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“Competing for Supply-Driven R&D Investments by  
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and the United States”

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**List of Abbreviations**

| <b>Abbreviation</b> | <b>Definition</b>                                              |
|---------------------|----------------------------------------------------------------|
| BERD                | Business Enterprise Expenditure on R&D                         |
| CIPA                | China Investment Promotion Agency                              |
| COI                 | Center of Innovation                                           |
| FDI                 | Foreign Direct Investment                                      |
| FTE                 | Full-Time Equivalent                                           |
| GERD                | Gross Domestic Expenditure on R&D                              |
| GOALI               | Grant Opportunities for Academic Liaison with Industry         |
| GOVERD              | Government Expenditure on R&D                                  |
| HERD                | Higher Education Expenditure on R&D                            |
| INTERN              | Non-Academic Research Internships for Graduate Students        |
| IPR                 | Intellectual Property Rights                                   |
| IUCRC               | Industry-University Cooperative Research Centers               |
| JETRO               | Japan External Trade Organization                              |
| JPO                 | Japan Patent Office                                            |
| JST                 | Japan Science and Technology Agency                            |
| METI                | Ministry of Economy, Trade and Industry                        |
| MEXT                | Ministry of Education, Culture, Sports, Science and Technology |
| MNE                 | Multinational Enterprise                                       |
| MOST                | Ministry of Science and Technology                             |
| NKP                 | National Key R&D Program                                       |
| NSF                 | National Science Foundation                                    |
| NSFC                | National Natural Science Foundation of China                   |
| OECD                | Organisation for Economic Co-operation and Development         |
| PETOE               | Plan for Educating and Training Outstanding Engineers          |
| R&D                 | Research and Development                                       |
| S&T                 | Science and Technology                                         |
| S-Innovation        | The Strategic Promotion of Innovative Research and Development |
| STCs                | Science and Technology Centers                                 |
| THE                 | Times Higher Education                                         |
| USPTO               | United States Patent and Trademark Office                      |
| WIPO                | World Intellectual Property Organization                       |



# 1 Introduction

## 1.1 The Globalization of R&D

Since the 1990s, the international economy has experienced a rapid growth of foreign direct investment (FDI) by multinational enterprises (MNEs). This global surge in investments was triggered by the renewed confidence in the positive benefits of FDI and the following liberalization of direct investment policies, but also from the privatization of publicly-owned corporations in countries around the world and the globalization and regionalization of the international economy (Blomström & Kokko, 2003, p. 1). According to United Nations Conference on Trade and Development (UNCTAD), the global inflow of FDI increased from \$184 billion in 1990 to \$1,297 billion in 2018, with the United States (\$252 billion) being the largest recipient of FDI, followed by the People's Republic of China (\$139 billion; hereinafter referred to as China) and Hongkong (\$116 billion; UNCTAD, 1992, p. 14; UNCTAD, 2019, p. 1).

Following along with this rise in FDI, multinational corporations started to develop more global value chains and established not just production, but also research and development (R&D) activities outside their home countries. Being the first stage of the development process, R&D has “the purpose of discovering or developing new products or services, improving existing products, or discovering or developing new or more efficient production processes” (Organisation for Economic Co-operation and Development [OECD], 2005, p. 118). In 2019, the total investments (domestic and foreign) of the top 2500 R&D companies totaled over €823 billion (\$905 billion)<sup>1</sup>, accounting for over 50% of the gross expenditure on R&D worldwide. Amongst the top R&D spenders, European and North American firms in the technology, pharmaceutical and automotive industries such as Alphabet and Volkswagen have been the leading drivers of innovation. However, also Asian firms contributed a large share of R&D spending, and amongst the top 50 companies, over 15% belonged to the Asian region, with corporates from Japan (12%), China (4%) and South Korea (2%) accounting for the majority of investments (Hernández et al., 2019, pp. 4-5).

## 1.2 R&D, Innovation and Productivity in East Asia

The motivations and drivers behind R&D investments are manifold and will therefore be discussed in more detail in the following chapters. However, it can be said that the literature generally distinguishes between two main motives of global R&D. For some MNEs, R&D is a measure to support production abroad and to adapt products and technologies to the needs of foreign markets (demand-driven), while in more recent studies, the host-country's innovation and knowledge capacity (supply-driven) was highlighted as main driver for firms to go abroad (Guimón, 2011,

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<sup>1</sup> 1 Eur = 1.1 USD

p. 78). This clearly indicates that aside from firm-specific reasons, the environment provided by a country plays a key role in attracting FDI. States are aware of this fact and increasingly try to influence the location decisions of foreign investors. For economies, this is important because generally, foreign MNEs are characterized by higher R&D intensities than their domestic counterparts (OECD, 2010, p. 192). Furthermore, by attracting R&D-intensive FDI, they expect to receive quantitative and qualitative benefits as well. Quantitative improvements include an increase of capital investment, production, employment, and tax revenues, whereas qualitative improvements are created through knowledge and technology spillovers to domestic firms, universities and other local research facilities (Guimón, 2008, p. 2; Velde, 2001, p. 6). This allows host-economies to develop knowledge clusters, to integrate more into global value chains and to increase productivity, which makes the “internationalization of business R&D a key dimension of science, innovation and technology policy” (Dachs & Zahradnik, 2017, para. 3).

In view of the importance of R&D investments for the development of national innovation systems and for sustaining or increasing productivity levels, this master’s thesis proposes to investigate and critically compare China’s and Japan’s host country environment for the attraction of supply-driven R&D by mapping their science and technology (S&T) capabilities and infrastructures and by assessing the incentive policies targeting R&D investments by foreign MNEs. The two countries have been picked for the comparative analysis, because for both, research and innovation play a vital role in their economic development plans. For China, the promotion of innovation and advanced technologies is crucial, because the economy has shown signs of slowing down, raising concerns about current development targets. China has for long relied on its manufacturing industry, a growing labor force, high levels of investments, and expanding exports to support the growing of the economy, however, a shrinking automotive and real estate sector and the trade dispute with the United States are affecting the second biggest economy in the world (Bradsher, 2019, para. 3). Adding to this, low fertility rates have created demographic challenges, leading to a critical turning point of labor market developments in 2017. Since then the country has experienced a shrinking of the labor force, weakening one of the major engines of economic growth in the East Asian country (World Bank, 2019a). According to a report by the World Bank, to maintain the present pace and to contend technology and innovation-based countries such as the United States, there are three key paths China has to take. First, it is necessary to allocate resources efficiently and to promote the competition within the Chinese market. Second, China has to further develop its innovation system and last, the adoption of advanced technologies and innovation needs to be accelerated. Especially the latter has large potential for sustaining economic development as there is much room for catching up in a number of industry sectors. In all three key paths outlined by the World Bank, an increase of FDI by foreign MNEs can be supportive. In order to develop more advanced

technologies and to promote innovation, the role of foreign enterprises becomes particularly important because by accelerating foreign R&D investments, knowledge and technology spillovers to the national innovation system can be facilitated. In addition, the presence of foreign MNEs increases the competition within the country, possibly sparking a productivity growth of domestic companies as well (Center for Strategic and International Studies, 2019, para. 2; World Bank, 2019b, pp. 21-22).

For Japan, innovation is seen as means to revitalize an economy that has been stagnating since the bubble burst in the 1990s. For years, labor productivity levels have lagged behind, and in 2017, Japan's labor output ranked more than 25% below the top half of OECD countries (Morikawa, 2019, para. 1; OECD, 2019, p. 9). In addition to low productivity levels, the aging society further elevates challenges for the government to recover its economy. According to the OECD, Japan's total population is projected to decline by around 25% until 2050. This would lead to a decrease of the working force in relation to the elderly population from 2.3 in 2015 to 1.4 in 2050, causing severe fiscal issues and a stagnating economic growth rate in Japan (OECD, 2018, p. 5). As the labor force and productivity are "twin drivers" for economic growth, the government must set appropriate measures (McKinsey Global Institute, 2015, p. 22). To tackle socio-economic issues and to sustain a decent labor force, it is essential for Japan to boost work force participation. This can be done by increasing the number of women in the labor market through the elimination of remaining obstacles such as high costs in childcare and unfavorable working hours (OECD, 2019, p. 9). Productivity growth on the other hand, could be achieved by removing regulatory barriers and increasing competition within the Japanese market. Similar to the Chinese case, the presence of foreign MNEs could provide additional contest in the market. Furthermore, a potential increase of innovation and technology spillovers through R&D of foreign MNEs has the capability of improving productivity levels as well, to tackle socio-economic challenges and to increase the comparative advantage of the country (OECD, 2017, p. 2). The latter becomes particularly important, because China's shift away from manufacturing towards an innovation and technology led economy applies further pressure on Japan. An increase of research and innovation processes especially in the fields where Japan is strong, however, could allow it to keep rivals such as China and South Korea at distance (Garcia-Herrero, 2018).

### **1.3 Thesis Outline**

As outlined earlier in the introductory chapter, the goal of this master's thesis is to compare the attractiveness of China and Japan for supply-driven R&D by MNEs. Therefore, the remainder of this study proceeds as follows. In the theoretical part, the research question, the relevance of this topic and the state of the art of the literature will be discussed. As the internationalization of FDI

has led to an extensive research in this area, the literature review will be split into three subchapters. The first subchapter will reflect on major concepts and theories in this field. Following, motivations and drivers behind R&D units will be discussed and quantitative and qualitative research determining the location-specific factors that affect multinationals' decision making will be reviewed. Building on the state of the art, a framework that serves as the basis for the study will be developed and then applied on the case countries. After the empirical analysis, the discussion of results will deal with the implications resulting from the respective strengths and weaknesses identified in both systems. Furthermore, to set a benchmark for international competitiveness, the outcomes will be compared with the United States. Finally, the conclusion will close this thesis with a summary of obtained findings and an outlook on further research needed in this field.

### **1.4 Research Question and Relevance**

The previous sections highlighted that the globalization of R&D activities has taken place in recent decades. For host-economies, an increase of foreign investments in R&D can contribute to the innovation system by facilitating knowledge spillovers and increasing the likelihood of productivity growth. With this in mind, nations have to become more sensitive to the factors that multinational corporations are looking at when rating locations for potential R&D activities. The aim of this study is to determine and compare the attractiveness of China and Japan for supply-driven R&D activities. To address this issue, it is necessary to evaluate and critically discuss their location-specific characteristics as well as their government policies in place to set off inward FDI by MNEs. In view of this, the following research question has been stated:

*(1) How do Chinese and Japanese location-specific characteristics differ and what are the similarities and differences of their promotion and linkage strategies for R&D investments by foreign MNEs?*

Furthermore, in the process of defining and comparing the strength and weaknesses of China and Japan in attracting supply-driven R&D, this study wants to not just compare the two East Asian nations with each other, but also internationally. Therefore, the United States will be used as benchmark country. The reasons for measuring China's and Japan's performance against the United States and not another country is apparent. It is not just the biggest receiver of inward FDI worldwide, but also the top spender in R&D. Numerous foreign multinational firms operate their R&D centers in the United States, adding to the productivity growth in the country and showing that the United States is a highly attractive place for innovative activities. From 2013 to 2015, R&D performed by foreign MNEs topped \$50 billion in each of these years and reached over \$60 billion in 2016, representing 16% of all business R&D in the United States (Organization for International Investment, 2019, p. 1).

To address this issue and to incorporate the United States as benchmark for international competitiveness, the formulation of another research question is needed:

*(2) How competitive are China and Japan in attracting supply-driven R&D by MNEs compared to the United States?*

As this research aims to study current location-specific characteristics and present government approaches towards supply-driven R&D, if not other indicated, most recent data will be considered for the comparative study. The relevance of this analysis is given for a number of reasons and has already been touched upon to some degree in this introductory chapter. Technology and innovation are not only important for firms to compete in a global innovation race, but they have also become more essential for economies as well. For China and Japan, technological advancements are crucial, because they allow them to increase their productivity levels, to stay internationally competitive and they help to tackle socio-economic issues such as a shrinking labor force. An effective way to facilitate innovative activities is to raise R&D investments by foreign MNEs. However, business investors perceive the attractiveness of the host-country environment in many different ways. An in-depth analysis of the systems will allow this paper to draw important policy implications as it could unveil factors that potentially deter foreign firms from establishing a subsidiary and it can assist in pinpointing mismatches within the Chinese and Japanese system (OECD 1997, p. 13). Furthermore, by studying important mechanisms such as the promotion of FDI and the creation of linkages between foreign and domestic actors in addition to the location-specific characteristics, this study will also be able to investigate the different approaches taken by the Chinese and Japanese governments in a global race for FDI and how they try to facilitate knowledge and technology spillovers from foreign MNEs. By adding the United States as benchmark to the analysis, a more complete picture regarding the strengths and weaknesses of the respective countries can be created and it will allow this research to determine where China and Japan stand internationally.

