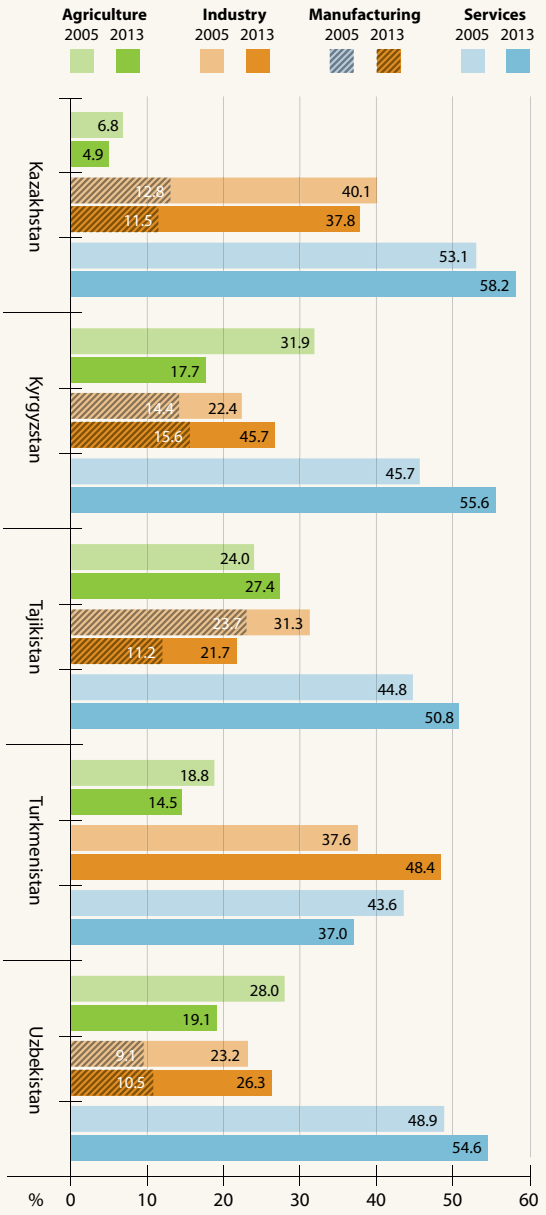
3. CAREC was founded in 1997. It partnered with six multilateral institutions in 2003 to help mainstream regional co-operation in transport, trade and energy, including infrastructure development: the Asian Development Bank (providing the secretariat since 2001); European Bank for Reconstruction and Development; International Monetary Fund; Islamic Development Bank; UNDP and; World Bank.

4. When the Eurasian Economic Union came into effect on 1 January 2015, the Eurasian Economic Community ceased to exist.

High literacy and medium development

Despite high rates of economic growth in recent years, GDP per capita in Central Asia was higher than the average for developing countries only in Kazakhstan in 2013 (PPP$ 23 206) and Turkmenistan (PPP$ 14 201). It dropped to PPP$ 5 167 for Uzbekistan, home to 45% of the region's population, and was even lower for Kyrgyzstan and Tajikistan.

Figure 14.2: **GDP in Central Asia by economic sector, 2005 and 2013** (%)



Note: For Turkmenistan, the most recent data are for 2012.

Source: World Bank's *World Development Indicators,* September 2014

All adult Central Asians are literate and a person born today can expect to live 67.8 years on average. UNDP considers Central Asia as having a medium level of human development. Kazakhstan's ranking in the Human Development Index improved by as much as 13 points between 2009 and 2013, compared to 7 points for Turkmenistan and 5 for Uzbekistan. Kyrgyzstan's ranking actually dropped 5 points.

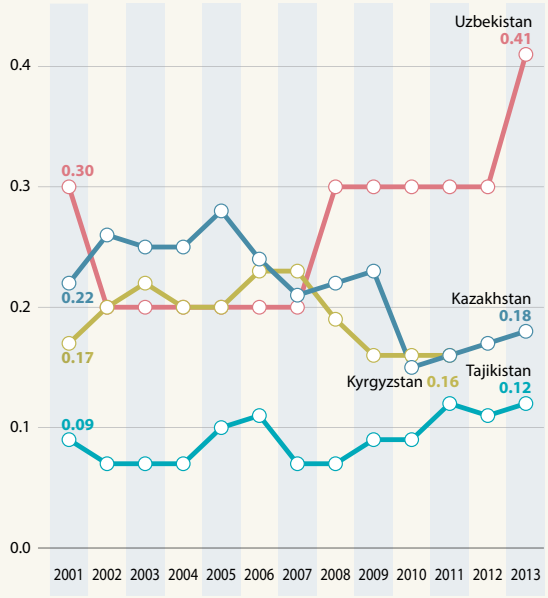
In 2013, the Earth Institute made an effort to measure the extent of happiness in 156 countries. Kazakhs (57th), Turkmens (59th) and Uzbeks (60th) were found to be happier than most, unlike the Kyrgyz (89th) and, above all, Tajiks (125th).

