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PATENTING IN KAZAKHSTAN

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ABSTRACT (ITALIANO)

Lo scopo principale di questa tesi è quello di presentare un'analisi empirica dello sviluppo di brevetti internazionali in Kazakistan nei tre maggiori uffici brevetti mondiali: l'USPTO, l'EPO, e il CNIPA. Da essi sono stati raccolti i dati relative alle domande di brevetto che includono la partecipazione di almeno un inventore residente in Kazakistan. Inoltre per identificare le famiglie di brevetti, sono state usate risorse su copertura globale. L'analisi valuta l'attività innovativa da parte di diversi richiedenti, le collaborazioni internazionali degli inventori e la partecipazione femminile.

I risultati mostrano una prevalenza di richiedenti locali (singoli individui in particolare). I richiedenti stranieri fanno parte principalmente di aziende commerciali. La maggior parte dei richiedenti stranieri ha richiesto protezione del brevetto solo all' USPTO, mentre i richiedenti locali generalmente hanno richesto protezione del prodotto anche all'EPO o persino ai tutti e tre gli uffici brevetti mondiali. Gran parte delle collaborazioni internazionali è avvenuta in combinazione con richiedenti stranieri. Meno di un terzo delle richieste prese in analisi hanno incluso partecipanti donne. Nonostante ciò, in media la partecipazione femminile rimane vicina alla media mondiale.

ABSTRACT

The main purpose of this thesis is to perform an empirical analysis of the international patenting activity of Kazakhstan in three of the largest world patent offices – the USPTO, the EPO and the CNIPA. The data of patent applications with the participation of at least one inventor residing in Kazakhstan was retrieved from these patent offices' databases. Additionally, resources with worldwide coverage were used for identifying patent families. The analysis assesses the patenting activity of different types of applicants, the international collaborations of inventors and the woman participation.

The analysis showed the prevalence of domestic applicants (individuals in particular) among the sample. Foreign applicants are represented mostly by business companies. The largest part of foreign applicants applied for patent protection to the USPTO only, however, national applicants tended to submit their inventions also to the EPO, and even to all the three patent offices. Most international collaborations occurred in the set of foreign applicants. Less than a third of all applications in the sample included a woman inventor. However, the average participation rate of women is close to the average world figure.

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ACRONYMS AND ABBREVIATIONS

AIA	The Leahy-Smith America Invents Act
CIS	Commonwealth of Independent States
CITIC	China International Trust Investment Corporation
CNIPA	National Intellectual Property Administration of the People's Republic of China
CNPC	China National Petroleum Corporation
EPO	European Patent Office
FDI	Foreign direct investment
GERD	Gross Expenditure in Research and Development
GII	Global Innovation Index
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IP	Intellectual Property
IPC	International Patent Classification
IPR	Intellectual Property Right
IT	Information Technology
JPO	Japan Patent Office
KIPO	Korean Intellectual Property Office

KZT	Kazakhstani Tenge (currency)
NIIP	National Institute of Intellectual Property
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
PPP	Purchasing Power Parity
R&D	Research and Development
SINOPEC	China Petroleum & Chemical Corporation
SMEs	Small and medium-sized enterprises
SPEs	Special Purpose Entities
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization
WTO	World Trade Organization

1. INTRODUCTION

New technologies are crucial for long-term economic growth. Therefore, development in science and technology determines the competitiveness of a country and its economic development. Dernis et al. (2015), among others, have stressed that innovation and technological progress lead to more efficient use of labour and capital inputs, thereby boosting productivity.

Development of technological innovations increases the role of research and development (R&D) and intellectual property (IP). Investment in R&D contributes to innovation development and the absorption of external knowledge. Patenting aims to promote innovation in any technological field. Intellectual property rights (IPRs) help to protect innovations and better appropriate economic returns.

Countries, which want to maintain and increase their competitiveness in the global market, have to innovate continuously because knowledge is a cumulative process. Companies need a good absorptive capacity to acquire new knowledge and build innovative skills to go along with the international competition. IPRs are important for competitiveness. On the other hand, firms can use the public information related to patents and other IPRs to investigate the performance of their competitors and improve their own.

This thesis examines the innovative performance of the Republic of Kazakhstan.

Since its independence from the USSR, Kazakhstan has experienced remarkable rates of economic growth mainly thanks to the availability of natural resources, especially oil and gas. Nowadays, it has an ambitious plan to be in the 30 most developed countries in the world by 2050. To achieve this goal, Kazakhstan has to diversify its economy to avoid excess leverage on natural endowments. Currently, the decline in the international price of commodities has a negative impact on the country's income. It is important to promote innovative development so as to reach economic sustainability in the long term.

According to the Global Innovation Index, in 2019 Kazakhstan ranked 79th out of 129 countries and 3rd in the Central and Southern Asia region, after India and Iran. However, the same index shows that there is a big gap between innovation inputs and outputs. Indeed, Kazakhstan ranked 64th in terms of investments made in innovative development, while only 92nd when looking at the results of innovation (see Cornell University, INSEAD, and WIPO, 2019).

Along with providing an overview of R&D expenditures and other innovation-related indicators, the thesis is mainly devoted to an in-depth analysis of the trends and development of international patenting activity in Kazakhstan. For this purpose, we collected the patent applications including Kazakhstani inventors that have been filed, from 1997 to 2019, to the foreign patent offices of major relevance: the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the National Intellectual Property Administration

of the People's Republic of China (CNIPA). The rationale for using international rather than national patent applications is that the inventions that have sought patent protection in different foreign countries are assumed to be of greater importance and value. By elaborating the information coming from these patent applications we were able to address some relevant research questions, such as:

- How many patent applications were filed to the participation of at least one inventor residing in Kazakhstan?
- How did the trend develop over time?
- In which technological fields the largest number of applications is concentrated?
- How do patent applications filed by foreign applicants differ from those filed by domestic applicants?
- To what extent do Kazakhstani inventors cooperate with foreign inventors?
- How much do Kazakhstani women inventors contribute to international patenting activity?

The analysis showed the prevalence of domestic applicants among the sample. National applicants mostly resulted to be individuals, while foreign applicants are mainly represented by business companies. The biggest share of foreign applicants applied for patent protection to the USPTO only, then followed by those filed to both the USPTO and the EPO. However, national applicants tended

to submit their inventions not only to the USPTO, but also to the EPO, and even to all the three patent offices. Most international collaborations occurred in the set of foreign applicants. More and more Kazakhstani women took part in the developing of inventions filed internationally. However, the average participation rate remained small, yet close to the average world figure.

This thesis is divided into 4 Chapters. Chapter 2 illustrates the economic and legal basis of patenting activities and describes the worldwide trends of patent applications. Chapter 3 reviews the literature related to the innovation activities and IPRs in Kazakhstan. Moreover, along with patenting activities, it provides an overview of the R&D and the inward foreign direct investments in the country. Chapter 4 illustrates the data and information taken from the international patent applications including Kazakhstani inventors, the methods used for the empirical analysis and the results that have been achieved. Finally, concluding remarks and policy considerations are contained in Chapter 5.

2. PATENTING ACTIVITIES: CONCEPTS AND PROCEDURES

2.1 Basic definitions

The OECD (2015: 8) states that "IPRs are exclusive rights held by the owners of a variety of knowledge-based assets that qualify for legal protection under applicable intellectual property laws". There are different types of IPRs: copyright, patents, design rights, trademarks, and geographical indications.

The term invention refers to a new to the world technical solution (product, method or process) to a specific problem in a specific technological field. It may be an improvement of a known product or method for a new purpose or a new process for creating an object or a new product for a given purpose. An invention can be patented if it is novel, not obvious and useful (i.e. susceptible of industrial application).[1]

A patent granted by the government provides the inventor with a temporary monopoly in exchange for the full public disclosure of the invention (Gibbs and DeMatteis 2003). A patent is a public document, which describes in detail an invention and fully discloses the technical knowledge behind the invention, so that

[1] According to the European Patent Convention, the following items cannot be patented: scientific theories and mathematical methods; aesthetic creations; presentations of information; schemes, rules and methods for performing mental acts, playing games or doing business, software for computers.

other “experts in the art” can replicate it. A patent grants the right to exclude anyone else from the exploitation (making, selling, using, or importing) of an invention for a stated number of years (WIPO 2004).

The process of obtaining a patent is long and expensive. Moreover, patents are often associated with undesirable lawsuits, when competitors may try to invalidate a patent or in order to sue alleged infringers. However, valuable patents are classified as long-term intangible assets. If patents have a high value, they can be sold upon the valuation of their worth or, alternatively, the patent holder can earn revenues by selling licenses. Thus, the owner should be responsible to manage, develop, and properly exploit patents to gain the maximum benefits.

The period for which the monopolistic right was granted to an inventor is generally 20 years after the filing date. Eventually the patent expires, and the owner no longer retains exclusive rights regarding its use. Therefore, the invention falls into the public domain, so that anyone can make, sell or import it.

The purpose of the patenting is to encourage invention and technical progress since patents can enable further technological developments through the information they disclose. According to OECD (2015: 8), “the economic rationale for IPRs is that it is in everyone’s long-term interest for people and businesses that create knowledge to have well-defined, enforceable rights to exclude third parties from appropriating their ideas, or the expression of their ideas, without permission”. Creating, developing and licensing new patented ideas can be an

effective way for businesses to protect new product launches, gain additional profits, and secure their future (Gibbs and DeMatteis 2003).

2.2 Patent procedures

According to the World Intellectual Property Organization (WIPO), a patent is granted by a national patent office of a country or by a regional office that operates for several countries. There are five regional patent offices: African Intellectual Property Organization (OAPI), African Regional Intellectual Property Organization (ARIPO), European Patent Office (EPO), Patent Office of the Cooperation Council for the Arab States of the Gulf (GCC Patent Office) and Eurasian Patent Organization (EAPO). If an inventor seeks to obtain patent protection in many countries around the world simultaneously, she can file an international application under the Patent Cooperation Treaty (PCT).

To obtain patent protection an inventor has to file an application. If she applies for a patent in a national patent office only, the patent will be valid only in the country where it is granted. The regional offices make it possible to apply for invention protection in one or more member states of the regional organization.

In the patent application, an inventor must provide the title of an invention, the related technical fields and a summary. Also, the inventor must describe the invention in details and clear language as well as its backgrounds (previous patented inventions or scientific literature); such a description is usually

accompanied by visual materials such as drawings, plans, or diagrams. The "claims" part of the patent application defines the specific items for which patent protection is sought. Additional supporting documents may be required depending on the patent office. In principle, applicants may prepare and file their patent applications on their own, but most of the time, due to the complexity of patent documents, they resort to the services of patent attorneys.

2.2.1 The cases of EPO, USPTO and CNIPA

The data used for the empirical analysis presented in Chapter 4 were collected from the EPO, USPTO and CNIPA. Therefore, in this section, the focus is on the procedures adopted by these patent offices. Practically they are considerably similar, but there are differences in some details (for example, fees and the time lag between stages). Figure 1 shows a simplified view of the major phases of their procedures.

After filing a patent application, these offices examine them for novelty, inventive step, and industrial applicability. At the EPO, the examination process consists of two phases: Extended Search (conducted to establish the state of the art concerning the invention) and Substantive Examination (provide an evaluation of the inventive step and industrial applicability). To convey a Substantive Examination, an applicant has to make a separate request within the six months after publication of the search report. If no request for examination is filed to the

EPO within the prescribed period, the application will be deemed to have been withdrawn (EPO, JPO, KIPO, CNIPA, and USPTO 2018, IP5 Statistics Report 2017).

In the CNIPA and the USPTO, the examination process is undertaken in one phase. At the USPTO, filing of a patent application implies an immediate request for examination. Conversely, at the CNIPA, filing of a national application does not imply it. In this case, a request for examination can be made no later than three years after filing an application, otherwise, the application will be deemed to have been withdrawn.

In all three patent offices, the application has to be published up to 18 months after the earliest priority date. It can be published earlier if the applicant makes a respective request.

After the examination of a patent application, the information about the intention to grant a patent or reject the application is communicated to the applicant. In the latter case, the applicant may make amendments to the application (generally in the claims). Then the examination is resumed. This stage can be repeated as long as the applicant continues to make appropriate amendments until the patent is granted, or the application is finally refused. In all three patent offices' procedures, an applicant can withdraw the application at any point in time before the application is granted or rejected. After the decision to grant the patent, the

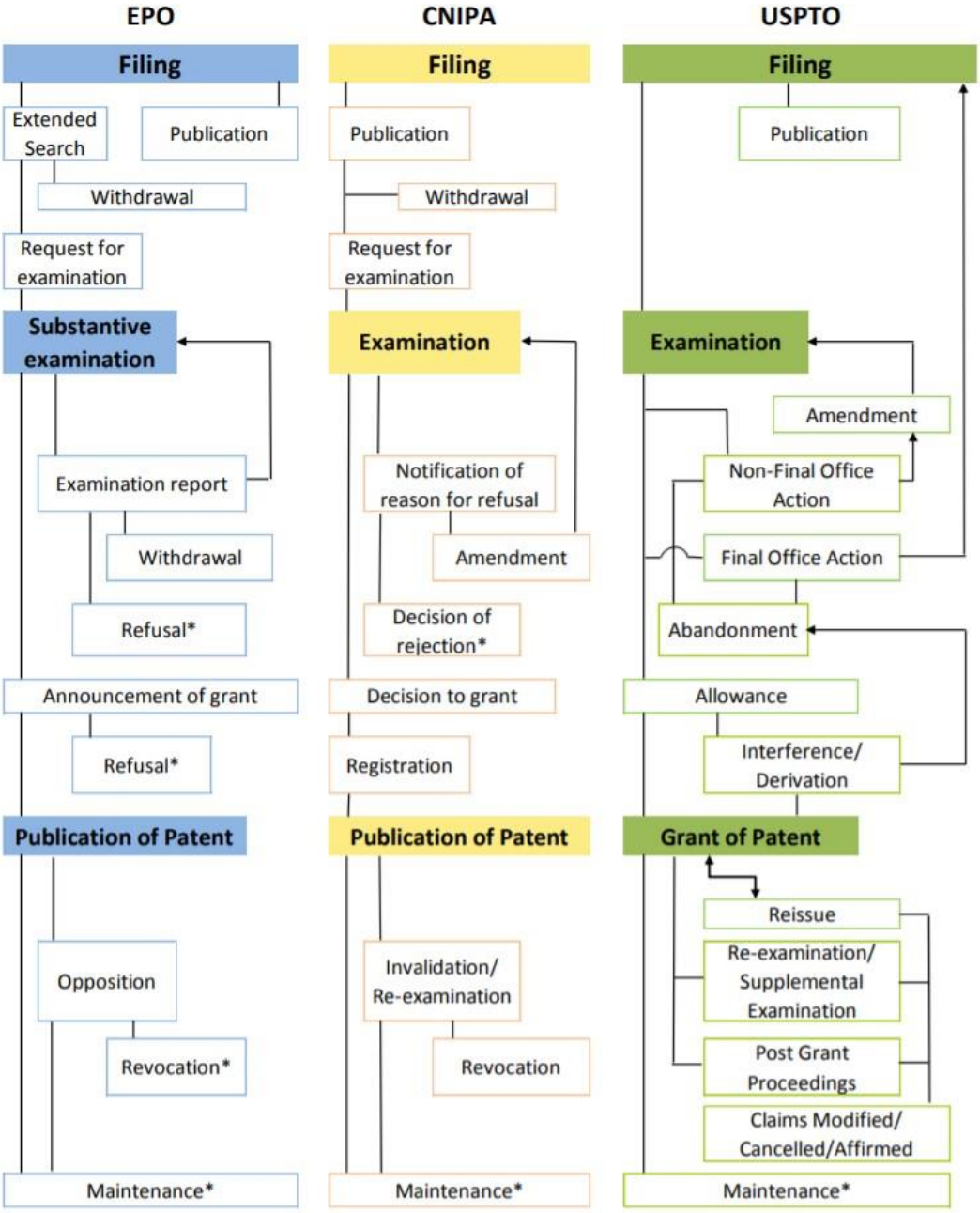
patent is published. The patents granted by the EPO must be validated in the member countries where the applicant is seeking patent protection.