## 2 Literature Review

### 2.1 Theories of FDI

Following along with the internationalization of FDI, scholars have tried to explain the motivations and reasons of firms to participate in overseas investments from a variety of angles. Therefore, before moving on to the analytical part of this paper, it is necessary to discuss and to recapitulate major theoretical concepts and the empirical literature on FDI and MNEs. This is important for two reasons: First, it provides the reader of this master's thesis with a comprehensive overview over existing literature, and second, the review of the state of the art will allow this study to develop a comprehensive framework for the comparative analysis of this paper. One of the earlier approaches that dealt with FDI and the location decisions of MNEs was the Heckscher–Ohlin model of the neoclassical trade theory. Heckscher and Ohlin highlighted the importance of country specific attributes such as land, labor and capital. These attributes allow firms to produce goods at lower cost as opposed to home-country production and therefore give them a comparative advantage over their business competitors (Faeth, 2009, pp. 166-167). However, it wasn't long until first scholars criticized the approach based on the Heckscher–Ohlin model for its limited ability to explain FDI flows. Therefore, Kindleberger (1969) and Hymer (1976) created a new framework, which stated that foreign firms needed ownership advantages, such as imperfect markets or government interference, to balance out the disadvantages of entering a foreign market and to be able to compete with local firms (Faeth, 2009, p. 167). By adding a time dimension to the ownership advantage theory, Vernon (1966, 1979) tried to explain why firms shifted from exporting products to FDI. For Vernon, each products life cycle consists of three stages: (1) the new product, (2) the maturing product and (3) the standardized product stage. The first stage incorporates R&D and initial manufacturing. Generally, this happens in the home country as firms benefit from their monopolistic advantage in the export markets. However, once the product becomes more standardized in later stages of the product cycle, MNEs tend to invest abroad and conditions such as the cost of production, patent protection and threats of new competition in the country of import become important considerations. Therefore, in the last stage of a product's life cycle, less developed countries are often favored due to the comparative advantage resulting through cheap labor costs.

Another major theoretical concept was developed by Buckley and Casson (1976), who were the first to extend and apply the internalization model to MNEs. Buckley and Casson argued that in a world of imperfect markets, which was characterized by high risk and uncertainty, firms aimed to reduce additional costs and to maximize their profits. Because of this, the incentive for firms to exterminate relationships with the external market and to create internal markets by bringing activities under a collective ownership were high. Once this internalization process crossed national

borders, MNEs were created. They further argued that there were four groups of factors that identified whether this process of internalization was necessary: (1) industry specific factors relating to the nature of the product and the structure of the external market, (2) region specific factors relating to the geographical and social characteristics of the region linked by the market, (3) nation specific factors relating to the political and fiscal relations between the nations concerned and (4) firm specific factors which reflect the ability of the management to organize an internal market (Buckley & Casson, 1976, pp. 33, 74). Hood and Young (1979) on the other hand, widened the scope of FDI theories by stressing the importance of location-specific advantages. For them, firms invest in economies with market features that allow them to achieve an improved outcome relative to alternative locations. This includes the access to protected markets, favorable tax treatments, lower production, transport costs and a favorable structure of competition.

However, some scholars were still unsatisfied with the existing concepts. Therefore, Dunning (1979) provided a further development of FDI theories by bringing together the internalization and traditional trade theory and constructing the so-called “eclectic paradigm” (Faeth, 2009, p. 171). The eclectic paradigm consists of three variables, which try to explain why firms operate overseas and why they chose FDI over other modes of entry such as export or licensing: (1) ownership, (2) location and (3) internalization. For Dunning, firms just engage in FDI if all three conditions are met (Dunning, 1979, p. 275). The ownership advantage enables firms to compete with business competitors in another market as these advantages compensate for the costs of setting up and operating activities in a foreign country. This includes factors such as reputation, trademarks or technological superiority through R&D (Dunning, 1988, p. 2; Lall, 1979, p. 1). The second condition of the eclectic paradigm, the location advantage, is concerned with the comparative advantage of a host-country. As already described earlier in this chapter, a host-country’s comparative advantages consist of immobile attributes such as land, labor and capital, which can just be fully utilized in that specific country. Therefore, enterprises engage in foreign production whenever they perceive that it is in their best interests to combine “spatially transferable intermediate products produced in the home country, with at least some immobile factor endowments or other intermediate products in another country” (Dunning, 1988, p. 4). The last parameter of the eclectic paradigm is the internalization advantage. Here, Dunning identified six reasons for bringing activities under a collective ownership: (1) the reduction of transaction and negotiating costs, (2) local market knowledge, (3) to gain advantage over one’s competitor through controlling the supply of inputs, product or production strategy and the access to markets, (4) to exploit, or protect oneself against, the consequences of government intervention, (5) to protect the property rights of the owning firm and (6) to make better use of capacity to gain advantage of size, joint production, integration and diversification (Dunning, 1979, p. 288).

## 2.2 Typologies of Foreign R&D Units

The review of major theoretical concepts has demonstrated that scholars across many fields have provided explanations for the reasons behind FDI. Early studies such as Kindleberger (1969) and Hymer (1976) stressed the importance of firm competitive advantages, while others argued that it was not one single factor, but rather a combination of multiple variables (Dunning, 1979). As the goal of this study is to evaluate the comparative advantage of the countries China, Japan and the United States for R&D investments by foreign MNEs, the focus will be put on host location-specific advantages. Before moving on to these specific determinants, however, the next section of the literature review will focus on the different types of R&D units and the distinct drivers and motivations behind R&D-intensive FDI.

Hakanson and Nobel (1993) for instance, studied the establishments of 170 foreign R&D facilities from Sweden's 20 largest manufacturing enterprises in the chemical and engineering industries and identified five different typologies of foreign R&D units: (1) market oriented units, (2) research units, (3) local production support units, (4) politically motivated units and (5) multi-motive units. The primary aim of market-oriented units is the adaptive development of products specifically geared to local market conditions, while the production support units assist the manufacturing facilities. Hakanson and Nobel argue that this is the case especially for subsidiaries that specialized in technologies or lines of production not found elsewhere in the corporation. While the former two motivations are related to product adaption and production support, laboratories that serve as research units have the motive to tap into foreign knowledge, to get access to skilled personnel not available at home and to establish links to foreign universities and research organizations. Politically motivated units on the other hand, don't undertake work abroad because of market or technological reasons, but as a result of political factors. This can be caused by labor legislations, by requests of local authorities or due to demands from the labor force (Hakanson & Nobel, 1993, pp. 399-401). Florida and Kenney had a closer look at Japanese investments in the United States and by doing so, they discovered two main patterns: (1) either R&D was established close to manufacturing plants to support the production and the adaption of products, or (2) facilities were located close to scientific institutions to gain access to researchers and technicians, showing that "the globalization of innovation is driven by a fundamental shift to a system of innovation-mediated production" (1994, pp. 365-366). Odagiri and Yasuda (1996) widened the scope of Florida and Kenney and analyzed overseas R&D of Japanese firms in the United States on the industry-area level (18 industries in 7 regions) and the company level (over 250 firms). Their results suggest that the larger the industry or firm, the higher the probability for establishing R&D overseas. This is the case because "the extension of R&D into abroad can be made without damaging the R&D scale (or scope) economies in the home country (Japan)" (Odagiri & Yasuda, 1996, p. 1076). More

interestingly, they uncovered that the motivations for R&D establishments overseas differed depending on the region and development level of the country. While the support of local manufacturing appeared to be central in Asia, in more advanced regions such as the United States and Europe, the access to advanced technological knowledge and R&D resources was most important. When studying R&D activities of foreign firms in the United States, also Dunning and Narula (1995) found that there were multiple drivers for R&D investments: (1) product, material or process adaption, (2) basic materials or product research, (3) rationalized R&D and (4) strategic asset-seeking R&D. The first type matches Hakanson and Nobel's market-oriented and support units and has the goal to support the adoption of products, materials, or processes for foreign markets. In contrast, R&D establishments that aim to conduct basic materials or product research are established because there often is a need for close interaction with the market. Furthermore, some research inputs or innovations might be immobile and can't be transferred to the home-country, requiring the establishment of basic materials or product research units. Other than the first two drivers, rationalized R&D has the purpose of cutting costs by increasing the efficiency of foreign production, while strategic asset-seeking R&D aims at acquiring competitive advantages by gaining access to foreign technologies, which are complementary to those already possessed (Dunning & Narula, 1995, pp. 42-44).

By studying Swedish firms' R&D activities, Fors and Zejan (1996) confirmed some of the previous findings and stressed that the adaption of products and processes for foreign markets were an essential driver for businesses to establish research facilities abroad. Contrary to this believe, Florida (1997) highlighted that some studies had overestimated the role of these demand-led factors in driving R&D-intensive FDI. By drawing from a survey of foreign-affiliated laboratories in the United States, he investigated that MNEs had a technology-oriented and not demand-oriented posture. Therefore, developing new product ideas, obtaining information on scientific and technological developments and gaining access to high-quality scientists, engineers, and designers was from importance for firms participating in the survey. Additional evidence that supported the significance of such a technology-oriented posture came from the regression analysis, which explored the relationship between R&D spending and activities. The findings from this analysis suggest that technology-oriented factors are the only aspects that are significantly associated with R&D spending.

To investigate the changing role of R&D facilities Pearce (1999) examined 190 production subsidiaries and laboratories of foreign MNEs operating in the UK. In line with studies such as Dunning and Narula (1995), Pearce found that there had occurred a shift from production adaption towards the support of strategic competitiveness. This implies that there is an increasing focus on supply-side factors and a decline of R&D activities close to the home base. Supply-side factors are

also key drivers for corporations from the biotechnology, drugs and electronics industries operating in the U.S. market (Serapio, Jr. & Dalton, 1999). Businesses from these industries establish R&D units in foreign countries because they want to tap into new knowledge and technologies rather than just supporting and adapting products for the U.S. market. Patel and Vega (1999) on the other hand, came to quite contradictory results. While they discovered an increasing importance of supply-driven R&D in the patenting activities of 220 of the most internationalized technology firms, they concluded that the number of MNEs engaging in overseas R&D to exploit the technological advantage of a host country was with 10% small. Rather MNEs located their technologies in areas where they were strong at home to support the adaption of products, processes and materials for the foreign market and to provide technical support to the off-shored manufacturing, showing little evidence that they went abroad to tap into foreign knowledge and to compensate for weaknesses in the home-country.

Thus far, the state of the art has shown that most studies have either found demand or supply-led considerations to be the most important drivers for global R&D. Building on these two lines of research, Kuemmerle (1999) provided a new model for the classification of R&D investments: (1) home-base-exploiting and (2) home-base-augmenting. Firms establish home-base-exploiting sites in order to utilize firm-specific capabilities abroad, if this mode of operation offers higher payoffs than the licensing out of processes or products to local firms. This leads to the establishment of facilities close to existing manufacturing sites and markets to adapt products. Home-base-augmenting in contrast, has the goal of supplementing firm-specific capabilities and leads to the establishment of R&D close to existing knowledge. In a study of 32 multinational firms from the pharmaceutical and electronics industries in five countries, most of the R&D sites fell into either one of these categories. Furthermore, in the majority of cases, firms established exploiting units before establishing augmenting units abroad (Kuemmerle, 1999, p. 184).

While Kuemmerle argued that the motivation behind R&D activities could generally be defined as either home-base-exploiting or home-base-augmenting, based on a study of 21 MNEs and their laboratories in Europe, Japan and the United States, Gerybadze and Reger (1999) concluded that there had to be distinguished between science and research-based and lead market-based investments. Each of these categories can be further split up into two types of firms. Science and research-based corporations are classified as “type a” when they are located in a large, developed home country with strong R&D capabilities in the particular sector. As they have already established their headquarters in a country with strong R&D capabilities, firms like this usually do not have strong incentives to locate significant parts of R&D abroad. In contrast, “type b” firms are located in smaller countries or in a country with less developed R&D capabilities. As they are dependent on R&D for innovation, these firms generally have strong incentives to locate parts of their research

activities abroad. In the second category, lead markets, type a firms benefit from the proximity to a world-class lead market and therefore, can establish an effective coupling of lead marketing, R&D and innovation in the home country, while type b firms are dependent on access to foreign markets, because the limited size of their home countries or the level of market sophistication forces them to perform some operations abroad. In a more recent study, Le Bas and Sierra (2002) studied the effects of home-country advantages and disadvantages on the likelihood of firms establishing R&D abroad, analyzing 345 firms with the highest patenting activity in Europe. Partially building on Kuemmerle's typologies of home-base-exploiting and home-base-augmenting, Le Bas and Sierra defined four strategies: (1) technology-seeking FDI in R&D, (2) home-base-exploiting FDI in R&D, (3) home-base-augmenting FDI in R&D and (4) market-seeking FDI in R&D. Other than Kuemmerle, however, they stressed the importance of home and host-country differences. Firms that exploit the home-base usually possess a competitive advantage in a technological field in their home markets, while the region in which they expand is rather weak in that specific technological field. When home-base-augmenting, firms that have a relative advantage in the home-base invest in countries that are also strong in that certain field or technology (Le Bas & Sierra, 2002, p. 593).

Von Zedtwitz and Gassmann (2002) conducted research with companies from Europe, the United States, Japan, South Korea, and China. By doing so, they gave rise to four models of international R&D organizations: (1) national treasure R&D, (2) technology-driven R&D, (3) market-driven R&D and (4) global R&D. The first type is called national treasure model because both, research and development, are established near the home-base with little to none activities at the international level. Companies with research and development at the home base usually are in a dominant position in their main technologies or their main market is domestic. On the far side of national treasure R&D is global R&D. Both, research and development are outsourced, and research is located close to high-quality research facilities. Technology driven R&D and market-seeking R&D on the other hand, take a middle ground. For the former, research is more internationalized than development and the shortage of qualified labor at home and the access to foreign research centers drives multinationals abroad. Companies with little globalized research but internationalized development are constituted as "market-driven" models. Out of the 81 companies studied, 10 companies fell into the first group, seven in the second, 42 in the third and 19 in the fourth group, showing that the market was the biggest driver amongst the companies analyzed (Von Zedtwitz & Gassmann, 2002, pp. 576-579).

Investigating 134 R&D investments by 49 German multinationals and grounding on the terminologies used by Kuemmerle, Ambos (2005) stressed capability-augmenting and capability-exploiting to be main drivers for more global R&D. Like other studies before, Ambos confirmed a sharp increase of the importance of resource-seeking rather than market-seeking motivations.