TRENDS IN EDUCATION AND RESEARCH

Persistently low investment in R&D

Common among the Central Asian republics is the persistently low investment in R&D. In the past decade, Kazakhstan and Kyrgyzstan have struggled to maintain gross domestic expenditure on R&D (GERD) at 0.2% of GDP. Uzbekistan's R&D effort intensified in 2013 to 0.4% of GDP (Figure 14.3). Kazakhstan has announced plans to hoist its own GERD/GDP ratio to 1% by 2015 (see p. 373), a target that will be hard to attain as long as annual economic growth remains strong.

Figure 14.3: **Trends in GERD/GDP ratio in Central Asia, 2001–2013**



Note: Data are unavailable for Turkmenistan.

Source: UNESCO Institute for Statistics database, July 2014; for Uzbekistan, Committee for Co-ordination of Science and Technology Development

A focus on university and research infrastructure

The governments of Central Asia have adopted the same policy of gradual, selective reforms when it comes to science and technology (S&T). Only two research institutions opened in the region between 2009 and 2014, bringing the total to 838. Both are situated in Uzbekistan (see p. 386).

The other countries actually halved the number of their research institutions between 2009 and 2013. This is because centres set up during the Soviet period to solve national problems have become obsolete with the development of new technologies and changing national priorities. Kazakhstan and Turkmenistan are both building technology parks and grouping existing institutions to create research hubs. Bolstered by strong economic growth in all but Kyrgyzstan, national development strategies are focusing on nurturing new high-tech industries, pooling resources and orienting the economy towards export markets.

Three universities have been set up in Central Asia in recent years to foster competence in strategic economic areas: Nazarbayev University in Kazakhstan (first student intake in 2011), Inha University in Uzbekistan, specializing in ICTs, and the International Oil and Gas University in Turkmenistan (2014 for both). Countries are not only bent on increasing the efficiency of traditional extractive sectors; they also wish to make greater use of ICTs and other modern technologies to develop the business sector, education and research. Internet access varies widely from one country to another. Whereas every second Kazakh (54%) and one in three Uzbeks (38%) were connected in 2013, this proportion is as low as 23% in Kyrgyzstan, 16% in Tajikistan and just 10% in Turkmenistan.

Box 14.1: **Three neighbourhood schemes**

The following three programmes illustrate how the European Union (EU) and Eurasian Economic Community have been encouraging Central Asian scientists to collaborate with their neighbours.

STI International Cooperation Network for Central Asia (IncoNet CA)

IncoNet CA was launched by the EU in September 2013 to encourage Central Asian countries to participate in research projects within Horizon 2020, the EU's eighth research and innovation funding programme (see Chapter 9). The focus of the research projects is on three societal challenges considered as being of mutual interest to both the EU and Central Asia, namely: climate change, energy and health. IncoNet CA builds on the experience of earlier EU projects which involved other regions, such as Eastern Europe, the South Caucasus and the Western Balkans (see Chapter 12).

IncoNet CA focuses on twinning research facilities in Central Asia and Europe. It involves a consortium of partner institutions from Austria, the Czech Republic, Estonia, Germany, Hungary, Kazakhstan, Kyrgyzstan, Poland, Portugal, Tajikistan, Turkey and Uzbekistan. In May 2014, the EU launched a 24-month call for applications from twinned institutions – universities, companies and research institutes – for funding of up to € 10 000 to enable them to visit one another's facilities to discuss project ideas or prepare joint events like workshops. The total budget within IncoNet CA amounts to € 85 000.

Innovative Biotechnologies Programme

The Innovative Biotechnologies Programme (2011–2015) involves Belarus, Kazakhstan, the Russian Federation and Tajikistan. Within this programme established by the Eurasian Economic Community, prizes are awarded at an annual bio-industry exhibition and conference. In 2012, 86 Russian organizations participated, plus three from Belarus, one from Kazakhstan and three from Tajikistan, as well as two scientific research groups from Germany.

Vladimir Debabov, Scientific Director of the Genetica State Research Institute for Genetics and the Selection of Industrial Micro-organisms in Russia, stressed the paramount importance of developing bio-industry. 'In the world today, there is a strong tendency to switch from petrochemicals to renewable biological sources,' he said. 'Biotechnology is developing two to three times faster than chemicals.'