At the EPO within nine months after granting of the patents, a patent opposition can be filed by any third party against a decision to grant a patent. If the opposition is not rejected, it can lead to a patent revocation or patent amendments (changes or reduction of claims).

Figure 1 shows that at the USPTO, there are two types of opposition procedures: Re-examination / Supplemental Examination and Post Grant Proceedings. In fact, in 2012 under The Leahy-Smith America Invents Act (AIA) additional procedures were introduced. Nowadays, there are six distinct procedures for third party opposition: post-grant review, inter parte review, business method review, ex parte re-examination, interference, and derivation.

Similar procedures are adopted by the CNIPA too. Any party, which does not agree with a decision of the patent office can file an appeal. For instance, applicants can appeal the decisions to revoke a patent. The CNIPA has Invalidation / Re-examination procedure. In the case of rejecting the patent application, the applicant may ask to make a re-examination. Any party, which considers that the grant of a patent right does not comply with the Patent Law, may make a request for invalidation of the patent right.

Figure 1. Patent procedures of EPO, CNIPA and USPTO



* Decision may be appealed

Source: EPO, JPO, KIPO, CNIPA, and USPTO (2018), IP5 Statistics Report 2017.

2.2.2 The PCT procedure

To protect an invention from infringers or imitators in today's global economy, an inventor needs patent protection in the entire world. Every country has its own legal procedures regarding IPRs and the foreign inventors have to comply with them. To file a patent application in each country of interest would require a large investment to meet the costs due to filing fees, translation charges and attorney fees (Vepachedu 2004). The PCT procedure enables an inventor to file for a single international patent in as many countries as she wishes, provided the countries are signatories to the Patent Cooperation Treaty (Cook 2002).

PCT came into force in 1978. All activities related to PCT are coordinated by WIPO located in Geneva. Nowadays, the PCT has 153 Contracting States. The PCT gives to inventors an alternative route to submitting patent applications simultaneously in the patent offices of all member countries and obtain priority for their inventions, without having to submit separate application in the countries of interest. PCT helps patent offices to make decisions about granting a patent and facilitates access to technical information regarding inventions (Vepachedu 2004).

According to "The PCT Applicant's Guide" issued by WIPO (2020), the PCT procedure consists of two main phases: international phase and national phase. It starts with the international phase, which includes filing an international application, international search and international publication.

Within 12 months from the date of filing of the first patent application, the inventor can file an international application under the PCT to the national or regional patent office or to the WIPO. This must comply with the PCT formality requirements. The application has to be filed in one single language, and the applicant should pay one set of fees (WIPO 2017). The country of origin is defined as the country of the inventor. If in one application there is more than one inventor, the application is divided equally between all of them and subsequently among their countries of residence. Then, the patent application is processed by the "Receiving Office".

The second stage involves the establishment of the international search report and written opinion by one of the "International Searching Authorities", which occurs after 16 months from the priority date. The international search is carried out in order to identify published patent documents and technical literature, which can influence the invention patentability.

In the third stage takes place the publication of the international application together with the international search report by the International Bureau of WIPO. After 18 months from the priority date, the content of the international application is disclosed to the world.

After 28 months from the priority date, it is provided supplementary international search and international preliminary examination (the additional patentability

analysis is usually carried out on an amended version of the application). These stages are optional.

The PCT procedure ends with the grant of national or regional patent. This is called the "national phase". The patent granting remains under the control of the national or regional patent offices. Therefore, after about 30 months from the earliest filing date of initial application, and after paying the national fees an inventor starts to pursue the grant of a patent directly before the national (or regional) Patent Offices (Rockman 2020).

2.3 Trends in patenting worldwide

As stressed in a report of the European Commission (2018: 196) "Patents are a standard component of composite indicators on innovation, mainly used to proxy technological output".

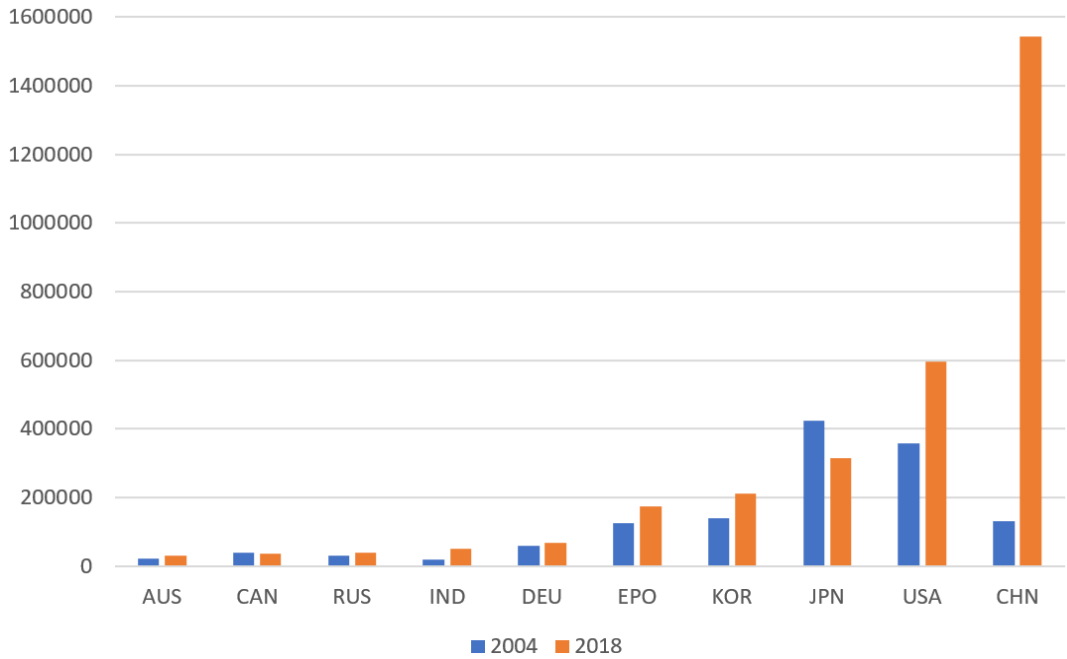
According to WIPO, the total number of patent applications in the world has increased over time. In 2004 innovators around the world filed almost 1.6 million patent applications, while in 2018 this number more than doubled and reached 3.3 million. About two-third of total patent applications worldwide in 2018 was filed in Asia. Over the last decade, Asia has increased its share and started to outpace other regions.

Figure 2 illustrates the total number of patent applications filed in the top 10 world patent offices. In 2004 the largest number of applications was filed in

Japan. However, in 2018 this number dropped by 26%. On the other hand, China ranked fourth in 2004, but by 2018 the number of applications has grown dramatically, up to more than 12 times in a time span of 14 years. Thus, China has gained the world leadership: 46% of the world patent applications in 2018 have been filed in the Chinese patent office (see Table 1).

Although with much lower absolute values, also India has greatly improved its position: in 2018 it overtook the performances of Australia, Canada and the Russian Federation. As for the US, it kept the second position in the world rank; in 2018 US inventors filed 67% more patent applications compared to 2004.

Figure 2. Patent applications for the top 10 offices in 2018 compared to 2004.



Source: WIPO (2020).

According to Table 1, about 84% of all patent applications filed worldwide in 2018 was received by the top five IP offices in the world: that is, along with EPO, USPTO and CNIPA, the Japan Patent Office (JPO) and the Korean Intellectual Property Office (KIPO).

Table 1. The patent application shares of the top five IP offices in the world, in percentiles.

	2004	2018
CNIPA	8	46
USPTO	23	18
JPO	27	9
KIPO	9	6
EPO	8	5
Total	75	84

Source: WIPO (2020)

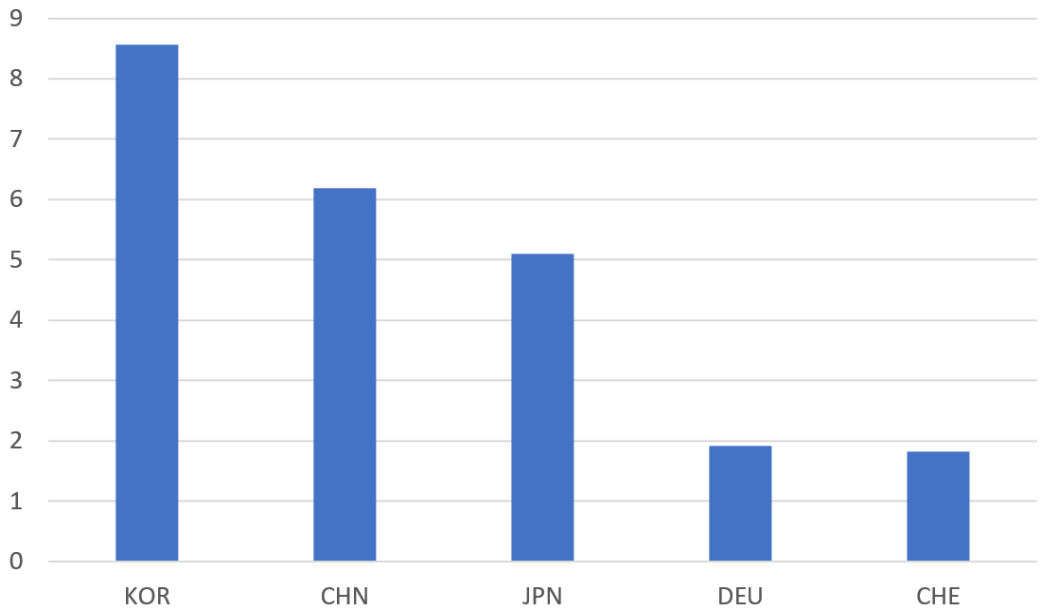
The IP offices of middle and low-income economies show considerably low levels of patenting. However, in 2018 the patent offices of some of the latter countries (such as Pakistan, the Philippines and Uzbekistan) saw a remarkable growth in the filings received.

The size of countries and their level of development have an impact on the differences in patent activity. A possible patent intensity indicator is the number of patent applications, multiplied by 1 billion, filed by the residents in a country

and divided by the GDP. This measure allows comparing filing activity among countries with economies of different sizes.

Figure 3 shows that in 2018 the most patent-intensive country was the Republic of Korea with 8.6 resident patent applications per billion GDP. China (6.2) was the second one, followed by Japan (5.1), Germany (1.9) and Switzerland (1.8).

Figure 3. Resident patent applications relative to GDP (PPP, billion USD) in 2018.

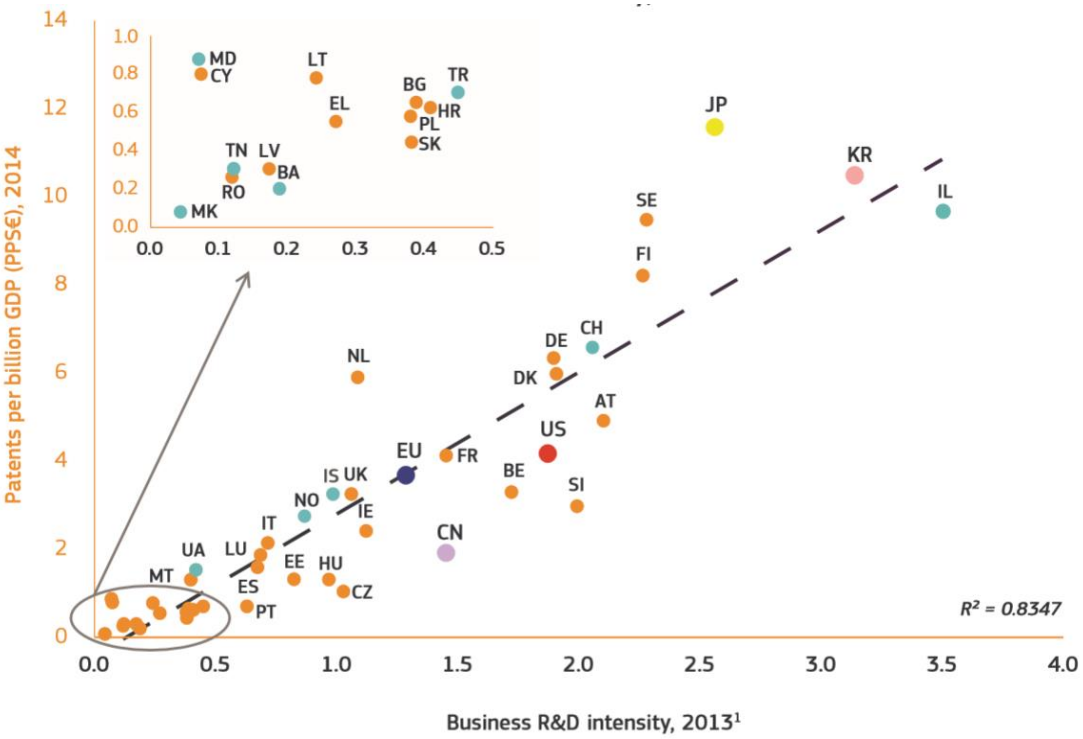


Source: WIPO Statistics Database (2019).

According to the European Commission (2018), countries with a high level of business expenditure on R&D tend to have higher patent intensity. Figure 4 documents the positive linear correlation between these two variables. Patents can be considered as a return on investment in R&D, assuming business R&D expenditures as knowledge input and patents as knowledge output.

According to Figure 4, Japan is the most efficient country in translating its business R&D investments into patent applications. The Republic of Korea also perform well and overtakes the European Union and the US.

Figure 4. Patent applications per billion GDP (PPS€), 2014 and business R&D intensity, 2013



Note: [1]CH:2012; TN: 2014.

Source: European commission (2018).

The distribution of patent applications by technology fields illustrates each country's areas of strength. According to the WIPO Statistics Database, in Germany for the period 2015-2017 the biggest share of applications was filed in the "Transport" sector; in China and the USA in "Computer technology", while in Japan and Korea in "Electrical machinery, apparatus, energy sector".

According to WIPO (2019), in 2018 the highest number of PCT applications were filed by the big telecom and electronics firms (such as Huawei Technologies, Intel, Samsung Electronics and others). Consequently, the patent propensity is linked to the high-tech orientation of the manufacturing sector. The share of the ICT sector and the presence of large R&D-intensive companies exert a strong impact on the number of patent applications. In general, aside from ICT services, manufacturing firms tend to patent more than service-sector companies.

2.4 Strategic patenting

According to Duhigg and Lohr (2012), in the US the number of patent applications related to software, ICT devices (especially smartphones) has increased significantly over the past few decades. Some major companies within the ICT industry, such as Apple, Samsung and Nokia, file multiple patent applications for strategic reasons. In their patent applications, firms try to cover all potential aspects of new technologies. Whether or not the patent office approves them, this prevents competitors from trying to patent the same ideas.

Usually, patents on software ensure ownership on concepts (namely algorithms or business methods) rather than material creations. Therefore, some patents have such a wide spectrum that they allow their owners to claim ownership on apparently unrelated products created by others. In this case, companies can be

sued for infringing patents that they never realized existed or never thought that such patents were related to their own innovations.

Recently, the number of patent lawsuits has increased in the US and most of the major ICT-related firms are involved in IPR battles. This does not occur in Europe to the same extent because, according to the European Patent Convention software products cannot be patented.

It can be argued that aggressive patent strategies make patent offices busy and overworked. By filing a huge number of patent applications, companies have exploited the patenting system's weaknesses. The common practice is that firms tend to file applications again and again until they win approval. This excess of patent applications makes their examination more difficult, leaving patent offices struggling since they are understaffed and plagued by employees' turnover. Consequently, the quality of the examination is decreasing (Duhigg and Lohr 2012).

Patent litigation is a very costly activity. Therefore, threats from "patent trolls" increased. Such companies are generally of small size and their main purpose is to buy patents from individual inventors, in order to sue over patent violations of large companies when the occasion arises. Often, firms prefer to pay the "troll" to avoid the lawsuit, because the patent may protect part of the manufacturing process of a product. An injunction may have the entire product shut down (Harhoff, Hall, von Graevenitz, Hoisl, Wagner, Gambardella & Giuri 2007).