Adding to this, not just the general motive but also the local network of the host-country was a key factor for firms. If these local networks were strong and well-developed, the likelihood of a firm establishing R&D facilities was higher than in host-countries with weaker networks. In the case of capability-augmenting, corporate research institutes possessed strong linkages to local universities and research institutions but less to production facilities. For capability-exploiting facilities linkages to local customers were most essential.

## **2.3 Determinants of Supply-Driven R&D**

### **2.3.1 Innovation Capability, S&T Infrastructure, Human Capital and IPR**

The review of empirical studies has shown that there are various typologies of R&D units that define the motives and drivers of FDI. However, when having a closer look at the existing literature, it becomes apparent that there can be generally distinguished between two main drivers: (1) demand and (2) supply-driven R&D units. Demand-driven activities highlight the importance of adapting products and supporting the production for overseas markets and therefore, is highly connected to the manufacturing of a business, while supply-driven R&D involves the establishment of facilities close to clusters of foreign knowledge. As discussed in the introductory chapter, the goal of this study is to identify the differences and similarities of China's and Japan's location-specific characteristics and their government promotion measures for supply-driven investments. Therefore, to create an analytical framework for the comparative analysis, it is not just important to define the different drivers and motivations, but also the specific host-country characteristics that affect firms' decision making. While some studies provided an overview of factors influencing MNEs's decisions that were not just limited to supply-driven FDI (Bania, Calkins & Dalenberg, 1992; Falk, 2004; Granstrand, 1999; Kumar, 2001; Thomson, 2011; Thursby & Thursby, 2006), others studied supply-seeking characteristics in particular (Abramovsky, Harrison, & Simpson, 2007; Cohen, Nelson & Walsh, 2002; Karlsson & Andersson, 2005), while again others looked at the importance of the legal framework in form of intellectual property rights (Branstetter, Fisman, & Foley, 2006) or R&D subsidies (Blomström & Kokko, 2003; Bloom, Griffith, & Van Reenen, 2002; Cantwell & Mudambi, 2000; Mudambi & Mudambi, 2005) in more detail.

Granstrand (1999) for instance, studied the investments of over 40 Japanese and Swedish firms in the chemical, electric, and mechanical engineering sectors. For Japanese firms, the S&T infrastructure of a host-country was the strongest attractor, while Swedish investments seemed to be more demand-led. However, results also showed that due to the rising diversification of technology for both, Japanese and Swedish corporations, collaborations with universities through various channels such as personal contact with researchers had increased in importance. Factors that were not directly related to either demand or supply-seeking such as government policies,

regulations and psychic distance were of rather limited importance. Kumar (2001) studied the activities of Japanese and U.S. MNEs in over 70 countries for the years of 1982, 1989 and 1994. By doing so, Kumar discovered that market size (demand-driven) correlated positively with investments from U.S. and Japanese affiliates due to the need to support production abroad. Aside from this, also the abundance of highly educated manpower and technological efforts by local research facilities (supply-driven) were found to be essential. The effects of patent protection and restrictive trade regimes on the investments of MNEs, however, could not be verified.

A study that investigated potential determinants in a group of OECD countries was conducted by Falk (2004). For the period of 1970 to 2002, Falk looked at determinants such as public sector R&D, human capital (average years of schooling, literacy rate, tertiary education), patent protection, industry structure but also at financial and fiscal incentives. His results showed that there were several potential determinants affecting the location choice of MNEs. This included the R&D expenditures by universities, patent rights as well as tax incentives. However, while the first and the last determinant had a positive impact on business R&D spending in both, the static and dynamic data models, patent rights only demonstrated significance in the static model. In the same year, Davis and Meyer (2004) published a study that analyzed the influence of four conditions on the incidence and level of subsidiary R&D: (1) local competitive conditions, (2) local supply conditions, (3) scientific institutions and (4) government support. By compiling the responses from over 2000 subsidiary managers in seven European countries, they found that only the presence of scientific institutions had a consistent, positive effect on the incidence and level on R&D, while government support had a positive effect on the incidence of subsidiary R&D, but not its level. Sanyal (2004) analyzed investments by U.S. MNEs and found that demand-led factors such as market size could not be identified as important attractor. Technological infrastructure and resource endowments on the other hand, were crucial in affecting decisions to invest abroad and empirical results suggested that the greater the technological infrastructure and the greater the human capital in the host country, the higher was the likelihood that U.S. MNEs were willing to locate abroad. Furthermore, a stronger patent protection in the host country was favorable to investment decisions by U.S. MNEs. This contradicted with studies such as Granstrand (1999) and Kumar (2001), who didn't find intellectual property rights (IPR) to be important. The "centrality" of scientific output as strong predictor for multinationals' R&D location decisions was confirmed by Doh, Jones, Mudambi and Teegen (2005), who based their study on activities by U.S. firms in the year of 1999. Institutional quality, and telecommunications infrastructure influenced R&D as well, while the presence of other MNEs' R&D facilities could not be identified as a positive factor (p. 1).

While these studies mainly focused on European or U.S. multinationals, Gassmann and Han (2004) contributed to the scarce research on foreign R&D in China. By conducting interviews with experts

and managers of big Western firms such as Siemens, Microsoft and VW, Gassmann and Han tried to determine the different factors that had convinced firms to establish subsidiaries in China and not in other locations. By drawing data from numerous information sources, they explored that attributes related to knowledge seeking, such as the availability of highly qualified personnel, the possibility to tap into Chinese innovation and knowledge networks, but also regional and local pockets of innovation were essential. However, due to the market size and current economic development of China, also demand-driven aspects such as the growth potential and cost advantages were found to be key elements for foreign multinationals. Thursby and Thursby (2006) studied the country level-factors that determine the location of R&D for (1) emerging markets, (2) developed markets and (3) home markets. By conducting a survey with companies from the United States and Western Europe, they investigated that for emerging markets, the growth potential was most important, followed by the quality of R&D and university faculties. In developed and home markets, the quality of R&D and universities, the collaboration between industry and educational institutions as well as IPR were most essential. Other than in emerging markets however, market growth potential was just ranked on the fifth position, showing the difference in emerging and developed nations. Moreover, results suggest that tax breaks are rather unimportant in emerging markets, while they are more powerful in developed countries. As the analysis of developed markets and home markets created similar results, Thursby and Thursby concluded that “the issue is not why firms locate at home or not, but why they locate in a developed economy versus an emerging economy” (Thursby & Thursby, 2006, p. 27).

Athukorala and Kohpaiboon (2010) examined patterns of U.S. based MNEs over a relatively broad time scope (1990-2004) compared to previous studies (e.g., Doh et al., 2005; Kumar, 2001). The analysis revealed that the intensity of investments was mainly determined by the factors market size, geographic distance, overall R&D capability and cost of hiring R&D personnel, while IPR seemed to matter only for developed economies. Furthermore, the paper concluded that when controlled for other relevant variables, government incentives did not have a significant impact on the level of R&D intensity. Cincera, Cozza, and Tübke (2010) investigated the investment efforts by the largest R&D spenders in the EU, which represented about one fourth of the total R&D amount invested by EU companies worldwide. In line with other studies, knowledge-seeking factors such as the availability of researchers and the access to specialized knowledge emerged as the main determinants. Though of less importance, considerations on the cost of employing researchers appeared also to matter for firms preferring a location outside their home country, particularly in emerging markets. Driffield and Menghinello (2010) analyzed high-tech firms of the five OECD countries France, Italy, Ireland, the United States and Spain on the local, regional and national level. On the national stage, a high intensity of business and public sector R&D attracted firms from the

selected countries. This also highlights the importance of well-trained scientists and technicians, because for Driffield and Menghinello, a high intensity of public sector R&D is synonymous with high numbers of well-trained R&D staff. In contrast, the workforce with only secondary education is negatively associated with investments, emphasizing the role of education (Driffield & Menghinello, 2010, p. 32). Demirbag and Glaister (2010) examined the impact of home and host country, industry, and firm level variables on the choice of location, based on a dataset of 1,722 R&D projects undertaken in developed and emerging countries from 2002 to 2005. At the regional level, the difference in R&D wage and knowledge infrastructure between home and host countries, the science and engineering talent pool size, and political risk level of host countries were important factors. At the firm level, the experience of overseas R&D projects and prior experience of research in the host country were important location determinants.

Thomson (2011) looked at the role of scientific capacity, cost of R&D inputs, the ease of communication and IPR in attracting R&D covering data from 1985 to 2006. To define the national scientific capacity of a country, the input to basic scientific research, scientific outputs, and a composite index of the quality of research universities were used as indicators. Furthermore, to determine the impact of R&D cost, Thomson established a measure of tax-based subsidies and a measure of pre-tax researcher wages while he used the Fraser index to determine the level of IPR. The results of the gravity model pointed at the importance of scientific capacity in attracting R&D. Furthermore, the study suggested that fiscal incentives were an effective strategy for countries which hoped to attract globally mobile R&D and that IPR had a statistically significant effect on the host-country attractiveness. In their research of 446 location decisions by multinational firms based in the EU, Siedschlag, Smith, Turcotte and Zhang (2013) confirmed results from previous studies of this literature review. They found that not just human capital, the proximity to centers of research institutes and the research and innovation capacity of the region but also the agglomeration of foreign R&D activities in a country were appealing for foreign MNEs. On average, the location probability of a representative R&D foreign affiliate increased with agglomeration economies from foreign activities. However, the data also implied that these characteristics were not equally important for all firms and for European multinationals, the effects of government R&D expenditure were stronger than for North American multinationals. Patent intensity and the proximity to research institutions on the other hand, had stronger effects in the North American case, showing that a country has to be competitive in every aspect to attract R&D from multiple destinations.

The studies discussed thus far, focused on a variety of different variables. Some research however, avoided to cover the whole spectrum of factors and looked at some characteristics in detail. A study that paid particular attention to IPR was Branstetter, Fisman and Foley (2006), who covered technology transfers in 16 countries over a period of 17 years (1982-1999) by drawing data from

the U. S. Bureau of Economic Analysis and the Balance of Payments survey. Their research confirmed the results of other studies (e.g., Falk, 2004; Sanyal, 2004; Thomson, 2011; Thursby & Thursby, 2006) and found that the firms analyzed valued positive changes in patent rights and responded by significantly increasing technology transfers to reforming countries. Other studies focused on the particular issue of industry-university relations (e.g., Abramovsky et al., 2007; Cohen et al., 2002; Karlsson & Andersson, 2005). Cohen et al. (2002) for instance, studied the role of public research in attracting industrial R&D, drawing from a survey in the manufacturing industry. The goal of the study was to identify the effects of such research on industrial R&D and to determine through which channels this influence could be exercised. Cohen et al. concluded that public research was critical for industrial R&D and that it contributed to the innovation activities by “suggesting” new ideas for projects or by contributing to the completion of existing assignments. This impact was exerted through numerous channels such as papers and reports, public conferences and meetings, informal information exchange and consulting (Cohen et al., 2002, p. 22).

Like the previous study, Karlsson and Andersson (2005) and Abramovsky et al. (2007) paid particular attention to the relationship between the industry and universities in their research. Karlsson and Andersson used firm and university data covering the years of 1995 to 2001 with the purpose of analyzing the locational relationship between industry and university R&D in Sweden. Results suggest that there is a connection between the location of industrial and university R&D and that the industry is quite sensitive to public activities and vice versa. Abramovsky et al. (2007) came to similar results by investigating the relationship between business R&D and institutions from the tertiary education sector in the UK. Based on data from the Office for National Statistics from the years of 2000 to 2003, they observed a strong evidence for the co-location of industry and university R&D. However, they also highlighted that business R&D was not equally attracted to universities and that differences could be identified between industries. Firms from the pharmaceuticals and chemicals industries for instance were only attracted by high-quality institutes of higher education, while firms in the machinery industry were also affected by universities other than elite institutions (Abramovsky et al., 2007, p. 136). While these studies looked at the relationship between business R&D and universities in one particular country, Belderbos, Van Roy, Leten, and Thijs (2014) widened the scope of analysis by covering 15 EU countries. Amongst the 286 manufacturing firms studied over the period of 2003 to 2008, U.S. firms were responsible for the largest share of projects (45%), followed by firms based in the UK (10%), Germany (8%), Japan (6%), and France (6%). Supporting the findings of previous studies, Belderbos et al. claimed that the probability of R&D projects being located in a host region was positively affected by the local academic strength. However, it was not the publication output itself that was perceived as most attractive by foreign firms. Rather it was the supply of PhD graduates and the presence of a critical

mass of academic research, opportunities for firms to link up with strong local scientific networks of university researchers and opportunities to acquire technologies.

### 2.3.2 Government Promotion

The definition of R&D typologies and the review of location-specific factors has shown that determinants such as a skilled labor force, a well-developed S&T infrastructure and well-defined IPR are fundamental for attracting supply-driven R&D units. However, for many, the attraction of inward FDI has become a competition between host countries and the importance of investment promotion policies has increased in recent years (Faeth, 2009, p. 187). Therefore, I would like to discuss this issue in more detail in this chapter. Morisset and Pirnia (1998) for instance, analyzed the relationship between tax policies and FDI and whether tax policies were able to compensate for other obstacles in the business environment of a host country. The authors found rather mixed results and concluded that incentives neither made up for serious deficiencies in the investment environment, nor generated the desired externalities. However, when other factors were equal between potential locations, taxes did exert an impact. Also, Globerman and Fraser (1998) state that investment incentives such as financial subsidies and tax rewards alone are generally not an efficient way to raise national welfare and that host governments might wind up offering subsidies that exceed the net benefits of the inward investment. Therefore, it is more important to eliminate restrictions for foreign MNEs rather than pursuing policies that actively support foreign firms through fiscal and financial subsidies. Furthermore, promoting a skilled labor force is far more important to inward FDI than tax holidays, low-interest loans and other subsidies to foreign investors. For Blomström and Kokko (2003) financial and fiscal subsidies as main policy to attract FDI are inappropriate, because spillovers of foreign technology and skills to local industry are not an automatic consequence of foreign investment and potential spillover benefits are realized only if local firms had the ability and motivation to invest in absorbing foreign technologies and skills (p. 20). Therefore, while providing incentives for foreign firms, it is also necessary to implement appropriate industrial policies that create a strong potential for spillovers, including linkages between foreign and local firms, education, training, and R&D.