Centre for Innovative Technologies

The Centre for Innovative Technologies is another project of the Eurasian Economic Community. It came into being on 4 April 2013, with the signing of an agreement between the Russian Venture Company (a government fund of funds), the Kazakh JSC National Agency and the Belarusian Innovative Foundation. Each of the selected projects is entitled to funding of US$ 3–90 million and is implemented within a public–private partnership. The first few approved projects focused on supercomputers, space technologies, medicine, petroleum recycling, nanotechnologies and the ecological use of natural resources. Once these initial projects have spawned viable commercial products, the venture company plans to reinvest the profits in new projects.

The venture company is not a purely economic structure; it has also been designed to promote a common economic space among the three participating countries.

Source: www.inco-ca.net; www.expoforum.ru/en/presscentre/2012/10/546; www.gknt.org.by

All three new universities teach in English and work with partner universities in the USA, Europe or Asia on academic programme design, quality assurance, faculty recruitment and student admissions.

International co-operation is also a strong focus of the research institutes and hubs set up in recent years (Boxes 14.1–14.5). The mandate of these centres reflects a will to adopt a more sustainable approach to environmental management. Centres plan to combine R&D in traditional extractive industries, for instance, with a greater use of renewable energy, particularly solar.

In June 2014, the headquarters of the International Science and Technology Center (ISTC) were moved to Nazarbayev University in Kazakhstan, three years after the Russian Federation announced its withdrawal from the centre. Permanent facilities within the new Science Park at Nazarbayev University should be completed by 2016. ISTC was established in 1992 by the European Union (EU), Japan, the Russian Federation and the USA to engage weapons scientists in civilian R&D projects[5] and to foster technology transfer. ISTC branches have been set up in the following countries party to the agreement: Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan and Tajikistan (Ospanova, 2014).

Countries at different stages of education reform

Kazakhstan devotes less to education (3.1% of GDP in 2009) than either Kyrgyzstan (6.8% in 2011) or Tajikistan (4.0% in 2012) but the needs are greater in the latter two countries, which have lower standards of living. Both Kyrgyzstan and Tajikistan have introduced national strategies to correct such structural weaknesses as ill-equipped schools and universities, inadequate curricula and poorly trained teaching staff.

Kazakhstan has made great strides in improving the quality of education over the past decade. It now plans to generalize quality education by raising the standard of all secondary schools to the level of its Nazarabayev Intellectual Schools by 2020, which foster critical thinking, autonomous research and proficiency in Kazakh, English and Russian. The Kazakh government has also pledged to increase university scholarships by 25% by 2016. The higher education sector performed 31% of GERD in 2013 and employed more than half (54%) of researchers (Figure 14.5). The new Nazarbayev University has been designed as an international research university (see p. 378).

Kazakhstan and Uzbekistan are both generalizing the teaching of foreign languages at school, in order to facilitate international ties. Kazakhstan and Uzbekistan have both adopted the three-tier bachelor's, master's and PhD degree system, in 2007 and 2012 respectively, which is gradually replacing the Soviet system of Candidates and Doctors of Science (Table 14.1). In 2010, Kazakhstan became the only Central Asian member of the Bologna Process, which seeks to harmonize higher education systems in order to create a European Higher Education Area.[6] Several higher education institutions in Kazakhstan (90 of which are private) are members of the European University Association.

5. In the past 20 years, ISTC has provided competitive funding for about 3 000 projects in basic and applied research in energy, agriculture, medicine, materials science, aerospace, physics, etc. Scientists from member countries interact with one another, as well as with international centres such as the European Organization for Nuclear Research (CERN) and with multinationals that include Airbus, Boeing, Hitachi, Samsung, Philips, Shell and General Electric (Ospanova, 2014).

6. Other non-European Union members of the Bologna Process include the Russian Federation (since 2003), Georgia and Ukraine (since 2005). The applications for membership by Belarus and Kyrgyzstan have not been accepted.

Table 14.1: **PhDs obtained in science and engineering in Central Asia, 2013 or closest year**

	PhDs		PhDs in science				PhDs in engineering			
	Total	Women %	Total	Women %	Total per million population	Women PhDs per million population	Total	Women %	Total per million population	Women PhDs per million population
Kazakhstan (2013)	247	51	73	60	4.4	2.7	37	38	2.3	0.9
Kyrgyzstan (2012)	499	63	91	63	16.6	10.4	54	63	—	—
Tajikistan (2012)	331	11	31	—	3.9	—	14	—	—	—
Uzbekistan (2011)	838	42	152	30	5.4	1.6	118	27	—	—

Note: PhD graduates in science cover life sciences, physical sciences, mathematics and statistics, and computing; PhDs in engineering also cover manufacturing and construction. For Central Asia, the generic term of PhD also encompasses Candidate of Science and Doctor of Science degrees. Data are unavailable for Turkmenistan.