3. INNOVATION ACTIVITIES IN KAZAKHSTAN

3.1 Overview of the literature

Over the past few years innovation activities in Kazakhstan have been studied and well discussed by some scholars. In their work, they provide statistical data, point out the main problems and make suggestions for improvements.

Suyunov, Mirkasimov and Karimov (2018) observed innovation activities in Kazakhstan since 2000. They show that the R&D initiatives in Central Asia lag considerably behind. In 2015 the research intensity (i.e. R&D expenditures over GDP) in four Central Asian countries — Uzbekistan (0.21%), Kazakhstan (0.17%), Kyrgyzstan (0.12%) and Tajikistan (0.11%) — was substantially lower than in developed countries. Between 2000 and 2015 Kazakhstan experienced a downward trend in gross expenditure on R&D as a share of GDP, despite strengthening legal framework on the fields of science, technology, and innovation. Also, the number of patent applications decreased from 2000 to 2016. Suyunov et al. argue that the problem is the lack of investment in R&D from the private business sector. In principle, private firms, striving to maximize their profits, tend to take more risks. Nevertheless, despite the business sector should have a high rate of return from R&D activities, the private investment in R&D remains scanty.

According to Suyunov et al. (2018), in the period between 2003 and 2016, the number of scientific and technical publications in Kazakhstan has significantly

increased. However, the authors suggest that this was mainly due to the requirement for postgraduate students to publish at least seven articles related to the topic of their dissertation in order to obtain a PhD degree. Accordingly, the current policy ascribes a greater importance to the quantity of publications rather than their quality or their citation impact. Indeed, these articles usually provide a little or no contribution to the stock of knowledge.

In 2016 Tashenova classified the regions of Kazakhstan in terms of inventive activity, using cluster analysis of the IPRs owned by business companies in 2015: number of issued titles of protection for inventions, utility models, industrial designs, selection achievements[2] and trademarks. The city of Almaty was excluded from the analysis as it has much higher numbers compared to the other regions. Her findings showed that the seventh cluster, which is represented by Astana, is the most powerful. The first cluster consisted of the South-Kazakhstan and Almaty regions has a high level of patent activity. These regions tend to be more innovative and, thus, they become more attractive for both domestic and foreign investments.

Mukhtarova and Myltykbayeva (2014) emphasize that the Republic of Kazakhstan is characterized by significant regional differences in the level of the

[2] Selection achievement is a new plant variety, a new breed of animal that are the result of the creative activity of a human. The Patent Law of Kazakhstan implies the protection of a selection achievement as IP. Patent on a selection achievement certifies the exclusive right of a patent holder for use of selection achievement, its priority and authorship of a breeder.

innovation capacity. By computing the innovativeness index of regions, the above authors were able to classify regions by their level of development of the innovative activity. They also evaluated the innovative capacity of each region. According to their analysis, the East Kazakhstan region, Almaty city, Pavlodar and Zhambyl regions have the highest level of innovative capacity. They also argue that the identification of innovative capacity of regions helps to implement relevant innovation policy adjustments within the framework of industrial innovative development on the national level, making the latter more effective in the long run.

Moreover, Tashenova (2016) shows that only a minor part of the patented inventions in Kazakhstan finds a practical application. The author emphasizes the lack of governmental support in the implementation of patented inventions, the small demand for SMEs innovative activities and deficient promotion of innovations on the market. Another problem is related to the fact that applicants do not have enough legal knowledge in IPR protection. Often legal entities involved in the creation of innovations do not have experts who provide methodological assistance in submitting patent applications. Therefore, others may legally circumvent a patent, slightly altering the process parameters or design elements. Additionally, there is need to improve the quality of patent attorneys' services and their professional competence as well as qualifying other experts in

the field of patents (such as lawyers, economists) to deal with patent litigation at international level.

When considering the manufacturing side, Tazhiyeva and Tynabekova (2016) argue that one of the main problems of innovative development in Kazakhstan is the separation of R&D activities from the mass-production. Often the results obtained by applied research are not commercialized and not introduced to the manufacturing process. The authors claim that in Kazakhstan there is an inefficient ratio between scientists, designers and workers in pilot production since for 25 scientists there are 4 designers and only 1 worker down the line. Whereas in advanced countries the ratio is 1:2:4.

Negative dynamics in the inventive activity have different causes. The main one is the lack of invention related to patent-intensive technological fields according to Uruzbayeva (2019). Indeed, Daiko, Dernis, Dosso, Gkotsis, Squicciarini & Vezzani (2017: 37) argue that "companies in the Computer & Electronics industry register, by far, the greatest number of IPRs and account for about one-third of total IP filings of top R&D investors". Therefore, Uruzbayeva claims that the IT sector in Kazakhstan needs support from the government. Thus, most Kazakhstani IT-companies are engaged in implementing foreign innovative solutions rather than developing their own. Moreover, there are factors as administrative and financial barriers in the form of bureaucracy and corruption, expensive bank

credits and lack of tax benefits. These barriers discourage the growth of inventive activities.

Nowadays, the main goal of the Kazakhstan's government is to diversify the economy, to avoid excessive dependence on domestic income and the extraction of natural resources. This can be achieved by encouraging the production and export of more knowledge-intensive products (United Nations Economic Commission for Europe 2012). Kurmanov and Aibosynova (2015) argue that the formation of sustainable innovative development entails a variety of social, economic, and political issues. Over the past years the government has established the necessary legislation and regulatory framework that reflect an innovative way of development. For example, The Law "on State Support for Industrial and Innovative Activities" (2012) defines the state's tasks to create favourable conditions for the development of high-tech industries (OECD 2017). However, Abdymanapov, Toxanova, Galiyeva, Muhamedzhanova, Ashikbayeva, & Baidalinova (2016) suggest that the measures taken at the macroeconomic level alone are not enough. The government's support to innovative entrepreneurship needs a multi-level approach. Also, it should be differentiated according to the development level and economic cycles. For instance, during recession periods, it is necessary to shift to indirect methods of support, including tax reduction, preferential loans and government support for financial leasing, franchising and innovative forms of distribution.

3.2 R&D activities in Kazakhstan

The relationship between R&D expenditures and patent performance is expressed through research productivity and patent propensity. In other words, an increase in R&D efforts may be translated into more patents in the long run. (Danguy, de Rassenfosse & van Pottelsberghe de la Potterie 2009).

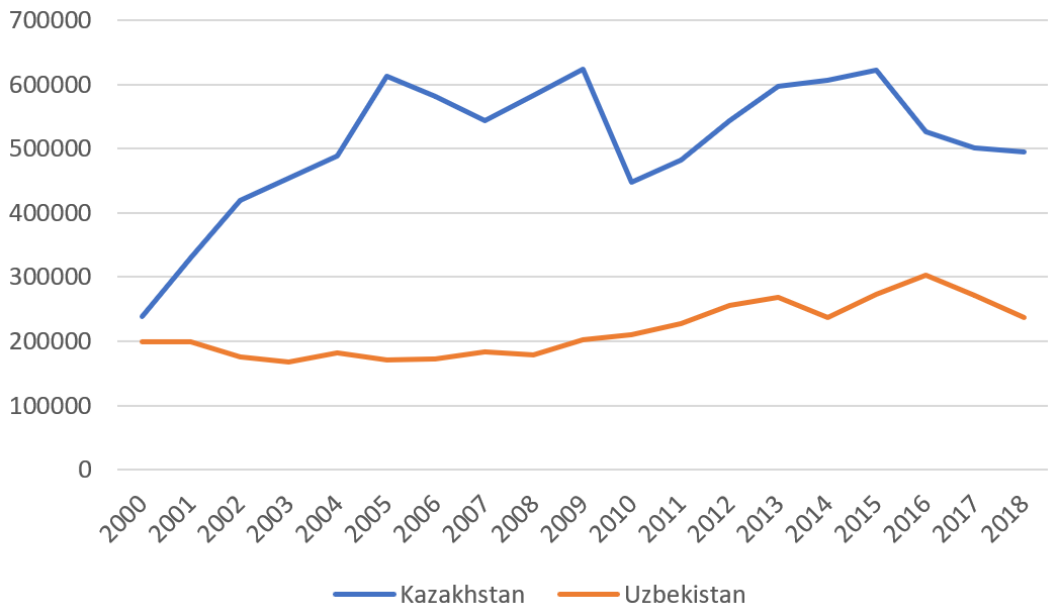
According to the UNESCO Institute of Statistics, in 2017 the total amount of R&D expenditure at current PPP prices in Central Asia was almost 1.7 million dollars. The biggest share between the Central Asian countries, 36% (almost 620 thousand dollars), refers to Kazakhstan.

R&D intensity (gross expenditure on R&D as a percentage of GDP) is the indicator used to compare the resources devoted to science and technology in different countries. According to the UNESCO Institute of Statistics, in 2017 the R&D intensity in Kazakhstan (0.13%) was noticeably low compared to the world average (1.72%). At the same time, taking into account other countries in the Eurasian region, Uzbekistan had a similar level of R&D over GDP ratio (0.16%), while the Russian Federation (1.11%) strongly outperforms both countries.

Figure 5 illustrates the gross expenditures on R&D measured in PPP dollars (constant prices – 2005) in Kazakhstan and Uzbekistan between 2000 and 2018. Despite the steady increase in R&D spending measured in the local currency (Kazakh tenge, KZT) over time, Figure 5 shows some downward periods in the Kazakhstan's GERD trend. The downward sections are linked to the periods of

KZT depreciation and inflation. In 2009 and 2014 the national currency was devaluated due to a drop in oil prices worldwide (Zholamanova, Arzayeva, Doszhan, Turlybekova & Kukiev 2018). It should be noted that Kazakhstan's economy has always been relying strongly on natural resources, having more than 50% of its export in the oil and gas industry (see OECD 2016). Such heavy dependency on natural resources makes the country to be vulnerable to external shocks.

Figure 5. GERD in Kazakhstan and Uzbekistan measured in PPP $ constant prices – 2005.



Source: UNESCO Institute of Statistics (2020).

Whereas in Kazakhstan GERD fluctuated, in Uzbekistan it shows a considerably less volatile pattern. Between 2000 and 2009 it remained substantially unchanged,

then it slightly rose and peaked in 2016. Since 2000 the gap between R&D spending in the two countries grew. In 2018 the total R&D expenditures in Kazakhstan were roughly twice as much as in Uzbekistan. A possible cause may be the faster economic growth in Kazakhstan in the same time span.

As it was mentioned in the literature survey, Mukhtarova & Myltykbayeva (2014) and Tashenova (2016) argued that there are regional differences in innovation activities. Also, R&D investments are distributed unevenly between the regions of Kazakhstan.

According to the National Statistics Committee, in 2019, R&D investments were concentrated in the most developed cities: Almaty and Nur-Sultan (Astana), accounted for 34% and 22% respectively of the total R&D budget. They are followed by the Mangystau and East-Kazakhstan regions with their shares of 12% and 9% respectively.

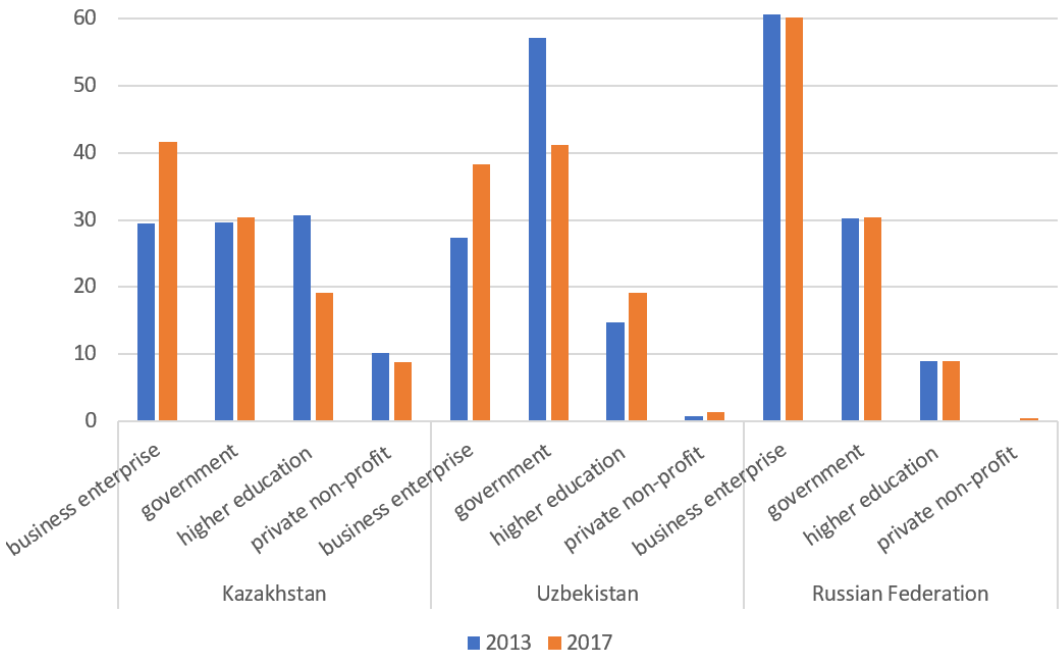
Table 2. GERD of Kazakhstan by type of activity from 2014 to 2018.

	2014	2016	2018
Basic research	23.0	20.7	14.7
Applied research	57.9	53.3	59.9
Experimental development	19.1	25.5	25.4
Total	100	100	100

Source: UNESCO Institute for Statistics (2020).

In Kazakhstan, as it generally happens, basic research is conducted mainly by public and higher education institutions, while applied research and experimental development by business enterprises. According to Table 2, between 2014 and 2018 the share of investment in experimental development increased by 6.3%, whereas at the same time the share of basic research declined by 8.3%. In 2018 almost 60% of gross R&D expenditures were related to applied research, 25.4% to experimental development and 14.7% to basic research. However, in most innovative countries the biggest share refers to the experimental development, for instance in the Republic of Korea it accounts for 64%, in Israel – 79%; in the US – 63%, in Japan – 64%.

Figure 6. GERD by sector of performance expressed in percentage.



Source: UNESCO Institute of Statistics (2020).

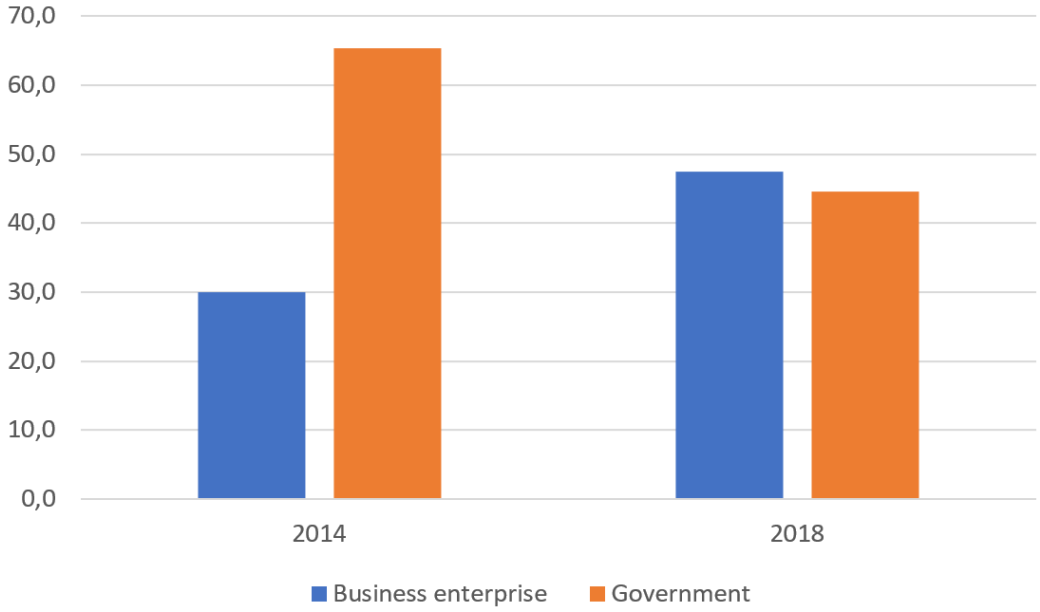
Figure 6 displays data about R&D expenditures by sector of performance in Kazakhstan compared with Uzbekistan and the Russian Federation in 2013 and 2017. Business enterprises of Kazakhstan accounted for 29% of total R&D in 2013, and in four years the expenditures in this sector increased by 13%. The share of government R&D remained at the same level, while the performance of higher educational institutions decreased by 12% (from 31% in 2013 to 19% in 2017).