Based on a survey conducted with British subsidiaries in the engineering sector, Cantwell and Mudambi (2000) studied the link between government incentives and the location of R&D activities and whether incentives were able to directly influence the location of such investments. They learnt that amongst incentives, tax credits had the strongest effects. However, like previous studies, Cantwell and Mudambi concluded that financial or fiscal support had a significant second order impact on investments rather than a primary effect. Bloom, Griffith, and Van Reenen (2002) examined the impact of fiscal incentives on FDI by studying tax data (tax rates, depreciation

allowances and personal and corporate income taxes) and R&D spending in nine OECD countries from 1979 to 1997. They investigated that tax incentives were effective in increasing R&D intensity and that a “10% fall in the cost of R&D stimulates just over a 1% rise in the level of R&D in the short-run, and just under a 10% rise in R&D in the long-run” (Bloom, Griffith & Van Reenen, 2002, p.1).

In a more recent study, Rodríguez-Pose and Wilkie (2016) have analyzed government policies and their effects in 29 European countries. By doing so they have tested the effectiveness of direct (e.g., grants) and indirect support measures (e.g., tax credits, R&D allowances). The results of the study suggest that there is a positive relationship between direct financial support measures and R&D investments. However, it also showed that indirect financial incentives did not have any effect on investments by multinationals. Furthermore, the analysis discovered that the provision of direct financial support for business R&D yielded greater returns in areas that were more innovative and knowledge intensive. Therefore, even though direct financial mechanisms have a positive relationship, they should not be deployed without consideration of context and should be integrated into broader strategies to attract foreign innovation activities (Rodríguez-Pose & Wilkie 2016, pp. 33-36). In line with previous studies, also Guimón (2009, 2011, 2013, 2018) highlights that the competition among countries has increased and therefore, governments need to boost FDI promotion policies. For Guimón, however, offering fiscal and financial support measures alone is not enough to stimulate inward investments and therefore, he stressed that investment promotion agencies need to put more emphasis on pre-investment (e.g., visits to research centers, ministries, etc.) and after-care services (e.g., assistance in applying to national R&D programs or assistance in recruiting local and foreign researchers) and that a country’s promotion policies need to be closely connected to their innovation strategies. Therefore, not only financial and fiscal incentives, but also pre- and aftercare services, university-industry linkages, the S&T infrastructure and human capital are essential.

## **2.4 Summary**

The review of FDI and MNE literature has shown that scholars across many fields have provided explanations for the reasons behind FDI. Early studies such as Kindleberger (1969) and Hymer (1976) stressed the importance of firm competitive advantages while others highlighted the importance of location-specific factors (Hood & Young, 1979). Yet, others argued that it was not one single factor, but rather a combination of multiple variables. Therefore, Dunning (1979) provided a further development of FDI theories by bringing together the internalization and traditional trade theory and constructing the eclectic paradigm. The eclectic paradigm consisted of three variables which tried to explain why firms operated overseas: (1) ownership, (2) location and

(3) internalization. For Dunning, multinationals only chose FDI over other modes of entry when all three conditions were met. As the goal of this study is to evaluate the differences and similarities of the Chinese, Japanese and U.S. investment environment for supply-driven R&D, following the review of major theoretical concepts, the focus was shifted to host location-specific advantages. However, before determining the decisive location factors for investments, it was necessary to distinguish between the different motivations and drivers behind R&D units. Although research has offered many classifications for the motivations of R&D investments (e.g., home-base-augmenting vs. home-base exploiting, science-based vs. market-based or capacity augment vs. capacity exploiting) a closer examination of the literature exposed that most units can generally be divided into two main categories: (1) demand-driven and (2) supply-driven investments.

Due to the technological diversification and rising significance of innovation in recent years, the increasing importance of the latter was particularly highlighted by the literature (e.g., Granstrand, 1999) and many empirical studies explored the location-specific determinants for supply-driven R&D by analyzing the investments of multinationals in developed and emerging markets. Studies such as Falk (2004) and Thomson (2011) for instance, argued that the R&D activities of local research institutions were particularly important for supply-driven R&D, while others highlighted the significance of the local S&T infrastructure (e.g., Davis & Meyer, 2004; Kumar, 2001; Thursby & Thursby, 2006) and human capital (e.g., Gassmann & Han, 2004; Siedschlag et al., 2013) for foreign MNEs' investment decisions. But also other types of determinants that can not be specifically assigned to either supply-driven or demand-driven R&D, such as intellectual property rights (e.g., Branstetter, Fisman, & Foley, 2006; Sanyal, 2004) and government support measures (e.g., Cantwell & Mudambi, 2000; Guimo'n, 2009) induced higher levels of investments. With these findings in mind, in the next chapter of this master's thesis, the analytical framework of the comparative study will be presented.

## **3 Analytical Framework**

### **3.1 Overview**

The review of FDI and MNE literature has shown that there can be generally distinguished between two main drivers of R&D-intensive investments: (1) demand-driven and (2) supply-driven R&D. Demand driven R&D stresses the importance of adapting products and supporting the production for overseas markets and therefore is highly connected to the manufacturing of a firm. Here, location-specific factors such as lead markets, market size and market potential play a vital role. The goal of this study, however, is to determine the attractiveness of host-countries for supply-driven rather than demand-driven R&D. This type of investment involves the establishment of facilities close to clusters of local knowledge and the literature has highlighted the importance of factors such as public and private investments in R&D, the S&T infrastructure, and the quality of human capital.

For the building of the analytical framework, I have decided to use and combine the results of several studies, rather than basing it on one specific research, because some frameworks often missed important criteria and therefore, did not allow for a complete examination of the R&D investment climate of my case countries. Based on this approach, the analytical framework for the comparative analysis will be divided into five categories: (1) innovation capacity, (2) S&T infrastructure, (3) human capital, (4) intellectual property rights and (5) government promotion. In the following section, each category of the framework and its subcategories will be explained in more detail. Moreover, to provide the reader of this paper with a better understanding of the framework, the chapter will conclude with a summary.

### **3.2 Innovation Capacity**

In the introductory chapter of this master's thesis, R&D was defined as an activity that has "the purpose of discovering or developing new products or services, improving existing products, or discovering or developing new or more efficient production processes" (OECD, 2005, p. 118). To develop new products or discover more efficient production processes, innovation plays a crucial role. Therefore, when establishing knowledge-seeking R&D facilities overseas, firms consider the innovation efforts of a host-country as important factor (e.g., Athukorala & Kohpaiboon, 2010; Driffield & Menghinello, 2010; Falk, 2004; Sanyal, 2004). Generally, this can be measured by looking at the R&D expenditure of a host-country. Gross domestic expenditure on R&D (GERD) is the main aggregate used for international comparisons and is composed of the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, universities, and government laboratories. It includes labor costs as well as services, items and equipment used

for research facilities. Furthermore, while R&D funded from abroad is part of a country's GERD, domestic funds for activities performed outside the local economy are excluded (OECD, 2015, pp. 111-112, 367-368).

To get a more precise picture of the concrete spending in a host-country and to allow for a better comparison, GERD can be further split up into three sub-categories: (1) business R&D expenditure (BERD), (2) government expenditure on R&D (GOVERD) and (3) higher education expenditure on R&D (HERD). BERD measures the spending within the business sector and comprises of all resident corporations, regardless of the residence of their shareholders (OECD, 2015, pp. 365). GOVERD represents the components of the GERD that are related to government units such as central, regional and local authorities, and non-profit institutions that are not market producers of goods and services nor part of higher education but controlled by the government. However, GOVERD does not include public corporations, even when all the equity of such corporations is owned by the government because the R&D expenditure of this type of corporation is already included in BERD. Last but not least, higher education expenditure on R&D. HERD presents all R&D expenditures within the higher education sector and therefore, comprises the spending of all universities, colleges and other institutions providing tertiary education. Furthermore, all research facilities that have their activities under the direct control of an institute of higher education, are included as well. Like all other measures, HERD can be evaluated in terms of total expenditure and in percentage of the total GERD (OECD, 2015, pp. 371-372).

Although the evaluation of the R&D expenditure is the most common way to determine the innovation capacity of a country, there is also another indicator that supports the measuring of such activities, which is patenting. To make patents internationally comparable and to capture important inventions, the OECD has developed the so called "triadic patent families". These are a set of patents registered in various countries to protect the same invention and have to be listed at three of the major patent offices: (1) the European Patent Office, (2) the Japan Patent Office (JPO) and (3) the United States Patent and Trademark Office (USPTO). Despite protecting patents in various countries, one that is considered as triadic patent family is credited to the country of residence of the inventor. As it takes additional costs when registering in three offices, patents included in triadic patent families are typically of higher economic value than others and therefore, are a good additional measurement for innovative capacity (Dernis & Khan, 2004, p. 17; OECD, 2008, p. 7). Generally, triadic patent families can be evaluated by comparing the total numbers of new patents claimed in a year and by looking at registrations in major technology sectors. As it corresponds to the first filing at any of the three major patent offices, for this, the priority date will be used rather than the application or grant date (OECD, 2008, p. 8).

### 3.3 S&T Infrastructure

#### 3.3.1 Institutional Quality

Aside from the innovation capacity, also the S&T infrastructure is an essential indicator for this study. As stressed by numerous scholars (e.g., Davis & Meyer, 2004; Demirbag & Glaister, 2010; Kumar, 2001; Thomson, 2011; Thursby & Thursby, 2006), the S&T infrastructure contributes to the attractiveness of a location for R&D-intensive FDI because it defines the actors within a country's national innovation system, the quality of institutions and the opportunities for MNEs to create linkages and to tap into local pockets of knowledge. For the comparative analysis of this study, the following factors will be considered: (1) the number and quality of universities and research institutions and (2) the ease for MNEs to collaborate with other public actors within the national S&T network. For the assessment of university quality, this paper will rely on the Times Higher Education (THE) World University Ranking. In 2020, this ranking graded the performance of 1,396 institutions across 92 countries, basing their evaluation process on five different metrics: (1) teaching, (2) research, (3) citations, (4) international outlook and (5) industry income. The first indicator accounts for 30% of the total evaluation and examine the learning environment by considering an academic reputation survey specifically designed for the ranking (15%), a university's staff to student ratio (4.5%), the doctorate to bachelor's ratio (2.25%), the doctorates awarded to academic staff ratio (6%) and the institutional income (2.25%). According to THE, the latter has the purpose of outlining a university's facilities available to students and the teaching staff and is scaled against academic staff numbers and normalized for purchasing-power parity (Bothwell, 2019, para. 2).

The second criterion that is used to measure academic quality is the volume, income and reputation of research (30%). This includes research productivity (6%), which is the number of publications issued in the academic journals indexed by Elsevier's Scopus Database, research income through grants and other funds (6%) as well as university reputation (18%), which indicates an institute's research quality. Following the evaluation of teaching and research quality, the next component that is considered for the ranking is citations (30%). Citations play an important role as they "define a university's role in spreading new knowledge and ideas" and are measured by taking the average number of times a university's published work is cited by scholars globally (Bothwell, 2019, para. 8, 11-16). The last two metrics used to determine the quality of the world's top universities are the international outlook (7.5%) and industry income (2.5%). While the former evaluates the ability of a university to attract undergraduates, postgraduates and faculty from all over the world, the latter defines a university's ability to help the industry with R&D, inventions and advisory activities. This means that the industry income indicator seeks to capture knowledge-transfer activities by looking at how much research income an institution earns from the industry. Like the institutional income

measurement, industry income is scaled against the number of academic staff and adjusted for purchasing power parity (Bothwell, 2019, para. 22-26).

#### **Corporate and government research institutes**

When firms invest abroad, they do not only consider the number and quality of universities, but also whether there are other research institutions (corporate and government) that produce high-quality scientific output. Siedschlag et al. (2013) for instance, argue that the agglomeration of R&D activities of foreign firms is appealing for other MNEs and that on average, the location probability of foreign affiliates increases with agglomeration economies from foreign R&D (p. 143). For the assessment of the institutional quality of corporate and government research institutes, the Nature Index will be used. The Nature Index features the global top 100 institutions in natural science by using article counts and fractional counts of article publications in 82 high-quality natural science journals as indicator for research output. An institution is given an article count of one for each article that has at least one author from that institution, regardless of the number of authors an article has. In contrast, the fractional count considers the share of authorship on each article. The total count available per article is one, which is shared among all authors under the assumption that each contributed equally. For authors who are affiliated with more than one institution, the author's count is then split equally between each organization (Nature, 2019, p. 31).