Source: UNESCO Institute for Statistics, January 2015

Table 14.2: **Central Asian researchers by field of science and gender, 2013 or closest year**

	Total researchers (HC)				Researchers by field of science (HC)											
					Natural Sciences		Engineering and technology		Medical and health sciences		Agricultural sciences		Social sciences		Humanities	
	Total researchers	Per million pop.	Number of women	Women (%)	Total	Women (%)	Total	Women (%)	Total	Women (%)	Total	Women (%)	Total	Women (%)	Total	Women (%)
Kazakhstan (2013)	17 195	1 046	8 849	51.5	5 091	51.9	4 996	44.7	1 068	69.5	2 150	43.4	1 776	61.0	2 114	57.5
Kyrgyzstan (2011)	2 224	412	961	43.2	593	46.5	567	30.0	393	44.0	212	50.0	154	42.9	259	52.1
Tajikistan (2013)	2 152	262	728	33.8	509	30.3	206	18.0	374	67.6	472	23.5	335	25.7	256	34.0
Uzbekistan (2011)	30 890	1 097	12 639	40.9	6 910	35.3	4 982	30.1	3 659	53.6	1 872	24.8	6 817	41.2	6 650	52.0

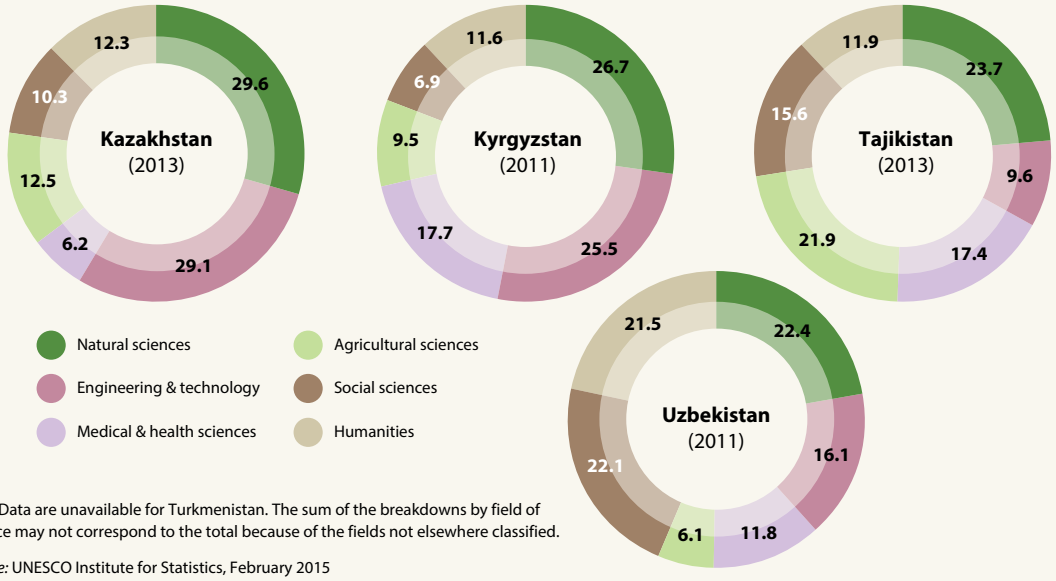
Note: Data are unavailable for Turkmenistan. The sum of the breakdowns by field of science may not correspond to the total because of the fields not elsewhere classified.

Source: UNESCO Institute for Statistics, February 2015

Kazakhstan is the only Central Asian country where the business enterprise and private non-profit sectors make any significant contribution to R&D (Figure 14.5). Uzbekistan is in a particularly vulnerable position, with its heavy reliance on higher education: three-quarters of researchers are employed by the university sector, at a time when many are approaching retirement age and 30% of the younger generation hold no degree qualification at all.

Kazakhstan, Kyrgyzstan and Uzbekistan have all maintained a share of women researchers above 40% since the fall of the Soviet Union. Kazakhstan has even achieved gender parity, with Kazakh women dominating medical and health research and representing some 45–55% of engineering and technology researchers in 2013 (Table 14.2). In Tajikistan, however, only one in three scientists (34%) was a woman in 2013, down from 40% in 2002. Although policies are in place to give Tajik women equal rights and opportunities, these are underfunded and poorly understood (see p. 381). Turkmenistan has offered a state guarantee of equality for women since a law adopted in 2007 but the lack of available data makes it impossible to draw any conclusions as to the law's impact on research.