In Uzbekistan, the largest share (57%) belonged to the government in 2013, but it decreased by 16% over time, while the share of business R&D increased by 11%. In Russia the distribution remained unchanged: most of the R&D expenditures are concentrated in the business sector (about 60%). Generally, in more innovative countries most of R&D is performed by the business sector.

In Uzbekistan and Kazakhstan, the share of business R&D improved over time but remained relatively small. According to Suyunov et al. (2018), it indicates that the private sector is still weakly motivated in R&D performance.

Regarding R&D funding sources in Kazakhstan, the government had the largest share (65%) in 2014. However, this percentage decreased over time and in 2018 it accounted for about 45% (see Figure 7). At the same time the share of funds from the business enterprises raised from 30% in 2014 to 47% in 2018. Thus in 2018, the sources of funds were distributed more equally.

Figure 7. Distribution of GERD by source of funds in Kazakhstan, in percentage.



Source: UNESCO Institute of Statistics (2020).

To compare the differences in R&D expenses among fields of science and technology we considered the shares recorded in the business sector. According to Table 3, among the business enterprises sector, the most R&D-intensive field is "Engineering and technology": in 2018 it accounted for 81% of total business R&D. The second R&D-intensive field is "Natural sciences", although the share of R&D expenditures decreased from 18% in 2014 to about 10% in 2018. The share of "Agricultural and veterinary" sciences also slightly declined through time; in 2018 it was equal to 7.5%.

Table 3. Kazakhstan's Business R&D expenditures by field, in percentage.

Field of science and technology	2014	2018
Natural sciences	18.3	9.8
Engineering and technology	66.2	81.2
Agricultural and veterinary sciences	10.2	7.5
Other fields	5.3	1.5
Total	100	100

Source: UNESCO Institute for Statistics (2020), author's calculations

According to the UNESCO Institute of Statistics, in 2018 the number of personnel involved in R&D in Kazakhstan was 22,378 people. The biggest share of R&D staff was involved in the higher education sector (39%). Personnel related to the Business sector accounted for 36%, followed by R&D staff worked in government (17%) and private non-profit organizations (8%).

If comparing at international level, the number of R&D personnel has to be normalized by the number of people employed. According to the UNESCO Institute of Statistics, in 2017 Kazakhstan and Uzbekistan had a similar level of R&D staff, 2.5 and 2.6 R&D personnel per thousand of total employment respectively. At the same time in the Russian Federation, it was much higher, roughly 4 times more.

3.3 The patent procedure at the National Institute Intellectual Property of Kazakhstan

In any technological field, the technical solutions concerned with a product, the method and usage of a known product for a new purpose may be protected as intellectual property. According to the Patent Law of the Republic of Kazakhstan (1999), the "product" may be defined as a device, substance, microorganism strain, plant or animals cell culture. The term "method" refers to "the process of affecting a material object using material resources" (Article 6, 2).

The Patent Law of Kazakhstan emphasizes that the following cannot be recognized as patentable inventions:

- discoveries, scientific theories and mathematical methods;
- methods of organization and management of the economy;
- symbols, schedules, rules;
- rules and methods of performing the mental operations, gaming;
- computer programs and algorithms;
- projects and arrangements for structures, buildings, territories;
- proposals relating solely the exterior appearance of manufactured articles;
- proposals that are contrary to the public interest, the principles of humanity and morality.

A patent certifies the priority, authorship and exclusive right to exploit an invention. A patent for an invention is valid for twenty years from the filing application date. In the case of an invention relating to a medical product or a pesticide (chemical), the period of validity of the exclusive right may be extended at the request of the patent owner, but not more than five years.

The national intellectual property system in Kazakhstan has developed after its independence. In 1992, by the Decree of the President of the Republic of Kazakhstan № 806 "On the National Patent Office under the Cabinet of Ministers of the Republic of Kazakhstan", the national patent office was established. Later it was developed to The Republican State Enterprise "National Institute of Intellectual Property" according to the Resolution of the Government of the Republic of Kazakhstan № 756 in 2002.

The National Institute of Intellectual Property (NIIP) takes part in international cooperation in the field of the legal protection of intellectual property. It performs work on international applications under the Patent Cooperation Treaty and the Madrid Agreement. Also, the NIIP performs work within the international cooperation with the WIPO, patent offices of other countries, and other international organizations.

To obtain a patent for an invention valid in the territory of the Republic of Kazakhstan, an inventor must file a patent application to the NIIP and attach supplementary documents, such as the receipt of payment of the application fee.

The application must include names of inventions, applicants and their place of residence or location. Non-residents can also apply for a patent, but only with an attorney who is licensed to practice law. The application must be compiled under the established requirements. The description and drawings of the invention must be presented in a clear and accurate form. They must disclose the invention in sufficient details to be replicated by others in a relevant field of knowledge.

Filed applications are assigned for examination. Examination of patent applications consists of the two stages: formal examination and substantive examination. The formal examination consists of a study of the application for compliance with the legal requirements. The applicant is notified about the result. If the application does not meet the requirements, the applicant is asked to submit corrected or missing documents within the period of three months from the filing date. In case of positive result of the formal examination, the applicant must pay a fee to proceed with the substantive examination within three months since the notification.

The substantive examination of the application includes the assessment on patentability, a search for the state of the art, a verification of compliance with the requirement of unity of the invention. If the claimed invention is not patentable, it has a lack of novelty or it differs only in an obvious manner from what is found in the prior art, the claims may be rejected. In the case of rejection, within three months an applicant has the right to file an objection to the Appeal Council. The

appeal is considered by the Board of Appeal within four months from the date of its receipt.

If the decision on patentability is favourable, a patent is granted. Within three months from the date of notification about the decision, the applicant must pay the fee for preparing a patent for its issue. Failure to pay the fee on time may result in the cancellation of the application. The payment period may be restored within three months if an applicant pays the fee for restoring the missed deadline.

The National Institute of Intellectual Property enters the information into the State Register of inventions, publishes information on the issuance of an electronic bulletin, prepares the patent and sends it to the patent owner by courier or through the postal service.

An applicant may draw up amendments (corrections of mistakes without changing the entity of an invention) or withdraw the patent application at any stage of its examination, but before entering the information in the State Register.

The Patent Law of the Republic of Kazakhstan provides for specific procedures aimed at speeding up the examination of patent applications. For inventions with favourable patenting conditions, such as inventions in the field of information and communication technologies or renewable energy sources, the examination procedure may take only six months.

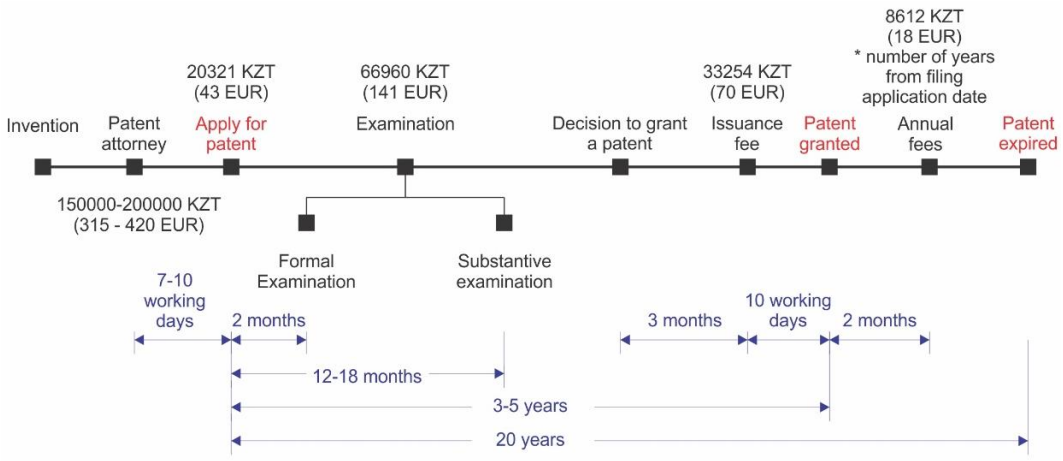
Once a patent is granted, the owner must pay maintenance fees on an annual basis, to maintain the validity of the patent. The first payment for maintaining the patent

in force has to be made within two months from the date of its publication and includes payment for the previous years, starting from the date of application.

Failure to pay the current maintenance fee on time may result in the termination of a patent. On request of the patent owner, the patent may be restored within three years from the deadline for payment of the maintenance fee.

Following the patent legislation, the patent holder may assign the received title of protection to an individual or legal entity. Any person (who is not a patent holder) has the right to use the object of the protected industrial property only with the patent proprietor 's permission based on a license agreement.

Figure 8. Cost of national patent application for legal entities



Source: Author's representation based on data from Kazakhstan National Institute of Intellectual Property and the Patent Law of the Republic of Kazakhstan (2020).

Figure 8 shows a schematic representation of the patenting procedure in Kazakhstan, which was compiled by the author based on the information taken from the NIIP and the Patent Law of Kazakhstan. It also contains the fees, that the applicant has to pay at each stage expressed in local currency and converted to EUR. The costs refer to large business companies and legal entities, while small and medium-sized firms and individual inventors can get a discount.

In Kazakhstan, generally, it takes three to five years to grant a patent, except for applications with the accelerated examination. The total cost of patent ownership for legal entities is approximately EUR 1000 - 1200, depending on the cost of the patent attorney. This is much lower when compared with the patent application costs (up to the patent granting) in Germany (EUR 1700 – 5100) and especially in Europe at the EPO[3]. It must be stressed that the EPO patent requires higher fees because it protects an invention not only in one country but in a group of countries chosen by the applicant. This requires translations to different languages. The fees charged by a patent attorney are also higher. The total approximated cost of the European patent (up to grant) includes the EPO fees, which is about EUR 5000, the patent attorney fees – EUR 10000, translation fees – EUR 3000.

[3] The actual cost can vary significantly depending on the specifics of each case (regarding the complexity of the patent and extent of the applicant's preparation).

3.4 Patenting activity in Kazakhstan

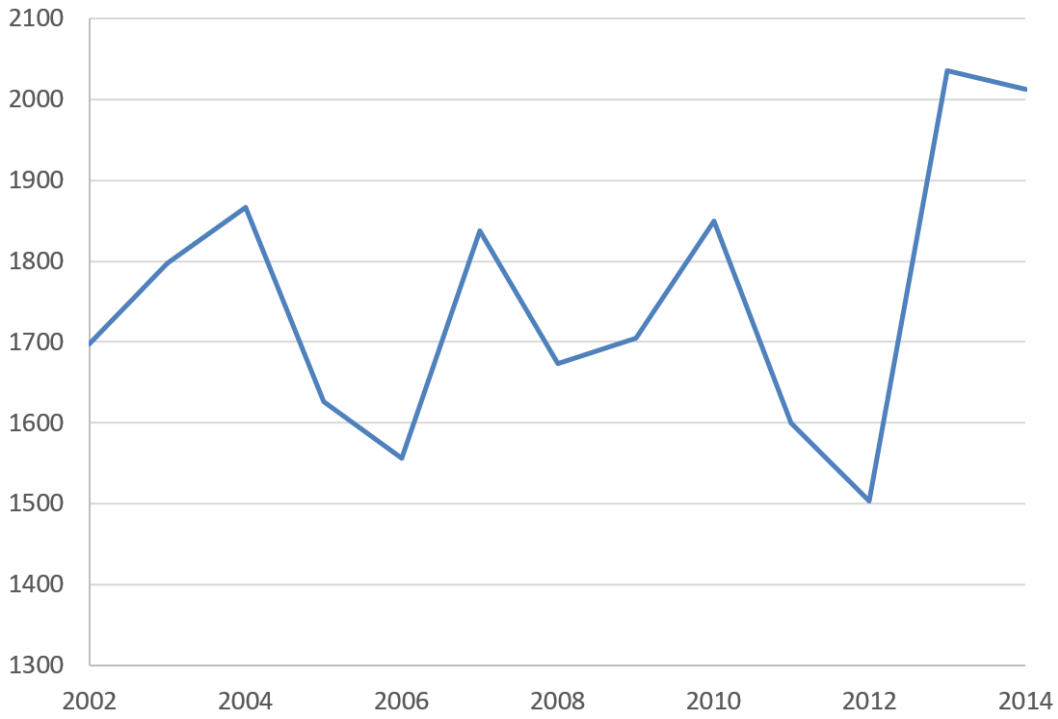
According to the NIIP's annual report for 2019, between 1992 and 2019 it received almost 46 thousand patent applications for inventions. Approximately 86% of them were filed by national applicants. Generally domestic applicants tend to file more patents in their home country than non-resident applicants. The share of foreign applications increased remarkably over time from 6% in 2002 to almost 17% in 2019. A possible cause might be the surge of the number of legal entities with foreign ownership registered in Kazakhstan over time. However, in recent years it was mainly due to a significant decrease in the patent applications from residents.

Figure 9 shows the number of patent applications received by NIIP in the period 2002-2014. Its trend fluctuated between 1500 and 1900 in such period, with a peak at 2036 in 2013. However, from 2014 the number of patent applications suddenly decreased (see Figure 11). This can be explained by the fact that in 2015 Kazakhstan joined the WTO and its patent legislation had to meet international standards that were not exactly in line with its own laws (OECD 2016). Therefore, in 2015 the regime changed, and a new legislation was applied.

Since 1992, there were two types of patents for inventions defined as "provisional patents" and "patents". The former was granted in case of the positive result of the formal examination of a patent application. The latter required also substantive examination. "Provisional patents" were valid for 5 years from the filing date.

This type of patent was cheaper, issued faster and allowed quicker implementation in the production line. The purpose of issuing this type of IP rights is to improve manufacturing and replenish the market with goods, as it was in weak conditions after the USSR collapsed.

Figure 9. Number of patent applications received by NIIP from 2002 to 2014.



Source: National Institute of Intellectual Property (2020)

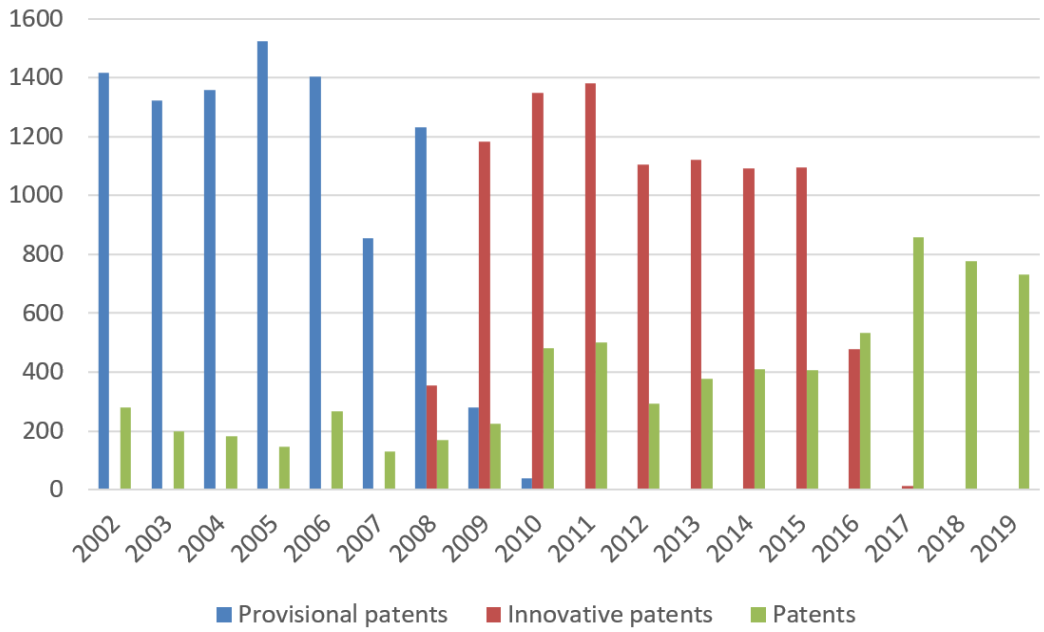
Since "provisional patents" were not exanimated on the novelty, the exclusive rights on IP were not granted. Therefore, making, using or selling any of such inventions was not protected and it left all under the responsibility and risk of the applicant.