However, Nature stresses that the information used is based on a relatively small proportion of data, and therefore it is best to combine their statistics with information from other sources. Because of this, Reuters Top 25 Global Innovators Government ranking will be used as another reference point for this study. This ranking relies on data of numerous research platforms such as Clarivate Analytics, InCites, Web of Science, Derwent Innovations Index and Derwent World Patents and Patents Citation indices and therefore allows us to get a more comprehensive picture of the institutional quality of research institutes in China, Japan and the United States (Reuters, 2019, para. 1). Yet, the downside of Reuters' classification is that private research facilities are not considered, and therefore, only government related facilities are part of the yearly publications. Other than the Nature Index, which relies on article counts to determine the research output of an organization, Reuters' innovation ranking relies on numerous indicators to determine the most-renowned research facilities. To narrow down the list of research facilities, Reuters first identified research organizations that published the greatest number of articles in scholarly journals, and then cross-referenced these numbers against the patents filed during the same period. Following this, the list was reduced to just those institutions that filed 50 or more patents at the World Intellectual Property Organization (WIPO; Reuters, 2019, para. 2-3). Following the selection process, each candidate was then evaluated using the following indicators: (1) patent volume, (2) patent success, (3) global

patents, (4) patent citations, (5) patent citation impact, (6) percent of patents cited, (7) patent to article citation impact (8) industry article citation impact (9) percent of industry collaborative articles and (10) total web of science core collection papers. Each indicator is judged equally apart from the indicators five and six, which receive 50% weighting each. This is the case because for Reuters, they are closely related in measuring the same phenomenon (Reuters, 2019, para. 7-17).

### **3.3.2 Research Collaboration**

Besides the high-quality of research institutions within a country's national innovation system, the ease to corporate with these institutions is of high value for MNEs as well. This is the case because collaboration enables companies the access to world-class academics and researchers. This can enhance the product development process and can give them competitive advantage over their business competitors. For universities, the access to additional research funding, technologies developed by the industry but also the enhanced status when competing for publicly funded projects are reasons to collaborate with industrial players (Bohain, 2018, p. 63). Linkages between local research facilities and foreign MNEs can be established through various channels such as collaborative research centers, R&D projects, R&D partnerships, technological alliances, research services but also education and training (Bohain, 2018; Cunningham & Gök, 2006; Guimo'n, 2009). Collaborative research centers are generally located at universities and tend to focus on specific and strategically important areas of applied research. These centers often closely engage leading businesses within their governing bodies and are means to cooperate over a longer time period. R&D research projects or research services on the other hand, are means of collaboration that entail smaller timescales and a smaller scope of cooperation, while education and training linkages are entailed through internship programs, but also through cooperation between universities and companies for master's and PhD theses (Cunningham & Gök, 2006, pp. 14- 15). For foreign firms however, it often takes considerable effort and costs to become familiar with institutions and local firms, which prevents them from developing valuable linkages within the S&T infrastructure through the channels described above. Therefore, the government needs to establish a framework that supports the creation of partnerships between local entities and MNEs. Such cooperation can be achieved through (1) national technology linkage programs, (2) education and training linkages, (3) reward systems for researchers that carry out work for companies and (4) funding of local entities that form partnerships with foreign multinationals.

### 3.4 Human Capital

#### 3.4.1 Tertiary Education

Highly connected to the S&T infrastructure and the quality of research is a country's human capital. Many studies have highlighted the positive effects of a well-educated labor force to attract inward FDI and to create knowledge and technology spillovers to local firms (e.g., Falk, 2004; Gassmann & Han, 2004; Kumar, 2001; Siedschlag et al., 2013). To determine the level of human resources for R&D, two factors need to be considered: (1) the tertiary education sector which educates young talents and (2) the number of researchers, technicians, and other R&D personnel. To evaluate the quality of the human capital, the first step is to look at the tertiary school sector. This is important because "higher education is a prerequisite to produce highly competent experts" (Adedeji & Campbell, 2013, p. 2). Furthermore, it is a channel to attract foreign talent from abroad and to educate them. This is important not just because there has been found to be a positive association between foreign students and the existence of quality assurance policies for education, but also because a high inbound mobility rate of students allows foreign MNEs to tap into a pool of talent that can support the development of innovation. Outbound students on the other hand, can contribute to the absorption of knowledge from other nations, which can help to upgrade the innovation capacity of their home country, assuming that such students return to the country of origin or maintain links with the local science base after their studies (Ilieva, Killingley & Tsiligiris, 2019, p. 5; OECD, 2019, p. 229).

Therefore, the following indicators need to be evaluated when measuring the quality of tertiary education: (1) annual expenditure on tertiary education, (2) university enrollment, (3) graduates by level of education and (4) tertiary inbound and outbound mobility. The annual spending on tertiary education covers private and public expenditure on universities and other institutions related to the higher education sector and can be measured by looking at total payments, by comparing expenditures in the tertiary sector to a country's total education spending, by defining it as a percentage of the GDP, or by looking at the annual expenditures per student (OECD, 2019). The second indicator, university enrollment, can be determined by looking at the gross rate of matriculation in a particular year. Other than net enrollment, which measures the participation of students in tertiary education of a particular age, gross matriculation considers the total enrollment regardless of the age and can exceed the population of the particular age group considered in net statistics. Because of this, the total gross matriculation in a country can also lead to ratios greater than 100% (UNESCO Institute for Statistics [UIS], n.d., para. 1; World Bank, n.d., para. 1). The number and ratio of graduates by education level can be defined by applying the international standard classification of education, which divides tertiary education into four categories (ISCED 5-8). ISCED five is generally considered as short-cycle tertiary education and is provided for

students that want to enter more advanced programs or that focus on practical, technical, or occupational skills. ISCED six to ISCED eight on the other hand, are classified as advanced research qualifications and can be categorized into bachelor's degree (ISCED 6), master's degree (ISCED 7) and PhD (ISCED 8; UIS, 2012). Last, to determine tertiary training in China, Japan and the United States, also the inbound and outbound mobility of students need to be evaluated. The former defines the number of students from overseas studying in a certain country and can be measured in total numbers and as a percentage of total tertiary enrollment. The latter determines the percentage of students studying abroad and receiving education in another country (OECD, 2019, p. 229).

### **3.4.2 Researchers, Technicians, and other R&D staff**

Following the assessment of higher education, the next step is to study researchers, technicians and other personnel that is performing R&D activities. In this subcategory, especially the evaluation of the former is important, because they are key actors for innovation and are involved in numerous processes such as the production of knowledge, product and method creation, or the management of R&D projects. Generally, when comparing the human capital of host-countries, R&D personnel in universities, government and private research facilities can be evaluated by measuring activities in full-time equivalent (FTE). FTE is the main statistic for international comparisons and is defined as the ratio of working hours spent on R&D divided by the total number of hours conventionally worked in the same period. Furthermore, the personnel can be evaluated in more detail by looking at the importance of the R&D staff within the domestic labor market, which can be done by studying the number of people employed in this field as percentage to the total labor force (OECD, 2015, pp. 165, 172).

## **3.5 Intellectual Property Rights**

To develop an ideal environment for innovative FDI, aside from educated human capital and a strong S&T infrastructure, a well-developed legal framework in form of IPR was found to be a key factor for foreign MNEs (e.g., Branstetter, Fisman, & Foley, 2006; Guimo'n, 2009; Sanyal, 2004; Thursby & Thursby, 2006). According to the World Trade Organization (WTO), IPR is the permissions given to persons over the creations of their minds and can be distinguished between two main areas: (1) copyright and rights related to copyright and (2) industrial property. While the former regulates the rights of literary and artistic works, the latter can be characterized as the protection of patents, utility models, industrial designs and trademarks, with each type having different attributes and criteria for protection. The assurance of rights to use industrial property aims at safeguarding fair competition and to protect consumers by allowing them to make informed choices between various goods and services (WTO, n.d.-a, para. 1-8). Furthermore, a well-established IPR regime is crucial because by providing protection from IP theft and the potential

loss of control over R&D and innovations, it creates an incentive for companies to invest in new R&D activities (Guimo'n, 2009, p. 368). As this study tries to evaluate the attractiveness of host-countries for supply-driven R&D, only the legal framework of industrial property will be considered. Here, importance will be paid to the following indicators: (1) extent of coverage, (2) duration of protection, (3) length and costs of the registration process (4) memberships in international patent agreements and (5) patent enforcement mechanisms if law is broken.

#### **3.6 Government Promotion**

The state of the art has shown that the primary factors affecting MNEs' decisions are the innovation capacity, the S&T infrastructure, human capital and the legal framework in form of IPR. However, as highlighted by many authors and summarized by Thomson (2011), technology-seeking R&D aims to source the best technology at the lowest cost (p. 518). Therefore, despite not playing a primary role for firms, government investment promotion can be an important secondary factor impacting inward FDI and thus, must be considered in a comprehensive study. For the comparative analysis, government support for corporations will be split into two sub-categories: (1) pre-investment and after-care services and (2) fiscal and financial incentives. Assistance for foreign corporations is provided before and after an investment in form of pre-investment and after-care services. Such support can be of high value for foreign MNEs and includes numerous measures. For pre-investment promotion, the government can offer visits to certain sights, R&D centers, universities or meetings with government officials. After-care services on the other hand, include support when applying to national R&D and other incentive programs, by assisting MNEs in the recruitment process of researchers or by processing all the necessary visa forms if they want to bring in expats. Fiscal and financial incentives include tax credits and allowances, grants and loans for foreign firms that want to invest in a particular country. Such measures can be offered in a number of ways. This includes support for the buildup of R&D infrastructure, subsidies that reduce the costs of R&D expenses such as patenting or education, but it is also a tool to lower taxes on income from patent licensing. Furthermore, by targeting certain industries or technologies, incentive measures offered by the government can also be a means to increase activities in areas particularly important for the economy (Guimo'n, 2009, pp. 367-369; Guimo'n, 2011, p. 79).

### 3.7 Summary

| Category                      | Measurement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Innovation Capacity</b>    | <p><b>R&amp;D Expenditure</b></p> <ul style="list-style-type: none"> <li>Gross domestic R&amp;D expenditure, total and % of GDP</li> <li>Business R&amp;D expenditure, total, % GERD</li> <li>Government R&amp;D expenditure, total, % GERD</li> <li>Higher-education R&amp;D expenditure, total, % GERD</li> </ul> <p><b>Patenting</b></p> <ul style="list-style-type: none"> <li>Triadic patent families, total filings, composition by major technologies</li> </ul>                                                                                                                                                                      |
| <b>S&amp;T Infrastructure</b> | <p><b>Institutional Quality</b></p> <ul style="list-style-type: none"> <li>Quality and number of universities (THE World University Ranking)</li> <li>Quality and number of corporate and government research institutions (Nature Index Global Top 100 Ranking; Reuters Top 25 Global Innovators Government Ranking)</li> </ul> <p><b>Research Collaboration</b></p> <ul style="list-style-type: none"> <li>National technology collaboration programs</li> <li>Education and training linkages</li> <li>Incentive schemes that induce partnerships (e.g., grant, tax credit)</li> <li>Reward systems for university researchers</li> </ul> |
| <b>Human Capital</b>          | <p><b>Tertiary Education</b></p> <ul style="list-style-type: none"> <li>Expenditure on tertiary education, % of total education and GDP</li> <li>Annual expenditure per student (FTE)</li> <li>Tertiary gross enrollment</li> <li>Graduates by level of education</li> </ul>                                                                                                                                                                                                                                                                                                                                                                 |

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                             | <ul style="list-style-type: none"> <li>• Tertiary inbound and outbound mobility</li> </ul> <p><b>R&amp;D personnel</b></p> <ul style="list-style-type: none"> <li>• R&amp;D personnel by function (FTE)</li> <li>• R&amp;D personnel by employment status</li> <li>• Researchers as % of the labor force</li> </ul>                                                                                                                                                                                                                                                                                                                                                |
| <b>IPR</b>                  | <ul style="list-style-type: none"> <li>• Extent of coverage</li> <li>• Duration of protection</li> <li>• Length and cost of the registration process</li> <li>• Membership in international patent agreements</li> <li>• Enforcement mechanisms</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Government Promotion</b> | <p><b>Pre-investment and after-care services</b></p> <ul style="list-style-type: none"> <li>• Visits to universities, research centers and other facilities</li> <li>• Assistance in establishing facilities abroad</li> <li>• Assistance in applying to national R&amp;D programs and incentive programs</li> <li>• Assistance in recruiting local and foreign researchers</li> <li>• Other pre-investment and after-care services</li> </ul> <p><b>Fiscal and financial support</b></p> <ul style="list-style-type: none"> <li>• Tax credits, grants, R&amp;D allowances, subsidies, and loans for the establishment of laboratories, patenting, etc.</li> </ul> |

Table 1. Summary of analytical framework

## 4 Empirical Analysis

### 4.1 China

#### 4.1.1 Innovation Capacity

Following the discussion of the theoretical part of this master's thesis, in the empirical analysis of this paper, China, Japan and the United States will be evaluated individually. Based on the structure of the analytical framework, in the first chapter, the innovation capacity will be measured by looking at the R&D expenditure and triadic patent family registrations. Before discussing the individual characteristics, however, it is important to note that for patents, information is of more limited nature than that of R&D expenditures. This is the case because statistics are often disclosed to the public, which makes the development of current data difficult. As a consequence of this, 2015 has been picked as reference year for triadic patent families, whereas R&D expenditures will be analyzed until 2018. Furthermore, to provide additional information on the innovative performance, official statistics on triadic patent families will be supplemented by nowcasts of the OECD for additional two years (Dernis, 2007, p. 1; OECD 2020c).