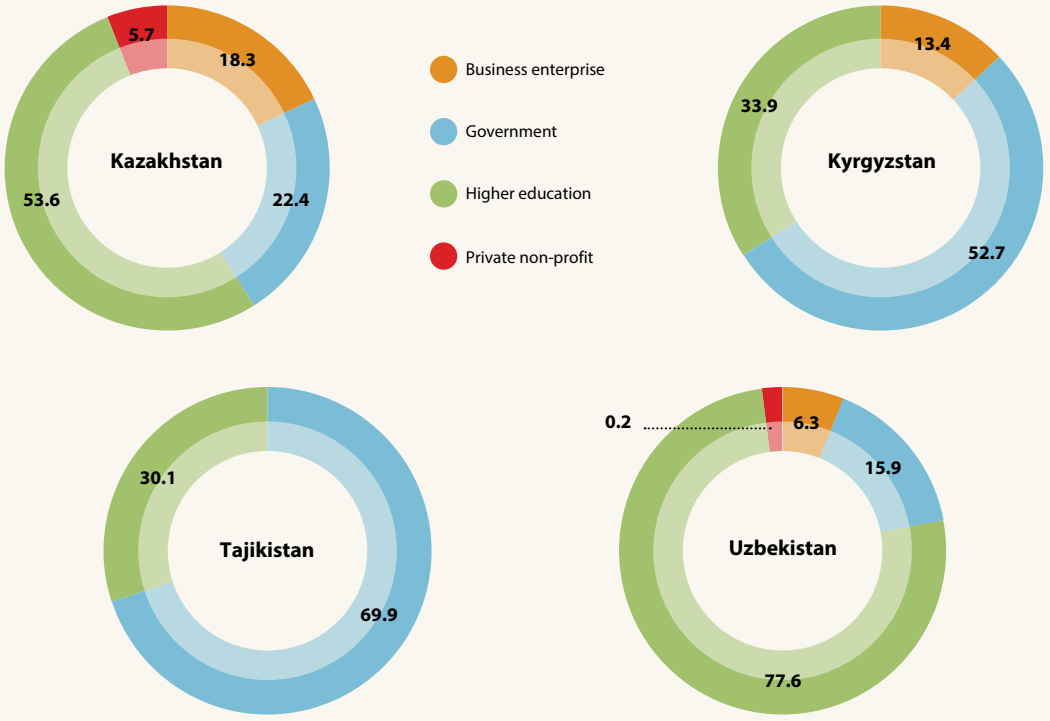
Figure 14.4: Central Asian researchers by field of science, 2013 (%)



Note: Data are unavailable for Turkmenistan. The sum of the breakdowns by field of science may not correspond to the total because of the fields not elsewhere classified.

Source: UNESCO Institute for Statistics, February 2015

Figure 14.5: **Central Asian researchers by sector of employment (HC), 2013** (%)



Note: For Kyrgyzstan and Uzbekistan, the most recent data are for 2011. Data are unavailable for Turkmenistan.

Source: UNESCO Institute for Statistics, February 2015

Kazakhstan leads the region for scientific productivity

Despite persistently low investment in R&D among the Central Asian republics, national development strategies are nonetheless focusing on developing knowledge economies and new high-tech industries. Trends in scientific productivity are useful indicators of whether these strategies are having an impact or not. As Figure 14.6 shows, the number of scientific papers published in Central Asia grew by almost 50% between 2005 and 2013, driven by Kazakhstan, which overtook Uzbekistan over this period. Kazakhstan and Uzbekistan both specialize in physics, followed by chemistry, which also happens to be Tajikistan's speciality. Kyrgyzstan, on the other hand, publishes most in geosciences and Turkmenistan most in mathematics. Articles related to agriculture trail far behind and are almost non-existent in computer sciences.

Of note are the strong international ties of Central Asian scientists – but not with each other. At least two out of every three articles were co-authored by foreign partners in 2013. The biggest change has occurred in Kazakhstan, suggesting that international partnerships have driven the steep rise in Kazakh publications recorded in the Science Citation Index since 2008. The three main partners of Central Asian scientists are based in the Russian Federation, Germany and the USA, in that order. Kyrgyz scientists are the only ones who publish a sizeable share of their articles with their peers from another Central Asian country, namely Kazakhstan.