The main problem was that applicants could apply for a “patent” only if a “provisional patent” was obtained before. Therefore, the period between the filing date and the moment IP rights were granted was long, since the standard procedure to obtain a “provisional patent” could last up to two years on average. This had a negative impact on the entrepreneurs, who therefore were not motivated to invest long-term and obtain final “patents”. Figure 10 shows that in the period of existence of “provision patents”, the biggest share belonged to them. This proves that many inventors after obtaining “provision patents” were not interested in applying for a “patent”. This characterizes that the bulk of inventions was small, imitated from abroad or did not have commercial value. Grudnitsky (2005) stated that “provisional patents” were similar to patent publication, as it was a legal confirmation of the authorship of an invention in Kazakhstan. For example, researchers applied only for “provisional patents”, not to achieve any commercial value, but merely to publish on scientific journals and prove their academic commitment.

In 2007 the patent law changed and “provisional patents” were substituted by the more valuable “innovative patents”, which grant exclusive rights on innovation over the territory of Kazakhstan. This type of patent was valid for a short period (three years with the possibility to extend the protection period for two more years) and application had to go through examination based on local novelty and industrial applicability. The implementation of “innovative patents” was supposed

to create favourable conditions for increasing interest in innovation activities by SMEs and increasing the production of domestic goods. But this did not overcome the difficulty to access the international market.

Figure 10. Three types of patents for inventions granted from 2002 to 2019.

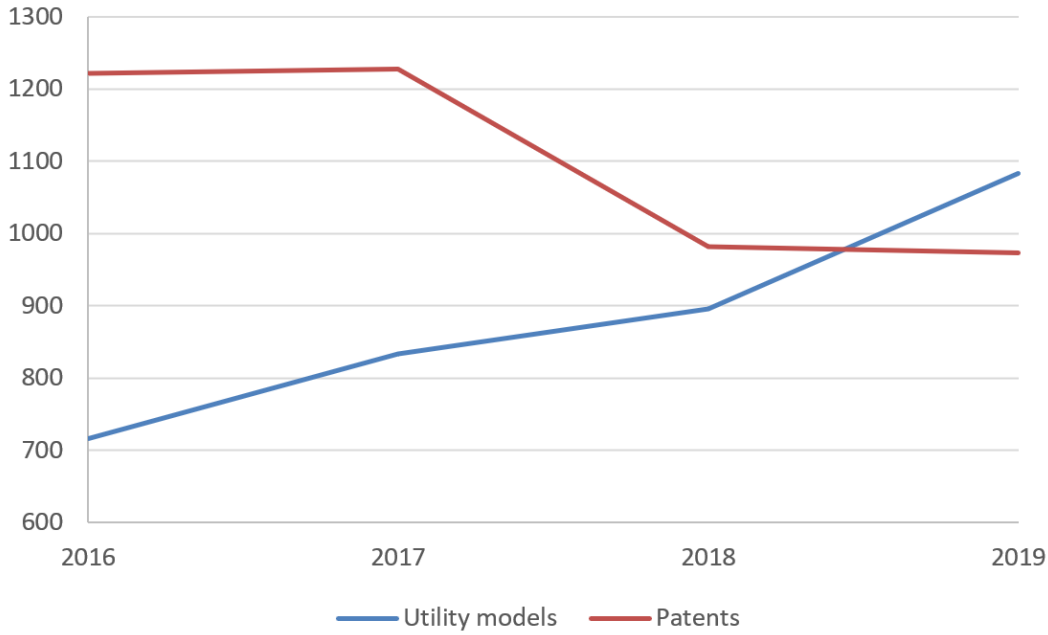


Source: National Institute of Intellectual Property (2020)

Figure 10 shows that most applicants preferred to obtain "innovative patents", since the beginning. For instance, in 2014 more than 70% of issued patents were "innovative patents". However, accessing the WTO required the cancellation of this type of patent. Then at the beginning of 2015, the "innovative patents" were excluded from the list of objects of industrial property of protection. Subsequently, the total number of patent applications for inventions considerably

decreased. However, according to NIIP, changes in the legislation had a positive impact on Kazakhstani patents valid at the international level. From 2014 to 2019 the number of "patents" granted increased by 78%.

Figure 11. Number of applications for patents and utility models received by NIIP from 2016 to 2019.



Source: National Institute of Intellectual Property (2020)

According to Figure 11, in recent years, the number of patent applications continued to decrease slowly. The decline occurred mainly at the residents' level. It is worth noticing that mainly domestic applicants preferred "innovative patents". After the cancellation of "innovative patents", applicants started to use an alternative and apply for a utility model. From 2014 the number of applications

for utility models increased sharply. As displayed in Figure 11, the number of applications for utility models increased by 51% between 2016 and 2019. This may indicate that domestic applicants are still adapting to the new patent legislation.

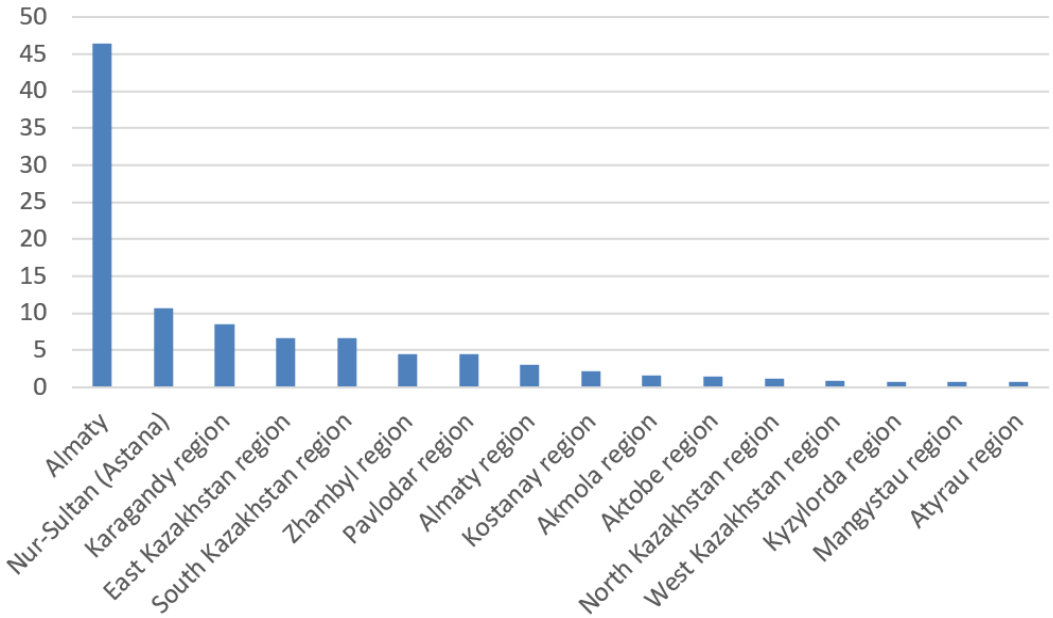
Even though utility models are quite similar to patents, they provide a different level of protection. Utility models grant a limited exclusive right to prevent others from commercially exploiting the new technical inventions without the right-holders' permission (WIPO 2017). Utility models have less stringent criteria for obtaining them and a shorter period of protection. In Kazakhstan it is not required to go through a substantive examination procedure, thus obtaining a utility model is faster and cheaper. The protection is valid for five years from the date of filing the application with a possible extension for not more than three years.

The total number of patent applications is distributed among regions unevenly. Figure 12 shows the distribution of patent applications for inventions filed by Kazakhstani residents between regions. These data refer to the years 2002-2019.

About 46% of all patent applications were filed by applicants from Almaty city. The second inventive region was Nur-Sultan, the current capital of Kazakhstan (before March 2019 the name of the city was Astana). The number of national applications received from Nur-Sultan is much less than from Almaty. This can be explained by the fact that Almaty has long been the Kazakhstan's most developed city: it has been a financial, economic and science hub since Kazakhstan belonged

to the USSR. In 1997 the capital was transferred to Astana, back then a small industrial city. The capital transfer gave a strong boost to the city's economic development. The high rates of economic growth attracted numerous investors. Nowadays, Nur-Sultan has become one of the largest business centres in the republic and its population grew in 4 times from 1997. Also, in terms of inventive activity, the share of patent applications from Nur-Sultan increased from 6% in 2002 to 14% in 2019.

Figure 12. Regional distribution of patent applications for inventions filed by national applicants from 2002 to 2019, in percentage.



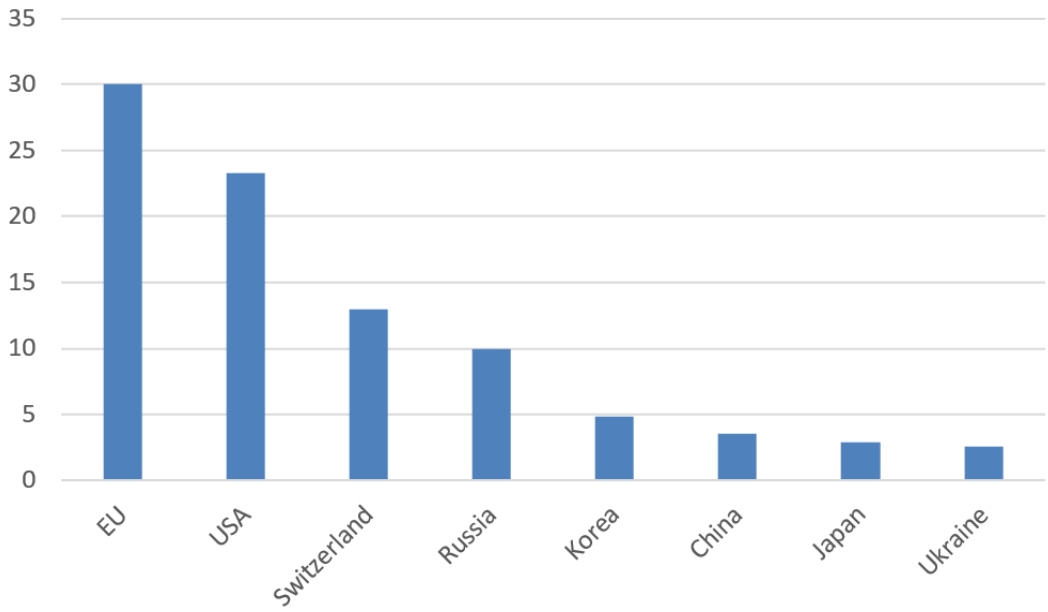
Source: National Institute of Intellectual Property (2020), author's calculations.

Besides the Kazakhstan's main cities, the highest number of patent applications were obtained from 2002 to 2019 from three regions: Karagandy region, East Kazakhstan region and South Kazakhstan region (with the shares of 8%, 7% and 7% respectively). It should be noted that these areas are also the most populated. To assess the patent intensity of the regions, the number of patent applications has been normalized by the number of resident people. The calculations were done based on the data from the Statistics Committee of Kazakhstan. Thus, in terms of patent intensity in the period between 2002 and 2019 the most innovative areas were Almaty city (on average 49 patent applications were filed per 100,000 people annually), Nur-Sultan (22), and three more industrialized regions: Karagandy (9), Pavlodar (8) and East Kazakhstan region (7).

As it was mentioned in Section 2, the bulk of R&D investments are concentrated in Almaty and Nur-Sultan, because they are the most developed cities, as well as East Kazakhstan region, the largest metallurgical center of Kazakhstan.

Also, Mukhtarova and Myltykbayeva (2014) state that the East Kazakhstan region, Almaty city and the Pavlodar region have the highest level of innovative capacity. Tashenova (2016) emphasized that in 2015 Astana city was the most powerful region in terms of inventive activity of business companies.

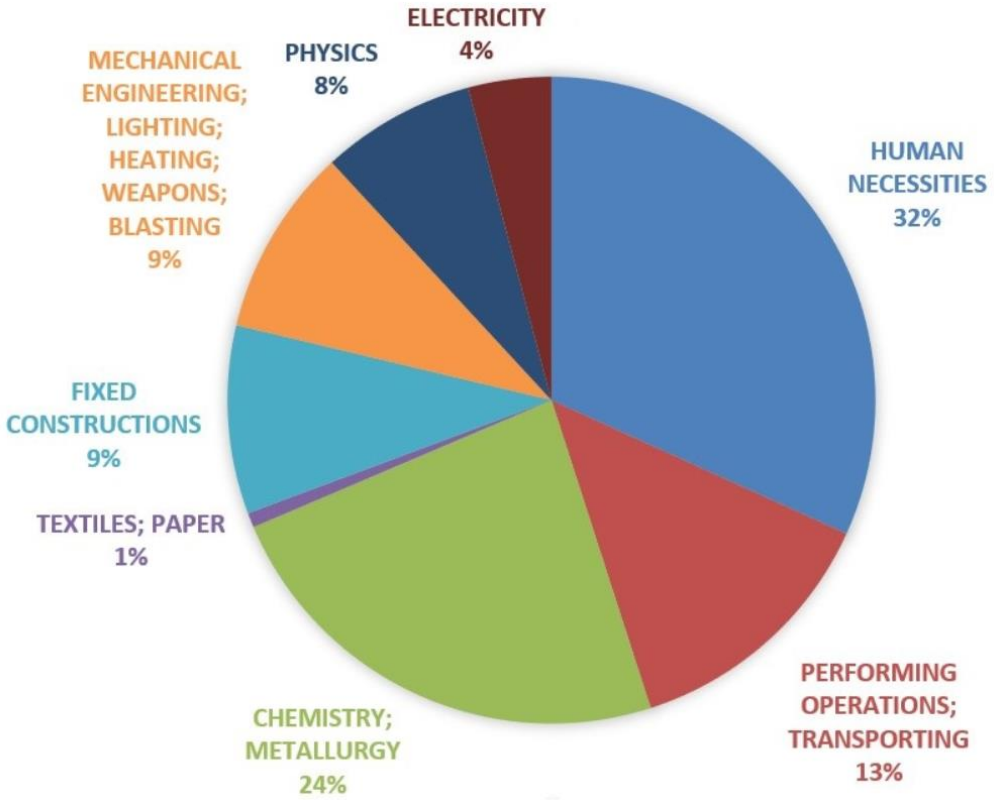
Figure 13. Distribution of patent applications for the issuance documents for inventions filed by foreign applicants from 2007 to 2019.



Source: National Institute of Intellectual Property (2020), author's calculations.

From 2007 to 2019 the NIIP received 2519 foreign applications from 55 countries. Figure 13 shows the distribution between 8 countries, which represents 91% of the total number of non-residents' patent applications. The biggest shares are from European Union countries – 746 patent applications (30%), and the USA – 582 (23%). The share of the European countries is mainly represented by the applications received from Germany, France and Italy.

Figure 14. Distribution of the issued patents for inventions under the IPC in 2010 – 2018.



Source: National Institute of Intellectual Property (2020), author's calculations.

The distribution of patents under the International Patent Classification (IPC) is presented in Figure 14. It gives an overview on the most active sectors of the economy of Kazakhstan in terms of the number of granted patents: A - «Human necessities» (32%) and C - «Chemistry; metallurgy» (24%). The sector of "human necessities" includes food products, agriculture, health items, personal or domestic goods, and amusement. Chemistry and metallurgy industries are historically the strongest sectors in Kazakhstan.

Table 4. National and foreign applicants who received the greatest number of patents for inventions in 2019.