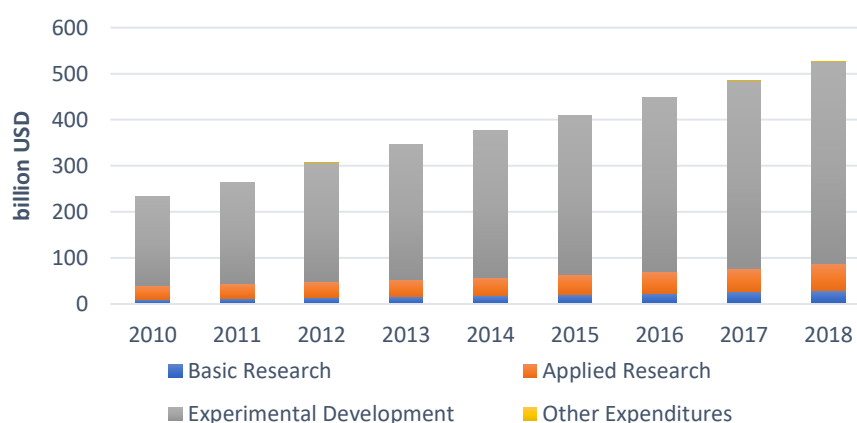


Figure 1. GERD by type of R&D – China (OECD, 2020c)

In China, the innovation capacity experienced a rapid growth, both, in terms of R&D expenditure and total triadic patent family filings. Spending in R&D more than doubled within eight years and increased from \$233 billion in 2010 to \$526 billion in 2018. As a result of this upsurge, also the value of innovative activities within the Chinese economy increased and the R&D intensity (R&D as part of the GDP) grew from 1.7%<sup>2</sup> in 2010 to 2.2% in 2018. A closer evaluation of the R&D composition showed that the overall growth in China was highly connected to the expenditure in experimental developments. From 2010 to 2018, spending in this area increased from \$192 billion to \$438 billion, accounting for 83% of the total R&D costs. Research on the other hand, only made

<sup>2</sup> Please note that values greater than 10 are rounded to the nearest integers, values below 10 to one decimal place and values below 1 to two decimal places

up for a comparatively small percentage of the total activities and in 2018, 5.5% and 11% respectively were spent on basic and applied research. As illustrated in Figure 3, the biggest bulk of R&D spending came from businesses, followed by the government and the higher education sectors. Expenditures in all three areas experienced rapid growth rates from 2010 to 2018, with R&D in the business sector having the most outstanding development. With \$407 billion, BERD accounted for over 77% of the total expenditure on R&D, while GOVERD (\$80 billion) and HERD (\$39 billion) contributed for 15% and 7.4% each (OECD, 2020c).

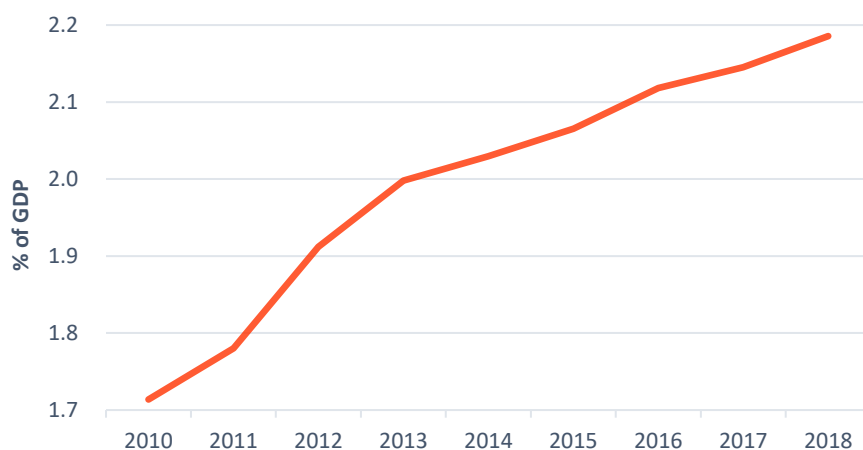


Figure 2. R&D intensity – China (OECD, 2020c)

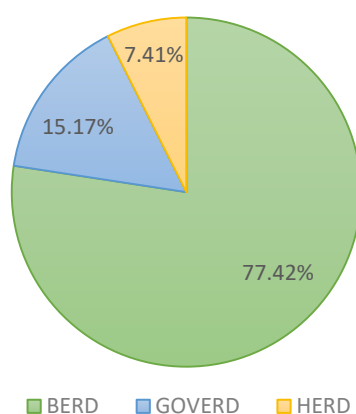


Figure 3. GERD by sector of performance (2018) – China (OECD, 2020c)

Following the analysis of China's R&D expenditure, the second indicator of innovation capacity, triadic patent family registrations, will be studied. As described in the analytical framework, triadic patent families are typically of higher economic value than others as it takes additional costs when registering in three patent offices and therefore, they are a good additional measure for innovation capacity (Dernis & Khan, 2004, p. 17). China experienced a strong development of patent filings in past years and between 2010 and 2015, registrations rose by over 123%. When incorporating nowcasts by the OECD, Chinese patenting activities showed an even stronger growth rate (+190%)

and with 4,152 triadic patent families, Chinese entities were projected to account for 7.6% of all global filings in 2017. Resembling the overall development of patenting activities, also in all major technology sectors an increase of registrations could be identified, except for the nanotechnology sector. In China, registrations in nanotechnology decreased from 42 in 2010 to 13 patents in 2015. Although patenting activities in this area were generally low, and only 415 triadic patent families were registered worldwide in 2015, it is not completely clear why China experienced such a decline. One possible explanation could be the intensive research that is required to develop technologies at an extremely small scale, because this generally leads to a long development process of new technologies (Morris, 2016, p. 1; OECD, 2020c).

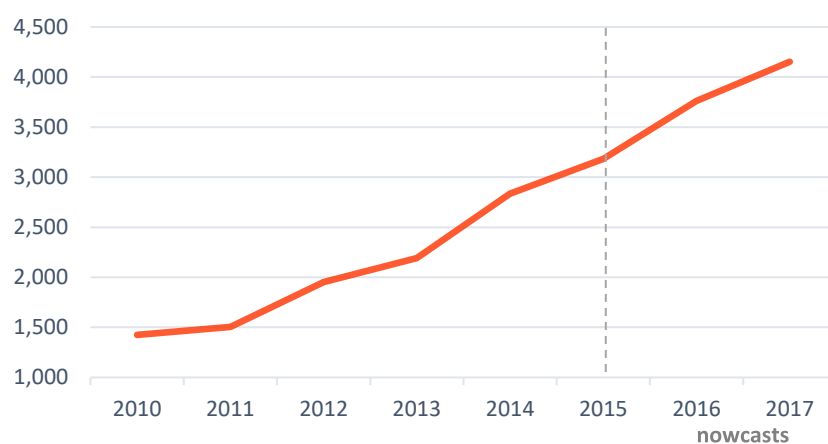


Figure 4. Triadic patent family filings – China (OECD, 2020c)

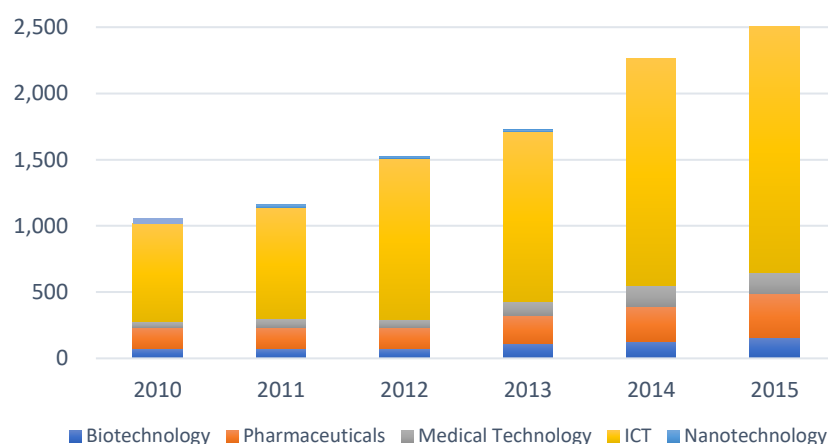


Figure 5. Triadic patent families by major technologies – China (OECD, 2020c)

While nanotechnology accounted for the smallest amount of triadic patent family filings amongst the major technologies, the ICT sector accounted for the highest value. In 2015, 1,886 patents related to ICT were filed, accounting for 60% of all registrations in that year. Although total numbers were lower than in the ICT sector, positive developments could also be explored in the pharmaceutical, medical technology and biotechnology sectors. In the pharmaceutical sector for instance, patent filings more than doubled between 2010 and 2015. In medical technologies, the number of triadic patent families rose from 42 to 164 (+290%) and biotechnology experienced an increase from 73 to 155 filings (+112%), showing that Chinese innovation increased in most major technology areas (OECD, 2020c).

### 4.1.2 S&T Infrastructure

After the analysis of the innovation capacity, in this chapter, the S&T infrastructure will be studied. As described in the analytical framework, when comparing the S&T infrastructure, factors such as the number and quality of universities and research institutes and the promotion of R&D collaboration between companies and research facilities through national funding programs need to be discussed. In the latest publication of the THE World University Ranking, China established eight universities in the top 300, and five in the top 150. Amongst the top institutions in the country, Tsinghua University (23) was ranked the highest, followed by Peking University (24) and the University of Science and Technology China (80). The latest results displayed a strong upward trend in recent years, because not only that the top institutions were able to steadily improve their rankings, but also the number of high-quality facilities has increased. In 2015 for instance, only six universities in China ranked amidst the top 300 globally and only two were in the top 150. Amongst the top three universities, especially the University of Science and Technology China has experienced a substantial improvement. In 2015, the S&T focused university only ranked amongst the top 225 globally. Since then, it gradually improved its quality, ranking amongst the top 150 in 2017 and entering the top 100 in last year's ranking (THE, 2015, 2020).

As we compare the top three universities by their individual results (see Figure 6), it becomes apparent that Tsinghua and Peking University were the strongest in terms of teaching and research, whereas the performance of the University of Science and Technology China was clearly weaker in these categories. While all three universities achieved similar results in the citations category, Peking University had the highest outcome in international outlook, which defines the attractiveness of a university for students and faculties from foreign countries. Tsinghua University on the other hand, outmatched other institutions of higher education in terms of industry income, which defines a university's ability to help the industry with R&D, inventions, and advisory activities, by achieving the highest score possible (THE, 2020).

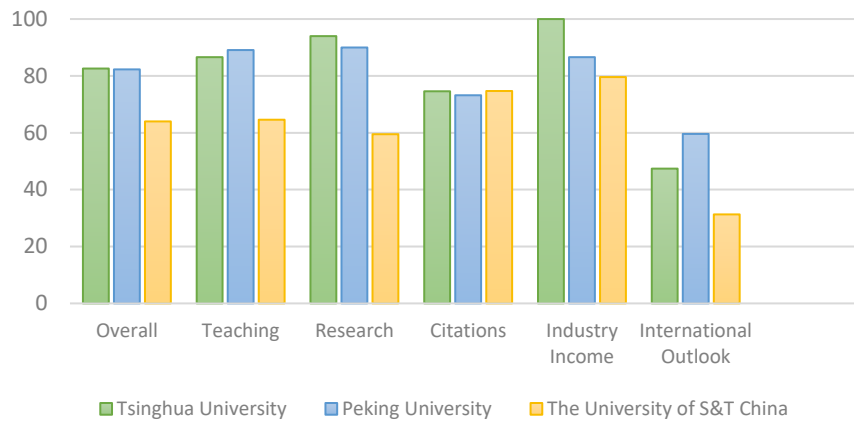


Figure 6. Top universities – China (THE, 2020)

In addition to the quality of institutions in the higher education sector, also the number and excellence of government and corporate research institutes indicated that China had become a major destination for high quality research. In the most recent innovation ranking by Reuters, the Chinese Academy of Sciences (10), which is China's major public research facility, ranked amongst the top 25 government institutions. In the newest Nature Index Global Top 100 ranking, which used article counts of publications in 82 high-quality natural science journals as indicator for research output, as many as eight government facilities and 13 corporations were placed amongst the top 100, with the Chinese Academy of Sciences ranking on the top position of all research facilities worldwide. In addition to China's major national research institute, the People's Liberation Army (23) and the China Academy of Engineering Physics (40) in the government ranking, and the China Shipbuilding Industry Corporation (15), FiberHome Technologies Group (18) and BGI (27) in the corporate ranking, were representatives that achieved high ratings. Most remarkably here, was the development of the China Academy of Engineering Physics and the China Shipbuilding Industry Corporation. Since the first publication in 2016, the former improved its position from rank 73 to 40, and the latter from 39 to 15, demonstrating the increasing importance of Chinese research institutes in a global context. Amongst the top representatives, the Chinese Academy of Sciences was particularly productive in the physical sciences and chemistry sectors, producing a total article count of 5,422 and a share count of 1,785. Likewise, the China Academy of Engineering Physics, the China Shipbuilding Industry Corporation and FiberHome Technologies Group had a high output in physical sciences and chemistry. The People's Liberation Army and BGI on the other hand, focused their research mainly on life sciences (Nature, 2016 & 2019b).

After the performance analysis of Chinese universities, public research facilities and corporations, it is now necessary to evaluate if the central government has implemented mechanisms that give foreign MNEs the opportunity to cooperate with such institutions and to integrate into domestic knowledge clusters. Before studying the specific measures, however, it is important to briefly

discuss the major actors in facilitating research collaboration. In China, these are the Ministry of Science and Technology (MOST) and the National Natural Science Foundation of China (NSFC). The former plans, funds and supervises the development of S&T related activities in the country and is in charge for the attraction of foreign talents, while the latter supports the activities of MOST by promoting and funding basic research in natural science. The Chinese government generally encourages partnerships between the industry and the academia in two ways. First, it supports universities that have established their own collaboration systems and offices. As most universities in China are public institutions, such collaboration systems and offices are to a large degree funded by the government and without financial support by the state, it would be difficult for them to initiate research projects with the industry or other institutes of higher education (MOST, n.d.-a; Wei, 2016). To provide additional support for the collaboration between the academic, public and private sectors, and to allow for partnerships in projects that exceed the scope of a single university, the Chinese government has also implemented three national programs that are accessible for universities and companies alike. These are (1) the National Key R&D Programs (NKPs), (2) the National S&T Mega-Projects and (3) the National Natural Science Joint Fund.