The number of patents registered at the US Patent and Trademark Office is minimal. Kazakh inventors were granted just five patents by this office between 2008 and 2013 and Uzbek inventors three. No patents at all were recorded for the other three Central Asian republics.

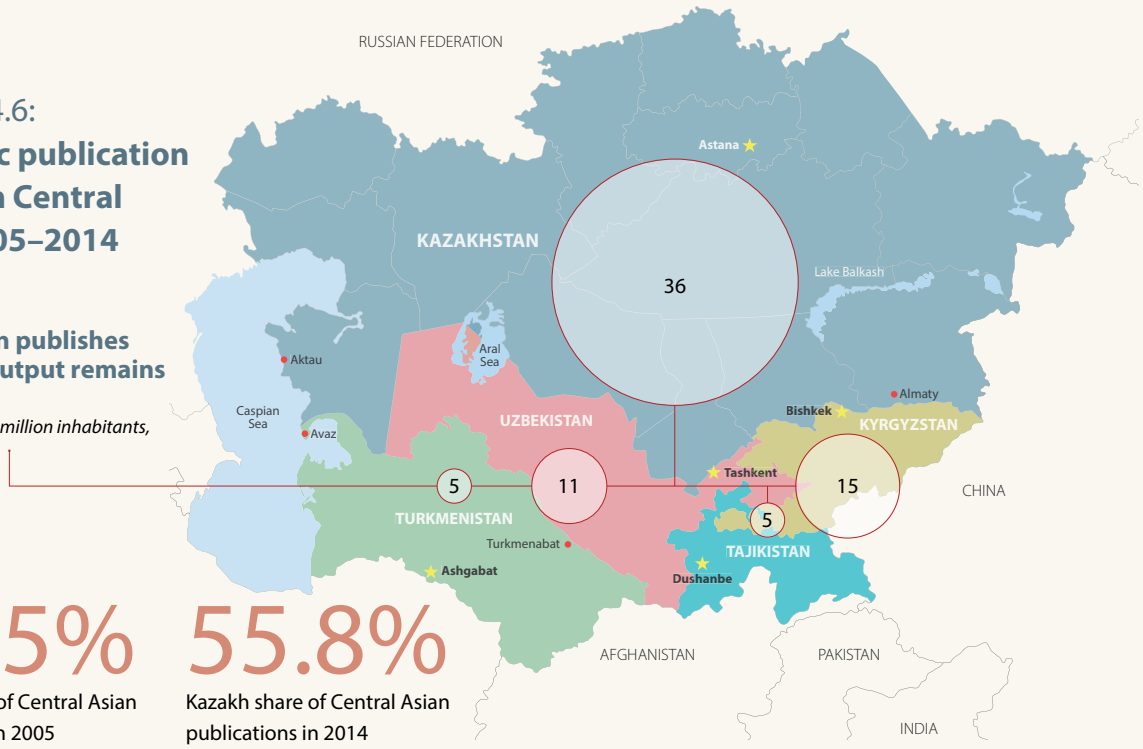
Kazakhstan is Central Asia's main trader in high-tech products. Kazakh imports nearly doubled between 2008 and 2013, from US$ 2.7 billion to US$ 5.1 billion. There has been a surge in imports of computers, electronics and telecommunications; these products represented an investment of US$ 744 million in 2008 and US$ 2.6 billion five years later. The growth in exports was more gradual – from US$ 2.3 billion to US$ 3.1 billion – and dominated by chemical products (other than pharmaceuticals), which represented two-thirds of exports in 2008 (US$ 1.5 billion) and 83% (US$ 2.6 billion) five years later.

Figure 14.6:

Scientific publication trends in Central Asia, 2005–2014

Kazakhstan publishes most but output remains modest

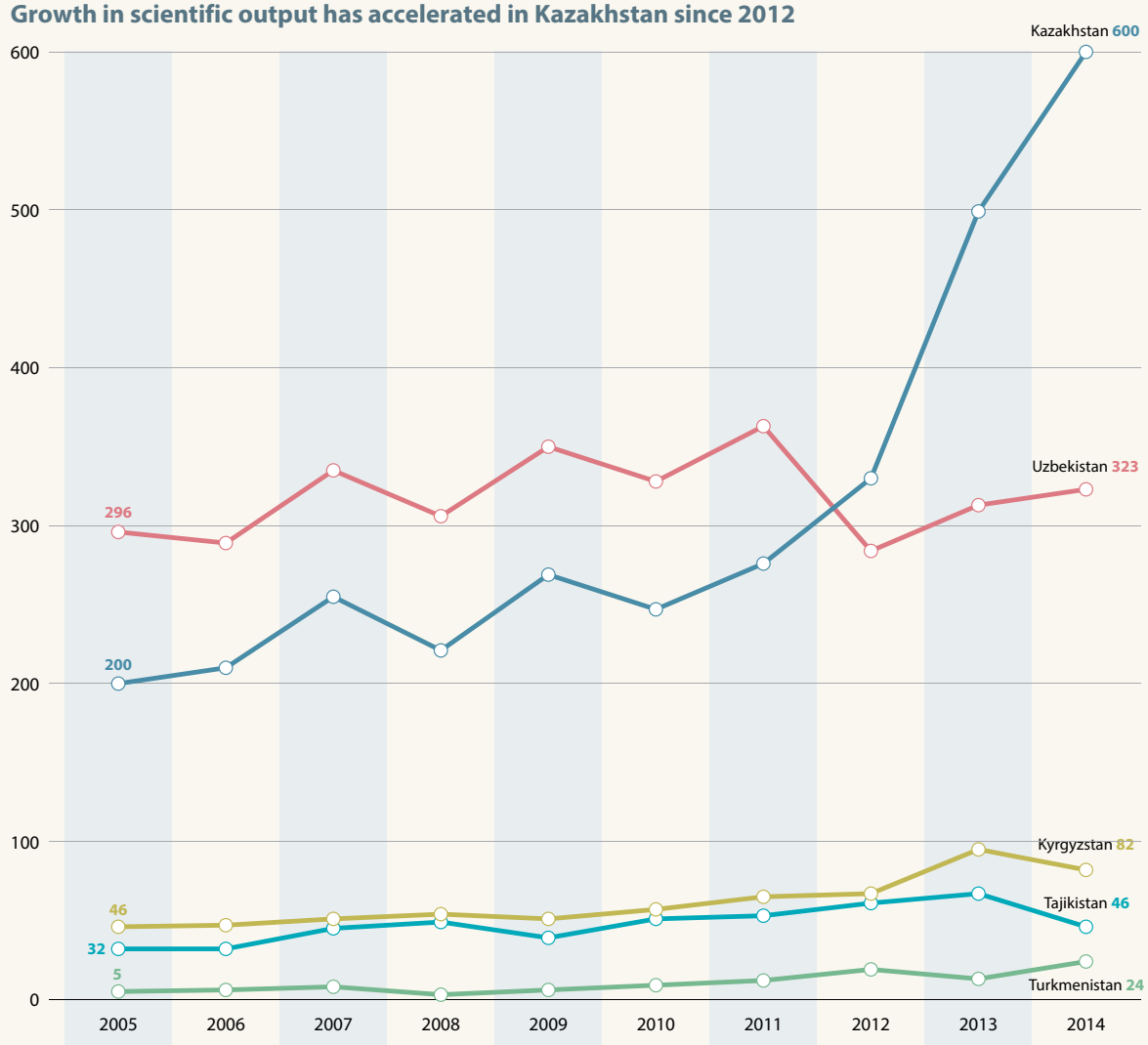
Publications per million inhabitants, 2014



34.5%
Kazakh share of Central Asian publications in 2005

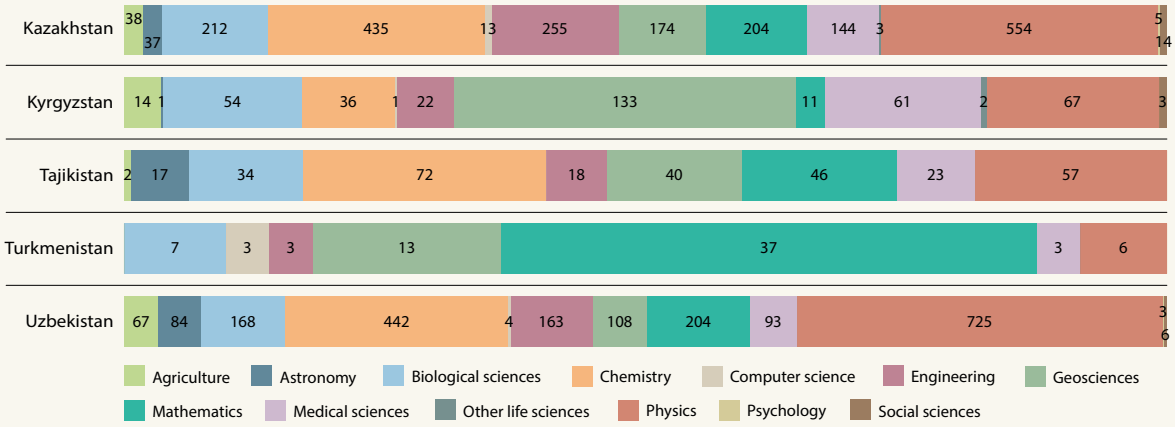
55.8%
Kazakh share of Central Asian publications in 2014