National applicants		Foreign applicants	
Kazakh National Agrarian University	10	Rail 1520 IP LTD	4
Semey Medical University	10	Invista Textiles (U.K.) Limited	4
National Center for Biotechnology	12	"Ural plant of auto-textile products" JSC	5
Karaganda State Technical University	12	Saint-Gobain Placo	6
Zhannat Kadyrov	65	Philip Morris Products S.A.	39

Source: NIIP (2019).

Table 4 shows the top 5 resident and non-resident applicants who were granted the greatest number of patents in 2019. It is important to notice that national applicants are three universities, one state-run research centre and a professor from Kazakh University Ways of Communications, whereas all 5 foreign applicants are business enterprises. This proves that Kazakhstani business companies do not have a strong motivation in patenting inventions.

3.5 Inward FDI to Kazakhstan

The importance of FDI has increased worldwide since FDI can bring significant benefits to host countries. Many governments have developed different policies to promote inward FDI.

One way that host economies can benefit from FDI is by creating high-quality jobs associated with higher wages and better working conditions. FDI can also have an impact on the quality of jobs available in domestic firms when there are knowledge spillovers from international to domestic companies. Transfers of knowledge can result from collaboration between domestic and foreign firms or from worker mobility when domestic companies recruit workers with experience in foreign firms (OECD 2008).

By absorbing new technologies, processes and modern management practices from foreign firms, domestic firms raise their productivity. Moreover, FDI increases product-market competition, which may strengthen incentives among domestic firms to improve their efficiency.

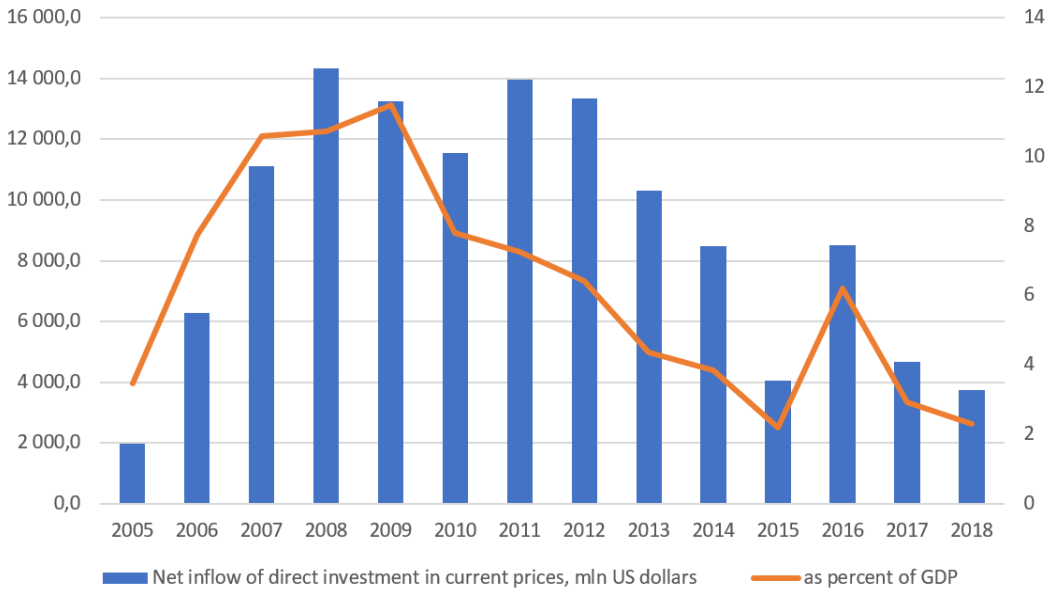
However, under certain circumstances, FDI may lead to the crowding out of local firms, reducing their ability to operate at an economically efficient scale.

According to the National Bank of Kazakhstan, during the period between 1991 and 2016, more than USD 280 billion of foreign investments from more than 100 countries were attracted.

Figure 15 shows the net inward flows of FDI to Kazakhstan in the period 2005-2018. From 2005 to 2008 FDI grew steeply reaching a peak of USD 14.3 billion. Then, after the global financial crisis of 2008, the trend went slightly down. In 2011 there was a recovery, but later the decline continued. This was also due to the fall of global oil prices since the extraction of natural resources is the most

attractive sector for FDI in Kazakhstan. Lower commodity prices reduced the trade turnover and income payable to foreign direct investors from the domestic oil sector (OECD 2016). In 2016 the trend recovered again and peaked at USD 8.5 billion, but by 2018 it more than halved.

Figure 15. Net inward flows of FDI to Kazakhstan, measured in current prices and as a percentage of GDP

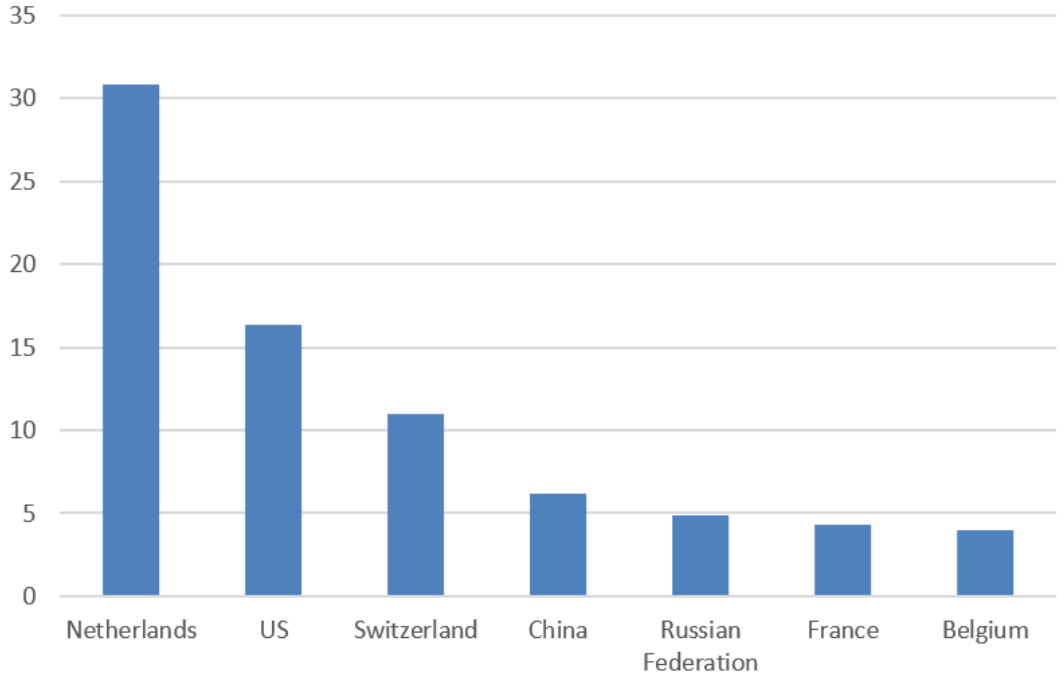


Source: UNCTAD Statistics (2020).

According to UNCTAD, between 2014 and 2018 the average annual inflows of FDI were equivalent to 3.5% of GDP in Kazakhstan, substantially above those of the Russian Federation (1.5%), China and Italy (1.2%) and OECD countries (1.9%). At the same time, other countries from the Central Asian region, such as

Tajikistan and Turkmenistan, had higher average annual inflows, accounting for 4.9% and 6.7% respectively.

Figure 16. Gross inflow of direct investment in Kazakhstan from foreign direct investors by countries between 2013 and 2019, in percentages.



Source: National Bank of Kazakhstan Statistics (2020).

According to the National Bank of Kazakhstan Statistics, between 2013 and 2019 the bulk of FDI (78%) were from 7 countries, showed in Figure 16. The largest investor country in Kazakhstan was the Netherlands (31%), following by the US (16%), Switzerland (11%) and China (6%).

The above figures derive from a strong presence of Dutch companies in the Kazakhstani market. For instance, the Royal Dutch Shell company hold the share

of 29.25% of the Karachaganak Field Project in the oil and gas industry. The Dutch company Food Ventures has launched the construction of the greenhouse in the Aktobe region (TCA 2019). According to Satubaldina (2019), other joint projects are going to be implemented in the field of food processing and agriculture. The Dutch Farm Frites company is planning to set up a plant of potato processing in the Zhambyl region, while the Greenhouse Delta firm will build a 200-hectare agriculture park in the Turkestan region.

However, some observers (OECD 2012; Dyker 2015; Asian Development Bank Institute 2014) argue that the role of Dutch FDI is much smaller, because the Netherlands may not be the exact origin of investments. The National Bank of Kazakhstan reports a figure for the stock of FDI from the Netherlands that is much high than that provided by Dutch statistics. Indeed, some projects were implemented through special purpose entities (SPEs)[4]. Therefore, inward FDI channeled through SPEs might come from Kazakhstan itself (OECD 2012). Domestic companies may invest at home through affiliates abroad for tax purposes or to provide greater legal protection of their investments. Asian Development Bank Institute (2014) and Zabortseva (2016) contend that also

[4] Special purpose entities are legal entities affiliated with another company. They have no substantial commercial activity in the country but are used by companies as devices to raise capital or to hold assets and liabilities.

Russian businesses make investments in Kazakhstan through the Netherlands SPEs.

As expected, inward FDI were mainly concentrated in the extractive industries. Between 2013 and 2019 around 86% of gross inflow FDI in mining and quarrying related to crude petroleum and natural gas extraction. In 2019 the industry attracted USD 12 billion out of total gross inflow FDI of 24 billion. About USD 3.5 billion were invested in the manufacturing industry, the majority of which were directed at the basic metals and fabricated metal products. Investments in professional, scientific and technical activities have shrunk from 7,361 million in 2013 to about 508 million in 2019.

The oil and gas, natural resources and extractive industries continue to remain the most attractive sectors for foreign investments. Many international oil corporations are active in Kazakhstan's oil and gas sectors. The US oil company, Chevron, is one of the largest foreign investors in Kazakhstan: it is the largest private oil producer, holding important stakes in two of the nation's biggest oil-producing fields – Tengiz and Karachaganak. Another US-based company, ExxonMobil, has had a continuous business involvement in Kazakhstan over 25 years and it is active in the development, production and transportation of oil and gas in Kazakhstan.

Talking about Chinese investors in oil and gas, CNPC, SINOPEC, CITIC are Chinese state-owned corporations, that have assets and equity in Kazakhstan,

while also providing oilfield services. China, also, was involved in several pipeline projects (see Olimat 2015).

To attract more FDI to support national development Kazakhstan government has undertaken a series of reforms aiming at improving the investment climate. The government has introduced specific measures such as tax reduction, state subsidies, partial or total exemption from duties and taxes on equipment and other materials (OECD 2017).

4. THE FOREING PATENT APPLICATIONS BY KAZAKHSTANI INVENTORS: AN EMPIRICAL ANALYSIS

As it was discussed in Chapter 3, for a long time the patent system of Kazakhstan was not in line with international standards. Thus, the share of national patent applications was much higher than that of foreign applications. The patent database of Kazakhstan includes a large number of "provisional patents" and "innovative patents", which were granted without a proper examination based on international criteria of patentability. Since "provisional patents" were assessed only for compliance with the filing application requirements, they could be issued for already existing inventions, although not susceptible of industrial application or having no commercial value. Moreover, applicants could apply for a "patent" only if a "provisional patent" was granted. Therefore, the patent application intensity was promising, but the number of most valuable inventions was small.

In addition, the cost of a national patent is much lower than an international one. For example, a patent application's cost (up to the patent granting) at the EPO could be 25 times more than at the National Institute of Intellectual Property of Kazakhstan. In the case of patenting abroad, Kazakhstani applicants have to pay, not only the official filing fees charged by each country's patent office, but also translation fees to the required languages and fees to hire a patent attorney. Thus, international applications are more expensive and the granting of patents more difficult and time-consuming. Consequently, international applications are

deemed to involve more important or high-quality inventions. This is especially true for the set of patent applications related to the same invention filed in many different countries by a common inventor(s). This collection of patent applications is also called "patent family".

For these reasons, this chapter presents an empirical analysis of the patent applications filed by Kazakhstani inventors to the EPO, USPTO and CNIPA, also focusing on those filed to all the three or two of the afore mentioned patent offices.

4.1 Data sources and methodology

As already stressed in Chapter 2, patent documents provide a rich set of information so that they represent a comprehensive resource for characterizing inventions and offer many possibilities of analysis. Such information, included in the official bulletins of national patent offices or international organizations or in metadata, refer to inventions (claims, filing date, publication date), inventors (name, country, city, address), applicants, and technology areas. All of them are collected and stored in patent offices' web databases. The analysis carried out in this chapter is based on data from patent applications including Kazakhstani inventors filed to the three patent offices: USPTO, EPO and CNIPA.

A patent application is filed by one or several applicants listed in the application form mentioning the country of their residence. However, the patent document

also reports the list of people involved in the inventive process (the inventors) and their residence. If the inventors' country coincides with the applicants' country, then the patent can be fully ascribed to a given country. If not, inventors residing in a given country have contributed to the invention that is owned by an applicant coming from another country.

These two types of patent application provide different information. For instance, the second type indicates how many people in a given country have been involved in the inventive activity of foreign applicants: although very rough, it could be a measure of the brain drain. In the same vein, the applications of local applicants could involve foreign inventors, and this could be a rough measure of brain gain. Therefore, in the subsequent analysis it is important to distinguish these two types of patent applications.

Table 5. Patent databases used in the analysis.

Search site	The name of the database
http://appft.uspto.gov/	United States Patent and Trademark Office Patent Full-Text Databases
https://register.epo.org/	European Patent Register
http://epub.sipo.gov.cn/	China National Intellectual Property Administration online gazette
https://patentscope.wipo.int/	The "Patentscope" database
https://worldwide.espacenet.com/	The "Espacenet" database

The databases provided by the EPO, USPTO, CNIPA and WIPO are listed in Table 5: they contain applications filed directly to the patent office or through the PCT procedure (see section 2.2.2).

Firstly, the patent applications' search was performed using the USPTO database. Thus, in order to get the documents that include at least one inventor residing in (or coming from) Kazakhstan, the USPTO provides the advanced search option, where the search query can be assisted by various field codes and logical operators. By applying the Kazakhstan country code "KZ" in the field "Inventor country" the search returned 137 results. All available patent applications were included in the analysis, regardless of whether patents were granted or not. The retrieved information required one-by-one assessment to identify patent applications related to the same inventions or those not belonging to Kazakhstani inventors. After careful review, only one irrelevant patent application was detected with mistyping in the bibliographic data. Additionally, the USPTO database stores patent applications with minor changes that do not affect the essence of the invention published under different numbers. Revision of the retrieved results revealed 9 cases with doubled inventions and 5 cases with tripled ones. After eliminating these duplications and triplications, the total number of USPTO applications with Kazakhstani inventors were 117.

To obtain patent documents from the EPO and CNIPA, the search strategy was similar to the one adopted for the USPTO. In the European Patent Register and

the China National Intellectual Property Administration online gazette names of inventors and applicants go along with the country prefix. The smart search was conducted applying keyword “KZ” in fields of inventor, applicant, priority number or PCT application data. The European Patent Register gave 59 hits while the CNIPA online gazette returned 65 results. The obtained information was entered into separate databases.

The main drawback of the above keyword search is the presence of several irrelevant or “wrong” results in the retrieved documents. After a manual screening and revision, 36 patent applications filed to the EPO and CNIPA were identified as unrelated to inventors residing in Kazakhstan and they were neglected.

The USPTO contains patent applications published since 2003, while the databases of the EPO, CNIPA and WIPO since 1991, namely the year of Kazakhstan independence from the USSR. However, assuming that the recent data is more relevant for this analysis, all obtained patent applications published before 2000 were eliminated from the sample. In the end, we get 52 patent applications filed to the EPO and 36 with the CNIPA.