The NKPs were redefined in 2014 and aim to help China advance in sectors such as agriculture, energy and health technologies, to enable a seamless development of technologies from basic research to commercialization and to establish cooperation between industries and universities. Since their reformulation, over 65 of such NKPs have been established, each consisting of numerous R&D projects. Furthermore, with the restructuring of the NKPs in 2014, also major R&D programs that were implemented by the central government in earlier phases were incorporated as major cornerstones. This included (1) the National Basic Research Program of China, (2) the 863 Program, (3) The National Key Technologies R&D Program and (4) the National Science and Technology Infrastructure Program. The former fosters basic research to meet the national strategic needs in agriculture, energy, information, resources and environment, as well as in health-related areas in accordance with the objectives of China's development goals. The 863 Program on the other hand, focuses on China's industrial competitiveness by funding applied research that is able to advance key technologies in biological, agricultural, pharmaceutical and advanced manufacturing technologies. The third NKP, the National Key Technologies R&D Program has the major goal of addressing "major S&T issues in national economic and social development" by developing and applying technologies that have the potential to overcome such issues or allow the development of new industry sectors, while the fourth NKP, the National Science and Technology Infrastructure Program, aims at strengthening the national S&T capacity and to promote international S&T cooperation (MOST, n.d.-b). Although all programs focus on research collaboration, within the four, the National Key Technologies R&D program in particular emphasizes the importance of

collaboration between universities, research institutes and companies. This is stressed by the Chinese government as it sees companies “as the principal entity in the implementation of projects that are highly industrialized or involve intensive engineering” (MOST, n.d.-c, para. 24). Although the amount of funding received for participation in R&D activities within the NKPs depends on the type of research, in 2016 and 2017 alone, a total of CN¥50.7 billion (\$7.1 billion)<sup>3</sup> was allocated to the program, showing the significance of such projects for the S&T development plans of China. Furthermore, in terms of project length, an average time frame of five years could be identified (China Innovation Funding, 2017 & 2018a).

Aside from the NKPs, another major platform that supports China’s technological progress are the national S&T Mega-Projects. In accordance with the objectives of China’s 13<sup>th</sup> Five-Year Plan and the developments in the 863 Program, the currently 16 S&T Mega-Projects aim to achieve significant technical breakthroughs and to support the industrialization in major fields regarding civilian, civilian-military and military applications. Like the NKPs, project periods in S&T Mega-Projects vary between three to five years with funding depending on the particular project. However, past spending indicates that the volume dedicated to such projects is massive, and over CN¥60 billion (\$8.4 billion) was spent by the central government on the 10 projects from 2011-2015 (China Innovation Funding, 2018b, para. 7). Last, the National Natural Science Joint Fund, which is administered by the NSFC and has the goal to advance research in fields that are essential for national demands and the industry. Such funds are established by forming partnerships between universities, local governments, ministries and corporates and by enabling the sharing of resources in form of researchers, infrastructure and capital. This means that the NSFC is not the only actor that provides money for such projects and also investments from corporates and other participants are required. Within this fund, several programs and research projects have been developed. Therefore, it is difficult to determine the exact amount of subsidy by the NSFC and the length of research cooperation. Generally, however, projects seem to target mid-term relationships of three to four years between the relevant actors (NSFC, 2016).

Before moving on to the next category of this analysis, with the Plan for Educating and Training Outstanding Engineers (PETOE), one more program needs to be highlighted. PETOE was launched as part of the National Plan for Medium and Long-Term Education Reform and Development and unlike the previous programs discussed, it aims to “enhance the adaptability of engineering education to social and economic development” by identifying training standards, by establishing a new joint-training system and by improving the quality of education in engineering together with the industry. Such program can be an effective mechanism to link human capital to foreign MNEs,

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<sup>3</sup> 1 RMB = 0.14 USD

because PETOE allows them to educate and directly connect to young researchers that will become available in the job market in the near future. For students in the field of engineering on the other hand, the PETOE program expands training possibility outside the university setting through industry-university partnerships (Jian, Yu, Sunyu, & Weifeng, 2015, p. 45).

### **4.1.3 Human Capital**

The evaluation of the S&T infrastructure has shown that some of the best research facilities are located in China and that the government has implemented a variety of measures to allow foreign MNEs to integrate into local clusters. Highly connected to the S&T infrastructure and the quality of research is a country's human capital. To determine the quality of human capital, the analytical framework outlined two main categories: (1) the tertiary education sector, which provides a pool of young talents and (2) the number of employees related to R&D work. For the evaluation of both categories, 2016 will be used as the year of analysis. Furthermore, as for the innovation capacity category, 2010 will be used as base year to measure some of the developments in this area. In China, spending in the education sector, including primary to tertiary education, accounted for 5.2% of the GDP in 2016, from which over 25% were spent in higher education (1.4% of the GDP). This equaled an annual expenditure of CN¥30,507 (\$4,271) per student. Like the total education sector, also tertiary education experienced a rapid development in recent years, and between 2010 and 2016, spending in this area almost doubled. However, due to the fast expansion of China's economy, the expenditures in higher education as compared to the GDP stayed with 1.4% the same. Although the Chinese government does not provide a statistic for the sources of funding for tertiary education, the data for total education implies that public funds account for the vast majority of capital and that money from private entities is less relevant to finance the education sector (Ministry of Education, 2018; National Bureau of Statistics of China, 2012, 2018).

Following the analysis of the financial contribution by the public and private sectors to tertiary education, it is now necessary to evaluate the number and level of young talents in higher education more closely by studying the gross enrollment rate, the level of graduates as well as the inbound and outbound mobility. As China is a developing country, the gross enrollment rate in tertiary education was initially low. In 2010, China had a rate of 24%, which put it into the same bracket as other developing nations such as Thailand and Vietnam. Other than these two, however, in the years following, China experienced a strong upward trend in university matriculation and in 2016, gross enrollment reached 48%, putting it in the same class as other upper- and middle-income countries. Data on gross school enrollment further showed that female participation in higher education increased faster than the participation of male students, and in 2016, women accounted for 53% of the total gross enrollment rate in China (UIS, 2020a).

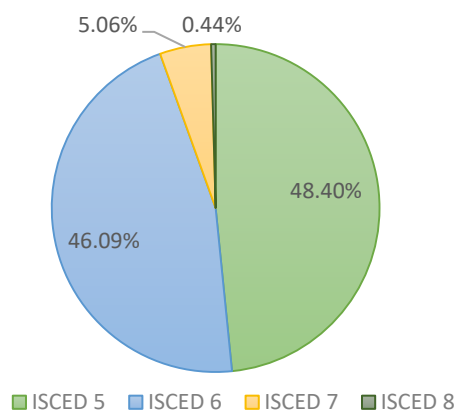


Figure 7. Graduates by level of education – China (UIS, 2020a)

In conjunction with matriculation numbers, also graduation figures increased rapidly and almost doubled between 2010 and 2016. As discussed in the analytical framework, tertiary education can be divided into four levels, with ISCED six to ISCED eight programs being classified as advanced research qualifications. In 2016, China had over 12 million graduates in the tertiary education sector, from which female students accounted for the biggest share (52%). When looking closer at the composition of these numbers (see Figure 7), it becomes apparent that the majority of graduates came from short-cycle (ISCED 5) and undergraduate programs (ISCED 6). The number of students completing more advanced education on the other hand, was comparatively low and graduates with a master's degree and PhD accounted for 5.1% and 0.44%, respectively. Furthermore, data indicated that the higher the education level, the lower the proportion of female students. While the ratio of women was over 52% of total graduation numbers, female graduates in PHD programs only accounted for 42% (UIS, 2020a).

Another important indicator that defines the quality of the tertiary education system is the inbound and outbound mobility rate of students. Especially the former helps to understand how effective a country's tertiary sector is in attracting foreign talent from which the domestic economy and foreign MNEs can benefit from. In China, the inbound mobility rate was relatively low compared to the outbound mobility, suggesting that Chinese students go abroad to gain knowledge and experience and not vice versa. In 2016, inbound mobility reached 0.31% of the total student body, with a slightly higher rate of male (0.36%) than female students (0.27%). Although there had been a slight upward trend since 2010 (+0.08%), China ranked still far below the average of upper middle-income countries (1.3%). The outbound mobility ratio on the other hand, reached 2.0% in 2016, which was slightly higher than the average of upper middle-income countries (1.9%). For outbound students, North America and Europe (1.2%) as well as East Asia and the Pacific (0.69%) were the most popular destinations (UIS, 2020a).

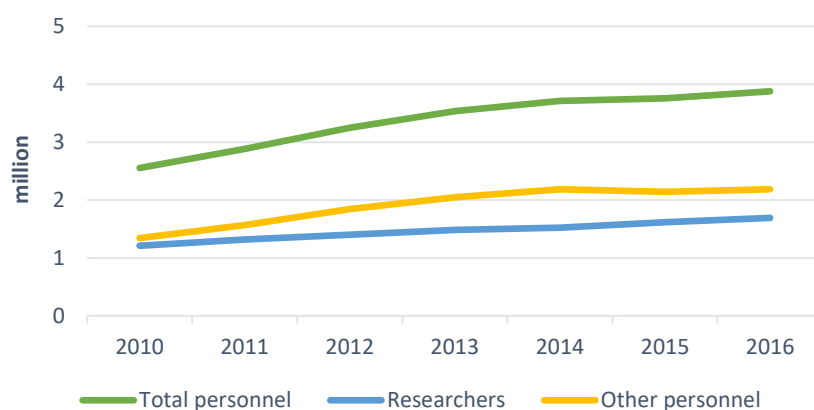


Figure 8. R&D personnel (FTE) – China (UIS, 2020b)

Following the evaluation of the tertiary sector, the last step is the assessment of researchers, technicians and other personnel that is conducting R&D activities. In this subcategory, especially the evaluation of researchers is important, because they are key actors for innovation and are involved in the numerous processes of exploring new technologies and improving existing ones. Generally, when comparing the human capital of host-countries, R&D personnel in universities, government and private research facilities can be evaluated by measuring activities in FTE. In China, R&D personnel experienced a rapid rise in past years and from 2010 to 2016, the total R&D work force grew from 2.6 million to almost 4 million. Following along with this upsurge, also the number of researchers increased from around 1.2 million to over 1.7 million in 2016 (+42%). The data provided by the OECD further displayed that businesses were the major employer for researchers in 2016, while the higher education and government sectors contributed for around one fifth each (UIS, 2020b).

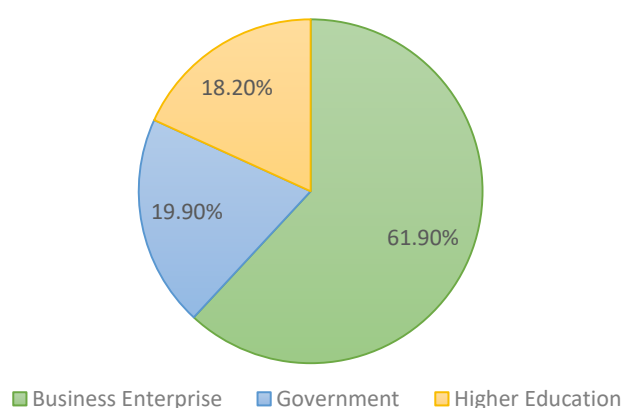


Figure 9. Researchers (FTE) by sector of employment (2016) – China (UIS, 2020b)

Due to the strong growth of employment in this area, not only the number of researchers and other staff in R&D increased in past years, but also their importance within the domestic labor market changed. Between 2010 and 2016, the share of R&D staff as percentage to the labor force increased from 0.33% to 0.48%, whereas the weight from researchers within the labor market rose from 0.15% to 0.21%. Although this showed a positive trend, the significance of R&D personnel within China did not increase as much as the progress of total numbers might have suggested. This is the case because like the development of the R&D workforce, also the total labor force in China experienced a strong upward trend throughout that period. As a consequence of this, both, total R&D staff and researchers, still account for a relatively small share of the total labor force (UIS, 2020b).

#### **4.1.4 Intellectual Property Rights**

To develop an ideal environment for innovative FDI, besides a high innovative capacity, an educated human capital and a strong S&T infrastructure, also a well-developed legal framework in form of IPR is a key determinant for the investment decisions of foreign multinationals. The protection of industrial property in form of patents, utility models, industrial designs and trademarks is important, because it ensures the rights to use the developed technologies and creates an incentive for companies to invest in new R&D activities (Guimón, 2009). When studying IPR, it is important to look at two main factors that affect the level and quality of the legal framework. These are the domestic laws that establish the legal system and its main elements such as protection terms and mechanisms as well as enforcement measures. Adding to this, also international agreements are a main aspect that determine the quality of IPR because they require domestic laws to establish some minimum standards and demand the synchronization of rights with other member countries.