Growth in scientific output has accelerated in Kazakhstan since 2012



The most prolific countries – Kazakhstan and Uzbekistan – specialize in physics and chemistry

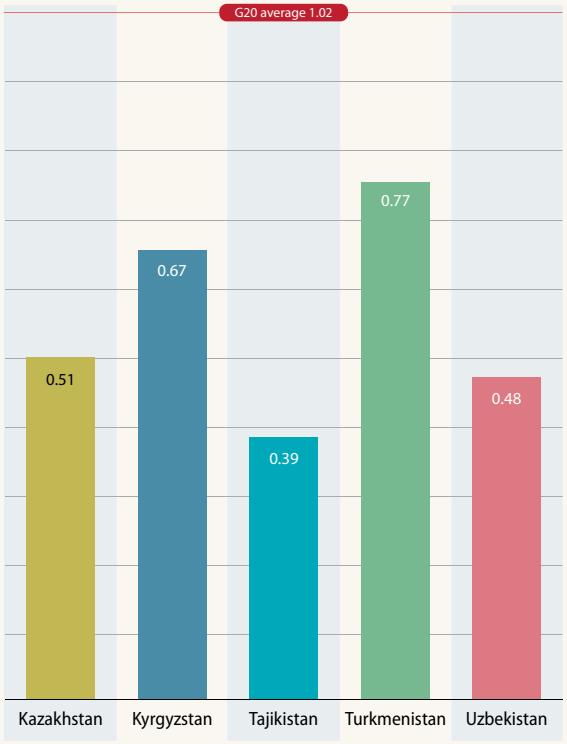
Cumulative totals by field, 2008–2014



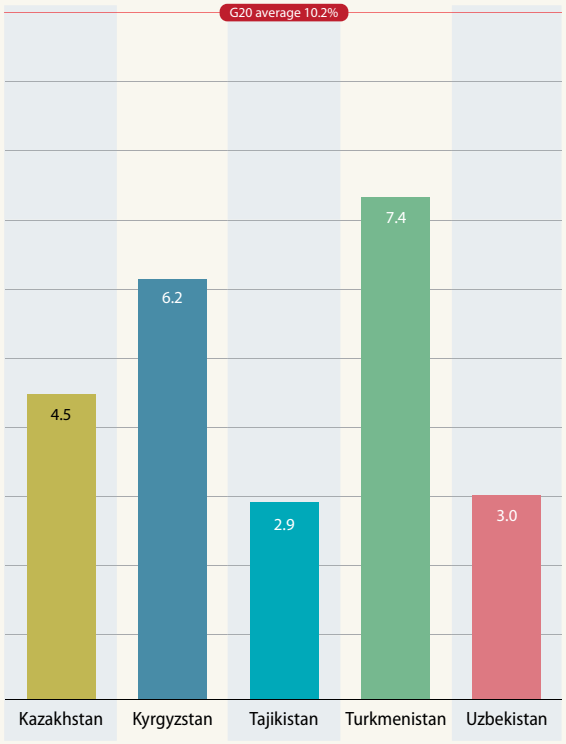
Note: Totals exclude unclassified articles.

The average citation rate is low

Average citation rate for publications, 2008–2012



Share of publications among 10% most cited, 2008–2012 (%)



The Russian Federation, Germany and the USA are the region's top partners

Main foreign partners, 2008–2014 (number of papers)

	1st collaborator	2nd collaborator	3rd collaborator	4th collaborator	5th collaborator
Kazakhstan	Russian Fed. (565)	USA (329)	Germany (240)	UK (182)	Japan (150)
Kyrgyzstan	Russian Fed. (99)	Turkey/Germany (74)		USA (56)	Kazakhstan (43)
Tajikistan	Pakistan (68)	Russian Fed. (58)	USA (46)	Germany (26)	UK (20)
Turkmenistan	Turkey (50)	Russian Fed. (11)	USA/Italy (6)		China/Germany (4)
Uzbekistan	Russian Fed. (326)	Germany (258)	USA (198)	Italy (131)	Spain (101)

Source: Thomson Reuters' Web of Science, Science Citation Index Expanded; data treatment by Science–Metrix