Along with some irrelevant or wrong information, it is possible that some patent applications did not appear in the search engine of the three afore mentioned patent databases. Therefore, in order to get possibly missing data a similar patent search was performed using additional resources with worldwide coverage: “Patentoscope” and “Espacenet”. These databases provide access to international

PCT applications, as well as to patent documents of national and regional patent offices. Moreover, they give information related to patent families. Therefore, they were used to identify family members – patent documents related to one invention filed to different patent offices. This search helped to gain more applications, especially filed to the CNIPA and the USPTO. It was discovered that not all original documents of Chinese patent office include the information about inventors' residency, thus some of them did not appear in the previous search. Missing applications of the USPTO published between 2000 and 2003 were also included in the sample.

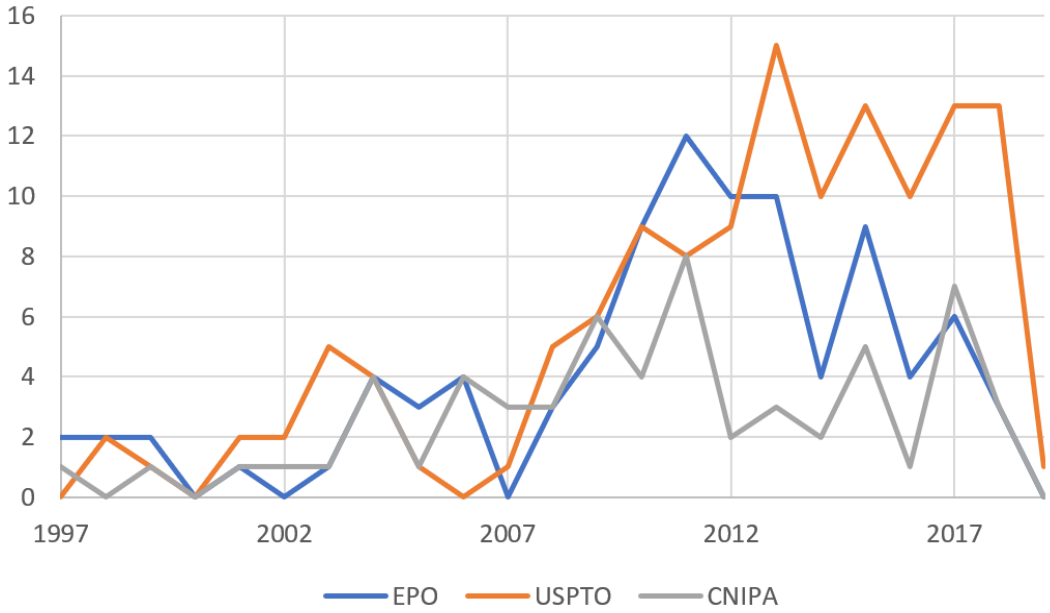
Along with the specific patent applications to the EPO, USPTO and CNIPA, the search provided the international (PCT) patent applications. PCTs have a specific publication number starting in "WO…". All applications were distributed among their patent families.

Including the PCT applications we get a total of 445 inventions with Kazakhstani inventors. However, only 175 of the above inventions (39%) were effectively applied with the EPO, USPTO and CNIPA. Each of these inventions were filed sometimes only in one country, other times in two and even in all the three countries (patent families with 2 or 3 countries/regions). Therefore, these 175 inventions gave rise to 285 applications. The data on applications will be examined later in Table 7.

4.2 Patent applications by patent office and applicants' nationality

Figure 17 shows the distribution of patent applications among the three patent offices over time. Between 1997 and 2019 the USPTO received the biggest share of the total number of applications (46%), followed by the EPO (33%) and the CNIPA (21%).

Figure 17. Number of patent applications with Kazakhstani inventors by patent office filed from 1997 to 2019.



Source: Author's calculations

The number of specific applications filed to the EPO, USPTO and CNIPA were small and fluctuated between 0 and 5 from 1997 to 2007. However, after 2008 the applications filed to all three patent offices increased. The trend of patent applications filed to the EPO after 2011 went down, while for the USPTO it

reached a peak in 2013. At the same time, the CNIPA trend stabilized although with some fluctuations. For the most recent years, the number of patent applications in all patent offices decreased significantly. Data for 2019 are probably incomplete due to the gap in time between filing the patent application, its publishing and its extension in different countries. For instance, some of the more recent USPTO applications (2017-2019) could be filed to the CNIPA in subsequent years (2020-2022).

Table 6. Distribution of patent applications by patent offices.

	EPO	USPTO	CNIPA	USPTO-CNIPA	EPO-CNIPA	USPTO-EPO	Total
EPO	22	34	5	33	-	-	94
USPTO	34	58	5	-	33	-	130
CNIPA	5	5	18	-	-	33	61
Total applications:							285

Source: Author's calculation

As mentioned before, some patent applications refer to the same inventions. As shown in Table 6, the inventions for which patent protection was sought in all three patent offices were 33. Then, there are 34 applications filed to both EPO and USPTO; 5 applications to both EPO and CNIPA; 5 applications to both USPTO and CNIPA. Hence, in total, there are 44 patent applications filed in two patent offices for the same inventions.

To summarize: 33 applications (all three patent offices) + 44 (two patent offices) + 22 (EPO only) + 58 (USPTO only) + 18 (CNIPA only) = 175 inventions.

According to Table 6, the majority of the USPTO applications are filed to the USPTO only (45%). Instead, the share of applications filed to the EPO only is not that big (23%), compared to the USPTO figure. On the other hand, most of the applications in the CNIPA are done only if there are other applications to the EPO and the USPTO. Therefore, we can infer that China is chosen as an additional country, but not autonomously.

Table 7. Patent applications by type of applicant

	Applicant and inventors from Kazakhstan		Only inventors from Kazakhstan		Total
	Number	Row percentage	Number	Row percentage	Number
EPO	67	71	27	29	94
USPTO	78	60	52	40	130
CNIPA	50	82	11	18	61
Total	195	68	90	32	285

Source: Author's calculations

Table 7 shows the distribution of the patent applications according to the type of applicant. In the first column, there is the number of applications filed with the participation of Kazakhstani applicants, whereas in the second one there are only foreign applicants.

In general, the patent applications with the participation of domestic applicants is predominate (68%). However, this is mainly due to the shares of domestic applicants in the EPO and the CNIPA (71 and 82% respectively). The biggest share of patent applications with foreign applicants (40%) belongs to the USPTO.

Table 8. Inventions with patent applications filed to the EPO, USPTO and CNIPA.

	Applicant and inventors from Kazakhstan		Only inventors from Kazakhstan		Total
	Number	Row percentage	Number	Row percentage	Number
In all three patent offices	24	73	9	27	33
In two patent offices	26	59	18	41	44
EPO only	20	91	2	9	22
USPTO only	33	57	25	43	58
CNIPA only	18	100	0	0	18
Total	121	69	54	31	175

Source: Author's calculation

The figures in Table 8, confirm the above considerations. The share of applications submitted by foreign applicants is relevant (43%) when the patent requests refer to the USPTO only. On the contrary, patenting to the CNIPA only or the EPO only involves almost exclusively domestic applicants. This is reasonable due to the geographical and economic proximity of Kazakhstan to both China and Europe. China and Kazakhstan have close trade and economic ties. The

European Union is also a main economic partner of the Republic of Kazakhstan, as in 1994 both signed a Partnership and Cooperation Agreement. More enhancements to this Agreement were ratified in 2016, also in relation to intellectual property. The partners agreed to promote the production and commercialization of innovative products and achieve an appropriate and effective level of protection of intellectual property rights.

Accordingly, domestic applicants are more interested in commercializing their innovations in the larger and richer markets that are close to Kazakhstan.

4.3 The most valuable patent applications

As stressed in Chapter 2, an invention with the patent protection requests filed in several countries is considered as more valuable. The possible limitation of this analysis is the time delay between the extension of patent application in different countries. Considering the time span of our analysis, it is possible that among the inventions with patent applications first filed to a unique patent office in 2017-2019, some will be extended in other countries in the subsequent year. Accordingly, it is possible that, at this stage, the number of valuable inventions is a little underestimated.

As already shown with Table 7, out of the 175 inventions developed with the participation of at least one inventor residing in Kazakhstan, only 33 (19%) have sought patent protection in all the three patent offices considered: USPTO, EPO

and CNIPA. Among these inventions with the largest patent families, 48% of them were filed by individuals. The other 52% relate to legal entities: 9 inventions were filed by foreign legal entities, 2 were submitted by Kazakhstani universities, 5 by scientific research institutes and 1 by a business firm.

Out of the 175 inventions, 44 inventions (25%) refer to patent families filed to two patent offices: 41% were assigned to foreign applicants only, 48% to individuals, 9% to Kazakhstani universities and 2% to business companies.

Table 9. Patent families by field of technology (in percentage).

Technology field	Three patent offices	Two patent offices
Chemistry	30.3	22.7
Mechanical engineering	36.4	22.7
Instruments	6.1	15.9
Electrical engineering	12.1	27.3
Other fields	15.1	11.4
Total	100	100

Author's calculations

According to the technology classification based on IPC codes (Schmoch 2008), the biggest share of the patent applications filed to three patent offices is present in the "Mechanical engineering" and the "Chemistry" sectors, whereas for those filed to two patent offices is concentrated in "Electrical engineering" (see Table 9).

Considering all these valuable inventions together (33+44), the more frequent and specific technological fields are concentrated in "Electrical machinery, apparatus, energy" followed by "Chemical engineering", Medical technology", and "Thermal processes and apparatus".

4.4 Foreign versus domestic applicants

Table 10 shows the distribution of the 175 inventions with patent applications by types of domestic and foreign applicant and by patent office.

Table 10. Inventions by domestic and foreign applicant and patent office

	Total	Only EPO	Only USPTO	Only CNIPA	EPO-USPTO	EPO-CNIPA	CNIPA-USPTO	EPO-USPTO-CNIPA
Total	175	22	58	18	34	5	5	33
Only Kazakhstani individuals	72	12	20	10	13	3	2	12
Including foreign individuals	17	4	5	1	1	1	1	4
Only Kazakhstani legal entities	30	4	8	5	4	1	0	8
Foreign legal entities	56	2	25	2	16	0	2	9

Author's calculations

Most inventions with individual applicants were filed by domestic applicants only. However, there are 17 cases in which the applicants are both national and foreign. Therefore, looking at domestic applicants, it emerges that most of them consist of individuals, whereas most inventions with foreign applicants (and Kazakhstani inventors) have been filed by legal entities. As already stressed, the former have been applied for patent protection not only to the USPTO but also to the EPO and even to all the three patent offices considered. Instead, most of the inventions with foreign applicants refer to the USPTO only followed by those filed to both the USPTO and EPO. In light of the different features of foreign and domestic applicants, in this section, we perform separate analyses.

4.4.1 Patent applications with foreign applicants

Overall, 56 patent applications were filed by foreign legal entities from 14 countries, including 2 of them submitted in collaboration with Kazakhstani legal entities. Most of them are business companies (about 78%).

According to Table 10, the biggest share of applications (almost 45%) were filed to the USPTO only. Another 45% were filed to the USPTO and the EPO or with all the three patent offices. This is reasonable, as most applications were filed by US companies (62%). Legal entities located in other countries/regions achieve smaller percentages: British Virgin Islands (10%), European Union (9%) and Russian Federation (9%). The biggest share of inventions belongs to three legal

entities of the United States: Vanderbilt University (16%), IBM Corporation (9%) and M-I Limited Liability Company (7%).

The Vanderbilt University is a US private research university founded in 1873. It enrols approximately 13,100 students and records a very high research activity (Vanderbilt University 2020). The Inventions involving Kazakhstani inventors refer to the "Medical technology" field: developing robotic prosthetic limbs devices and methodologies for controlling them.

IBM is a company with approximately 352,600 employees. It is mainly specialized in the production of computer hardware, middleware and software (IBM 2020). The inventions included in our analysis were developed with two Kazakhstani inventors and refer to the "Computer technology" field.

Also, the M-I was a business firm operated in the oil and gas industry. In 2010 it was merged into another company: the Schlumberger Technology Corporation. The M-I supplied drilling and completion fluid systems and services, solids control equipment, and waste management services. The inventions considered in our analysis mainly refer to earth drilling and well construction process. The sample also included 3 inventions filed by the Schlumberger Technology Corporation, developed with the participation of Kazakhstani inventors (M-I SWACO 2020).

Overall, foreign applicants were strong in the "Computer technology" field (23% of inventions), "Medical technology" (18%) and "Pharmaceuticals" (13%).

Inventions with foreign applicants were developed by teams of inventors coming from different countries: 53 inventors out of 173 (31%) were residing in Kazakhstan. Some of them participated in the creating process of two or more inventions.

To calculate in a different way the contribution of Kazakhstani inventors, we computed their ratio for each patent application and, then, the sum of the ratios was divided by the number of applications.

Since some inventions were developed with the participation of Kazakhstani inventors only, their contribution computed in this way turned out to be quite high. On average, inventors coming from Kazakhstan contribute to patent applications filed by foreigner legal entities by 43%.

From 1997 to 2007 the number of patent applications with the participation of Kazakhstani residents in the inventive process was very small and fluctuated between 0 and 3. However, over the last decade the situation has improved, and more inventors from Kazakhstan collaborate with foreign legal entities.

4.4.2 Patent applications with national applicants

Groups of individual inventors listed as applicants refers to the applicant type "individual applicants". Overall, 74% of all inventions filed by domestic applicants refer to individuals. This share remained the same for a last decade with some fluctuations.

As shown in Table 10, individual applicants mostly applied for patent protection to the USPTO, EPO and all three patent offices.

Only 17 out of 89 inventions were filed by domestic individuals in collaboration with foreigners.

Overall, 32 inventions related to national legal entities including 2 of them submitted in collaboration with foreign legal entities. They will be analysed in detail in the Sub-section 4.4.2.1.

Overall, among 121 inventions filed by national legal entities and individual applicants about 13% related to the "Materials and metallurgy" field. The latter was followed by "Electrical machinery, apparatus, energy" and "Civil engineering" (both with a 9% share).

4.4.2.1 National legal entities

The patent documents' bibliography provides the legal entities' names and their locations. Based on this information they were classified into 3 groups: higher educational institutions, scientific research institutions and business firms. Overall, among 23 legal entities (some of them have filed more than one patent application), there are 11 scientific research organisations, 7 business firms and 5 universities.

Table 11. Inventions with patent applications filed by national legal entities.

	Total	Only EPO	Only USPTO	Only CNIPA	EPO-USPTO	EPO-CNIPA	CNIPA-USPTO	EPO-USPTO-CNIPA
Business companies	7	1	0	4	1	0	0	1
Scientific Research Institutes	15	3	3	3	0	1	0	5
Universities	10	0	5	0	3	0	0	2
Total	32	4	8	7	4	1	0	8

Author's calculations

Table 11 shows the distribution of patent applications by type of legal entities and the patent office. In terms of innovative activity, the biggest share among national companies contributes to research institutes (47%), followed by universities (31%) and business companies (22%). Collaboration between legal entities from different institutional sectors was fertile ground for the development of 2 innovations. In both cases, it was assumed that the contribution was equally shared between them.

Half of the Kazakhstani universities' inventions were filed in the USPTO only, the biggest share of inventions of business firms was submitted to the CNIPA only, whereas scientific research institutes preferred to patent their inventions in all three patent offices at the same time.

Table 12. Top national entities in terms of number of patent applications

	Number of inventions	Number of applications
Nazarbayev University	6	8
Institute of Batteries	2	6
Kazakh National Agrarian University	2	5

Source: Author's calculations

Table 12 illustrates the legal entities filed the biggest number of patent applications among others. The biggest share belongs to two universities: Nazarbayev University, Kazakh National Agrarian University; and one research institute - Institute of Batteries.

The biggest number of inventions filed internationally were developed at Nazarbayev University. It is an autonomous higher education institute established by the former president Nursultan Nazarbayev in 2010 to integrate science, education and industry in order to promote Kazakhstan's development. The main goal was to develop it to a world-class university with a strong research programme.

Nazarbayev University is the most internationalised university in Kazakhstan. It attracted many professors from different countries to implement international best practices. Currently, 85% of the faculty members are the international staff (OECD 2017).

Consequently, 4 out of 6 inventions in our sample filed by Nazarbayev University were developed with the participation of foreign inventors. These inventions refer to the probe measurements of objects after micro- and nano-sectioning using scanning probe microscope.

Another invention discloses a method of measurement temperature during treatment of tumour formation. The last one belongs to the electrochemical industry or by the technology classification based on IPC codes to "Electrical machinery, apparatus, energy" and describes aqueous lithium-ion battery.

This innovative battery was developed by a doctor of Technical Sciences, a professor in Chemical Engineering at Nazarbayev University, also being president and founder of the Institute of Batteries. Therefore, the inventions submitted by the Institute of Batteries also refer to the "Electrical machinery, apparatus, energy" technological field and describe other rechargeable batteries without toxic heavy metals.

Kazakh National Agrarian University is the leading university in Kazakhstan in the agricultural sector with almost 8000 students and more than 800 academic faculty staff. The faculty conducts basic and applied scientific researches as well as other scientific-technical projects. Moreover, the university participates in joint scientific projects with international organisations, as the UNESCO and FAO (KazNAU 2020).

The inventions of Kazakh National Agrarian University refer to “Mechanical engineering” field. They describe new methods for threshing agricultural crops, including magnetic treatment of freshly threshed seeds.

4.5 International collaborations

The assembled database offers the chance to evaluate international technological collaborations, considering the place of residence of the people who developed each invention.

As it was stressed in the previous section, most international collaborations occurred in the set of applications filed by foreign companies. Therefore, the analysis for the set of applications with foreign applicants is performed separately from those with domestic applicants.

Only 11 foreigners out of 105 total inventors participated in developing inventions filed by national legal entities only. The data show that 10 of them were residents of the Russian Federation and 1 was from Germany. About 30% of these inventions were developed with the participation of at least one person in the team of inventors who were not resident in Kazakhstan. Most of inventions with foreign inventors were submitted by Kazakhstani universities (about 50%), and lesser by research organisations (20%).

Overall, the contribution rate of foreign inventors amounts to 12%. This index was measured by calculating the number of foreign inventors in relation to all

listed inventors for each given patent application, assuming a uniform contribution of all inventors. The same method was applied in Section 4.1.1 to compute the contribution rate of national inventors in patent applications filed by foreign legal entities.

Considering the set of applications filed by individuals, there are 18 inventions (20%) developed in cooperation with foreign inventors. Overall, out of 23 international co-inventors 14 were residing in the Russian Federation, 6 – in the US. The contribution rate of these international co-inventors was 9%.

To sum up, most co-inventors of domestic patent applications were from the Russian Federation. This was expected since Kazakhstan and Russia have a common past. The former USSR had a single economic area, as well as cultural values and traditions, a common system of scientific activity and innovative development coordination. In addition, in 2012 between Russia, Kazakhstan and Belarus was established the "common economic space". This common market for goods, investment and labour has enhanced the trade flows between these countries (Çengel, Alpay, and Sultangazin 2013). Geographical proximity and language compatibility also contribute to long-term cooperation between Kazakhstani and Russian people in the field of science, technology and innovation.

As expected, there is a more diverse list of inventors in the set of patent applications filed by foreign applicants. Since most of the applicants are US legal

entities, the largest proportion of foreign inventors comes from the United States (36%). As the US are prominent in innovation, they also attract many foreign scientists and engineers. Along with Kazakhstani inventors, Russian inventors account for 24%, followed by Europeans (21%).

Considering foreign applications, 53 out of 173 (31%) inventors resided in Kazakhstan. As it was mentioned in Section 4.4.1, on average, Kazakhstani inventors contribute to patent applications with foreign legal entities by 43%. On a lower extend they contribute to foreign universities, and on a higher extend to business companies. Most of Kazakhstani inventors collaborate with US inventors (45% of inventions with foreign applicants), followed by inventors from the European Union (27%) and from the Russian Federation (18%).

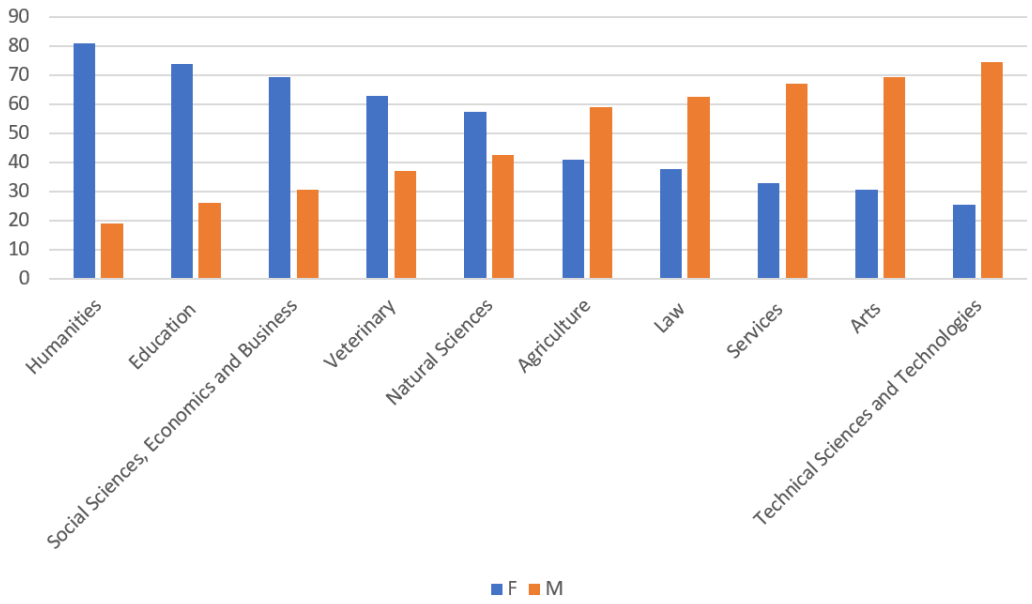
4.6 Woman participation in patenting activity

In the view of Shaw and Hess (2018: 7) "women are less likely than men to enter into and advance in the fields of science, technology, engineering, and mathematics, and less likely to patent and commercialize their inventions when they do".

According to the National Statistics Committee, in 2018 females constitute almost 52% of the population of Kazakhstan and 54% of university enrolment. As shown in Figure 18, at the beginning of the 2017/2018 academic year, female university enrolment overtook the number of males in the field of study "Natural sciences".

However, in “Technical Sciences and Technologies” the number of female students lag considerably behind. According to the UNESCO Institute of Statistics, in Kazakhstan the number of researchers were recently distributed almost evenly between gender. But in the field of “Engineering and technology” there is a lack of women representation. This is remarkable because these fields play a crucial role in patenting activities.

Figure 18. Gender distribution of university enrolment by field of science in Kazakhstan



Source: Ministry of National Economy of the Republic of Kazakhstan Statistics committee, (2020).

Using the information taken from the patent applications database, the gender gap in innovation activity in Kazakhstan was assessed. Women’s participation in international patenting was evaluated by considering the number of innovations

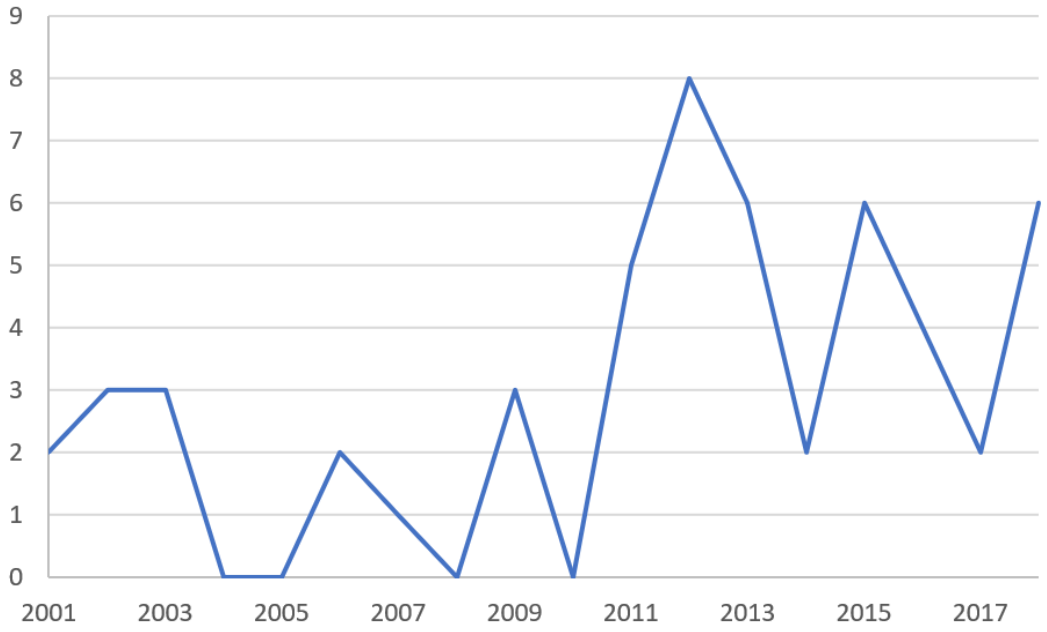
which were developed with the participation of at least one-woman inventor residing in Kazakhstan. In this case, the total sample of 175 inventions was used, because we are interested in finding the share of women on total Kazakhstani inventors. For the purpose of this analysis, a first name-based gender identification method was used to identify male and female inventors and extract female gender statistics.

When calculating the total male/female inventors' ratio among those who reside in Kazakhstan, it emerges that roughly for every woman there are 5 men. Out of 175 inventions, 42 were developed with the participation of Kazakhstani female inventors, therefore, the share of inventions with women participation recorded in patent applications was 24% on average. However, the contribution of Kazakhstani woman inventors was only 9% when calculated by dividing the number of females over the total number of inventors involved in each patent.

Thus, the share of Kazakhstani women participating in the international patent activity appears to be low. However, this number is not that low compared to other countries. WIPO (2016) states that in 2015 at the global level women's participation rate accounted for 29%. This indicator varied across countries, with the lowest level of gender equality on the African continent to the highest in Asia. The underrepresentation of women in patenting activity can be explained, in general terms, by the woman's role in society, when priority is given to the family

and the raising of children, which may interfere with the development of a professional career, including the fields of technology and engineering.

Figure 19. Number of Kazakhstani women inventors participated in patenting activity, 2001-2018



Source: Authors' calculations (2020).

Figure 19 shows the number of women inventors residing in Kazakhstan who participated in international patenting activity from 2001 to 2018. As the total number of patent applications grew over time, more and more women were included in the patenting process. The participation rate of Kazakhstani female inventors also had a positive trend.

Based on additional information, it emerges that women prefer to work in collaborations with other inventors: indeed, in the sample, there are no female inventors who developed their inventions on their own. This can be caused by the fact that obtaining an international patent is expensive, especially for women who in general have a lower income than men.

According to WIPO (2016), women participation in international patenting is higher in the universities and public research organizations than in the business enterprises. Then considering inventions submitted by national legal entities, Kazakhstani women participated in 67% of patent applications filed by scientific research institutes, 40% by universities and only 29% of those filed by business companies.

The participation rate of Kazakhstani female inventors in patent applications filed by foreign applicants is more than half of national applicants. The possible explanation is that foreign applicants are mainly business companies. As it was stressed before, women are less likely to participate in patenting in business enterprises. Another explanation considers the gender gap as a factor, since women may have fewer opportunities for international higher education, international mobility and work experience in international firms. Thus, women may tend to rely on a network based mainly locally, rather than globally, to develop and innovate.

5. CONCLUDING REMARKS

IPRs play an important role in protecting inventions. Disclosed information of inventions can promote further technological developments, induce more innovation and technological progress. Innovations lead to the economic development of a country and enable sustainable economic growth.

Kazakhstan is a country heavily dependent on natural resources and vulnerable to external shocks. Therefore, Kazakhstan seeks to diversify its economy and achieve sustainable growth through industrial and innovative development. However, the country does not perform well in innovation activity.

Kazakhstan's R&D spending is critically low compared to other countries. Most R&D was carried out by universities and the public sector, which indicates low motivation in R&D performance by business firms. Therefore, the results of R&D often have no practical application. Indeed, Kazakhstani firms are most interested in adopting new advanced technologies from developed countries.

Thus, Kazakhstan strives to attract FDI from advanced countries. However, most inward FDI has been mainly concentrated in the extractive industries. In recent years the global oil price has plummeted, causing some foreign companies operating in the oil and gas sectors to suspend their activity in Kazakhstan. As a consequence, inward flows of FDI have steadily decreased.

The patent system of Kazakhstan, which was not in line with international standards before joining the WTO, has improved over time. The previous patent

law allowed to grant provisional and innovative patents without a proper examination based upon international patentability criteria. Therefore, most of these inventions were not valuable. However, after the 2015 change of patent regime, the number of “real” patent applications has significantly increased.

Since patent applications in foreign countries usually include high-quality inventions, the empirical analysis was not based on national patent applications but on international applications with the participation of Kazakhstani inventors filed to three biggest patent offices of the world: USPTO, EPO and CNIPA. The analysis has shown that also the number of patent applications filed internationally has raised over time.

The patent applications under exam were firstly broken down by the type of applicants. Overall, the biggest share belonged to domestic applicants. Most individual applicants were residing in Kazakhstan only. However, there were some inventions submitted in collaboration with foreign and domestic individual applicants and a few inventions with national and foreign legal entities.

The biggest share of patent applications was received by the USPTO, followed by the EPO and the CNIPA. Mainly individual applicants filed their patent application with the EPO and CNIPA, whereas legal entities preferred the USPTO and the EPO. The reason behind this is that most foreign legal entities were based in the United States. This country has a big innovative capacity and attracts scientists and engineers from different countries, including Kazakhstan. Foreign

legal entities filed to China at a lower extent. By them, China is chosen as an additional country, but not autonomously. However, individual applicants and national legal entities were more interested in patenting in China, due to geographical proximity and economic ties with Kazakhstan.

Among patent applications filed by foreign legal entities, most of them were business companies (about 78%), whereas considering the patent applications filed by national legal entities the share of business firms accounted by 23% only. This suggests that Kazakhstani business companies do not have a strong motivation in international patenting.

The distribution of patent applications by technology fields illustrates the different areas of strength. Foreign applicants were strong in patenting-intensive fields, such as “Computer technology”, while national applicants thrived in “Materials, metallurgy”.

Inventions with the patent protection requests filed in several countries/regions were considered as the most valuable. The share of such inventions in our sample accounted for 44%. They were mainly filed by individuals and foreign legal entities and at a lesser extent by domestic business firms.

The participation of foreign inventors in developing inventions filed by national legal entities was small, with a contribution rate of only 12%. Most of them were filed by Kazakhstani universities. The most common co-inventors were residing in the Russian Federation. This was predictable, since being in the same

federation for many years, they used to have a common system of scientific activity and innovative development coordination.

The number of Kazakhstani women inventors participated in international patenting activity has been small although it has improved over time. The Kazakhstani female/male inventors' ratio was 1/5. Less than a third of all international applications included at least one-woman inventor. The underrepresentation of women in patenting activity can be explained by the woman's role in society when priority is given to the family and the care of children.

To improve the innovative performance of Kazakhstan some recommendations are in order. The government should attract more FDI in the sectors different from the extractive one, in order to shift the focus to technology-intensive industries, namely ICT, biotechnology and renewable energy.

Since intellectual property is a result of R&D performance, the government should raise the involvement in R&D activities by domestic firms. Promoting incentives to large business enterprises to increase innovation activities will help to enhance the commercialization of inventions. Also, small and medium-sized enterprises should be supported with subsidies to perform R&D activities. Additionally, enhancing collaboration and coordination between business companies, research institutes and universities would be beneficial to all parties involved.

Intellectual properties are a useful tool to foster innovation and to transfer knowledge. It is important to educate business companies about the importance of IP rights and the patenting process. Cooperation of local researchers with the international scientific community would be beneficial in the development of innovations. Moreover, the involvement of more female researchers in innovative activities can help increase IP output in Kazakhstan. The government's role for all the above issues is crucial. Thus, the government needs to implement a series of carefully thought and effective strategies if wants to achieve the "Kazakhstan 2050" goal.

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