In China, patents are regulated by the Patent Law, which was introduced in 1984 and generally distinguishes between three different types of patents: (1) invention patents, (2) utility model patents and (3) design patents (WIPO, 2014). The difference between these distinct kinds is that invention patents are generally characterized by a higher level of technology and a longer life cycle than utility models, while design patents refer to the appearance of a product or item (JPO, 2020a). Other than patents, rights related to trademarks are regulated by the Trademark Law, which was first adopted in 1982. Under the law, trademarks are defined as "any sign that distinguishes the goods of a natural person, legal person, or other organizations from those of others, including any word, device, letter, number, three-dimensional sign, color combination, sound and combination" (WIPO, 2014, chap. 2). As China is a member of different multilateral, regional and bilateral agreements, these laws have to adopt a minimum international standard that is harmonized with the IPR of other signatory members. Here, particularly the TRIPS Agreements as major multilateral arrangement on intellectual property has to be highlighted. The TRIPS Agreement was implemented in 1995 and

since China's accession to the WTO in 2001, all standards and characteristics covered in the treaty also apply to the Chinese IPR. This includes major features such as a minimum duration of protection for patents and trademarks, the definition of major elements that have to be protected by the law as well as enforcement and dispute settlement mechanisms. Furthermore, the TRIPS Agreement has introduced the most-favored-nation treatment to intellectual property, which means that China has to grant the same level of rights to all members of the WTO (WTO, n.d.-b). Also, China joined the WIPO in 1980 and since then has signed and ratified 14 WIPO treaties. This includes major international agreements such as the Paris Convention for the Protection of Industrial Property, the Patent Cooperation Treaty and the Strasbourg Agreement Concerning the International Patent Classification. In addition to this, it has entered a number of bilateral and regional treaties in form of free trade agreements, investment protection agreements and specific intellectual property treaties, mainly with countries that are not part of major multilateral arrangements (WIPO, n.d.-a).

Based on these laws and agreements, China has established three different terms of protection for patents and trademarks. A patent granted for inventions is valid for 20 years, whereas the protection for utility models and industrial designs is limited to 10 years. If filed successfully, also trademarks are valid for 10 years, however, other than in the case of utility models and industrial designs, the term of protection can be further extended if needed. Registrations procedures of patents and trademarks have to be undertaken at the China National Intellectual Property Administration, which was established as part of reforms in 2018 and merged previous existing administrative bodies into one agency. Past statistics show that the filing process as well as the costs of registration can vary significantly between the different types outlined above. For invention patents, the application process takes between three to five years on average. For patents of utility models and industrial designs, these procedures are much shorter, and only take one year on average, whereas the registration of trademarks takes between 14 to 18 months. Though additional fees can increase the costs of registering intellectual property, generally patent registrations in China are cheap, and application and examination fees only add up to CN¥ 3000 (\$420; WIPO, 2014; Wong, 2019).

Although international agreements establish a minimum standard of rights, a major issue of treaties such as TRIPS is that they consider “the special needs of the least-developed country Members in respect of maximum flexibility in the domestic implementation of laws and regulations” (WTO, n.d.-c, para. 12). Due to this, the international standards established by such major multilateral agreements are often not as comprehensive as some would expect and also in China, the legal framework has for long been a problem for foreign enterprises. Such problems have been caused by a variety of factors including forced transfers of intellectual property to gain market access, trade secret theft, as well as bad faith filing of trademarks. The latter has been an issue for companies

conducting business in the Chinese market because the system gives the rights of a mark or sign to the first person to register, regardless of whether such signs have been filed in other countries by other companies already. Due to this, owners of trademarks in other countries can be prevented from registering and using their signs in the Chinese market through other parties, which leads to a loss of rights to use legal ways against people that infringe intellectual property (Guo, 2020; USPTO, 2019). However, the government has realized the importance of a high level IPR for becoming a technology leader and therefore, has increased its efforts to improve the legal framework in recent years. To solve some of the issues listed above and to establish a sounder IPR, the central government introduced a number of reforms in 2019, which included a new draft of the Patent Law and an amendment of the Trademark Law. Amongst the main features of the draft were higher damages for patent infringement as well longer terms of protection for design and pharmaceutical patents. The amendment of the Trademark Law aimed to fix the problem of bad faith filing by raising fines and allowing Chinese authorities to reject and penalize applications if such filing is suspected (Guo, 2020; Pugatch & Torstensson, 2020). In addition to this, China implemented a new foreign investment law with the aim to stop trade secret theft as well as forced transfers of intellectual property and it removed some issues regarding licensing as well. Furthermore, it improved the court system by introducing more efficient and more consistent mechanisms, especially in the case of innovative technologies. The court system and its enforcement mechanisms were first reformed in 2014 and 2017, when specialized intellectual property courts were formed in Beijing, Shanghai, and Guangzhou and tribunals were set up in 18 other cities. However, especially in intellectual property issues related to high technologies, enforcement standards often differed across regions. Therefore, with the reforms in 2019, a new intellectual property court was implemented within the Supreme People's Court to speed up and unify procedures of intellectual property regarding innovative technologies (Guo, 2020; Wong, 2019). Last, as a consequence of the trade dispute with the United States, most recently, China and the United States have signed the first part of an economic and trade agreement. This bilateral agreement aims to ensure better intellectual property protection and enforcement for both parties, with particular focus on pharmaceutical-related intellectual property, trade secrets and confidential business information (United States Trade Representative, 2020).

Although the Chinese government has increased efforts to develop a stronger IPR, many of the issues in the legal environment still remain, and it has yet to be seen if reforms are efficient enough to solve major problems such as bad-faith filing, forced intellectual property transfers, and the standard differences between the East and the more underdeveloped regions, where a lack of expertise and inconsistent standards remain a major problem for intellectual property owners (European Commission, 2020). Furthermore, China has yet to sign or enforce some of the major

WIPO agreements regarding legal and administrative procedures of industrial property. This includes the Hague Agreement Concerning the International Registration of Industrial Designs, the Patent Law Treaty and the Singapore Treaty on the Law of Trademarks. The Hague Agreement for instance, allows owners of industrial designs to register their designs in multiple countries by just filing one single application with the WIPO, whereas the Patent Law Treaty and the Singapore Treaty on the Law of Trademarks were introduced to unify patent and trademark registrations and to simplify such procedures (WIPO, n.d.-b, n.d.-c).

### **4.1.5 Government Promotion**

Following the analysis of IPR in China, in the last category, government promotion efforts on the national level will be evaluated. As described in the theoretical part, this can be an important secondary factor impacting inward FDI and thus, must be considered in a comprehensive study. The literature suggests that China is generally more restrictive than some other economies when it comes to FDI. In recent years, however, relaxations in certain industries have occurred and in 2018, 22 sectors from areas such as finance, infrastructure, trade and commerce and energy related industries were taken from the so called “negative list” and were made accessible to foreign firms (Ernst & Young, 2018, p. 1). For the promotion of this increasing openness, the Ministry of Commerce and the China Investment Promotion Agency (CIPA) are the main actors in charge. CIPA supports Chinese firms that aim to expand to countries abroad as well as foreign companies that have interest in establishing a foreign base in the Chinese market and is guiding the work of investment promotion agencies of different regions in the country. By doing so, CIPA provides a variety of services through their foreign and regional offices. To boost the investments of foreign investors into the country, to improve the efficiency of procedures and to handle matters in a more centralized way, China has established the so called “one-stop examination and approval services” (Ministry of Commerce, 2014, p. 93). These include consultations, information services regarding laws, regulations and legal procedures, as well as specific market or industry investigations and publications related to the business environment. Adding to the pre-investment services provided by CIPA, on behalf of the Chinese Ministry of Commerce, the major investment promotion agency also implemented aftercare services such as the support in labor recruitment, enterprise registrations and measures related to taxes and insurance. Furthermore, it supports international enterprises by handling complaints across regions, cities, or industries, by supporting the managing of business licenses and by giving advice in construction-related procedures such as planning (Ministry of Commerce, n.d.).

Like for most investment promotion agencies, also the planning and organization of networking events in and outside of the country as well as trainings, forums, conferences, and exhibitions are

part of CIPA's responsibilities. Amongst the major events organized are the China International Fair for Investment and Trade, which takes place numerous times a year in Xiamen, a city in the southeast of China. The major Chinese trade fair focuses on investment negotiations and promotion in the Chinese market in general, but also highlights certain regions that aim to increase foreign activities. Furthermore, by allowing international promotion agencies to take part, this trade fair also provides an opportunity for potential investors to make regional comparisons. Adding to the major national fair for investment promotion, also the Central China Investment and Trade Expo and the China International Green Innovative Products & Technologies Show need to be highlighted. As the name implies, the former focuses on regional potentials in central China. For the Chinese government, the measure to promote the six provinces located in this area is essential to distribute industries from the East and to convince potential investors from abroad to invest in central regions rather than in hubs at the Eastern coastal areas. The China International Green Innovative Products & Technologies Show is an exhibition that focuses on green technologies and serves as stage to connect developers of such technologies and services with the demand side. Especially in China and its environmental issues, this is an important platform for the government's plans to boost the development of clean energy technologies (Ministry of Commerce, 2014).

However, Chinese efforts to attract foreign investors are not just limited to pre-investment and aftercare services, and additional fiscal and financial measures to increase inward FDI are in place as well. Before looking at these specific strategies, however, it has to be noted that China offers incentives on the national and regional level and that the government has created five special economic zones and 14 coastal cities as special investment areas. However, as the scope of this research is limited, this master's thesis will focus on national level rather than local or regional level agendas. On the national level, China offers a variety of programs that target foreign MNEs who are engaged in the production of highly innovative technologies. The Chinese government offers a tax allowance for all companies that are active in R&D and fulfill the eligibility requirements. This system was introduced as a permanent benefit in 2015 as part of China's "Made in China 2025" strategy and in 2018, the government tried to induce even higher amounts of R&D spending by increasing the tax allowance rate from 150% to 175% (OECD, 2020b). Adding to the super-deduction, China further offers a reduced rate of the corporate income tax for enterprises that develop high and new technologies. This tax incentive decreases the corporate income tax from 25% to 15% regardless of the company's investment type and where its headquarters are located, which implies that also foreign enterprises are eligible for this incentive. Yet, to benefit from tax credits in this specific area, there are a number of prerequisites that have to be met. First, firms have to be registered in mainland China for at least one year before the application is submitted. Second, they have to possess IPR to the key technologies used for the enterprise's main products or services.

Third, income derived from high and new technology products or services should amount to at least 60% of the enterprise's total revenue, 60% of the enterprise's total R&D expenditure must be taken place in China and at least 10% of the total number of the enterprise's employees should be engaged in R&D and related activities. Adding to this, technologies are only applicable if they are listed in the official catalogue of high and new technology areas published by the central government (China Innovation Funding, 2019).

In addition to the high and new technology tax incentive, the Chinese government has further implemented a tax credit system for enterprises that offer advanced technology services. Like in the case of the high and new technologies, eligible firms benefit from a reduced income tax of 15%. Furthermore, it allows firms to remove education fees of up to 8% of the total salaries related to such advanced technologies from the income tax. Foreign MNEs that want to qualify for such fiscal incentive must provide at least one service that allows companies to outsource their information technology, their technical business or their technical knowledge processes. Adding to this, companies have to receive over 50% of its annual income from the technically advanced services, they have to achieve no less than 35% of its annual income from offshore service outsourcing and they need a minimum of 50% of employees that have been educated in tertiary education. Although for this fiscal measure a number of requirements have to be met as well, benefits for advanced technology service companies are generally easier to obtain than that for high and new technologies (KPMG, 2017, pp. 1-2). Before moving on to the empirical analysis of Japan, two incentive measures that have been implemented to raise R&D activities most recently need to be highlighted. As a temporary measure, the central government extended a value added tax exemption for purchases of domestic R&D equipment, which is applicable from the beginning of 2019 to the end of 2020 (The Hong Kong Trade Development Council, 2020). Furthermore, the Chinese legislature has introduced a new law in 2018, which widened income tax exemptions for foreign investors on re-invested profits in all areas that are not on the negative list as a temporary measure. To be eligible for this benefit, however, investments must be made into sectors supported by the government and foreign MNEs have to devote investment returns directly into invested companies (Xuequan, 2017; Yao, 2018).

## 4.2 Japan

### 4.2.1 Innovation Capacity

After the analysis of China's host-country environment, in this chapter the attention is turned to the Japanese case. Japan experienced a rather moderate growth of R&D spending in past years and the total GERD rose from \$153 billion in 2010 to \$173 billion in 2018 (+13%), with a small setback in the years of 2015 and 2016. Although spending on R&D did not expand as quickly as in many other countries, the R&D intensity of almost 3.3% in 2018 shows that innovation plays a vital role in Japan's economic development plans and with a constant intensity of over 3%, it ranks amongst the top countries worldwide. The composition of Japan's GERD further displayed that the expenses in experimental developments accounted with \$111 billion for 64% of all R&D costs. However, also in research, fundamental spending occurred and in 2018, Japan spent \$22 billion (13%) on basic and \$33 billion (19%) on applied research (OECD, 2020c).

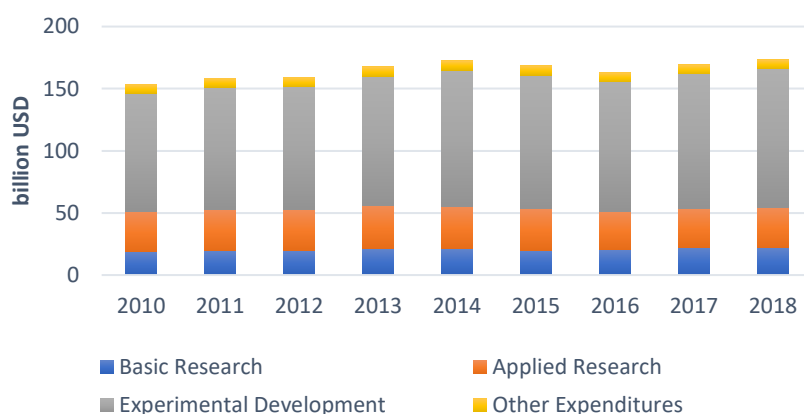


Figure 10. GERD by type of R&D – Japan (OECD, 2020c)

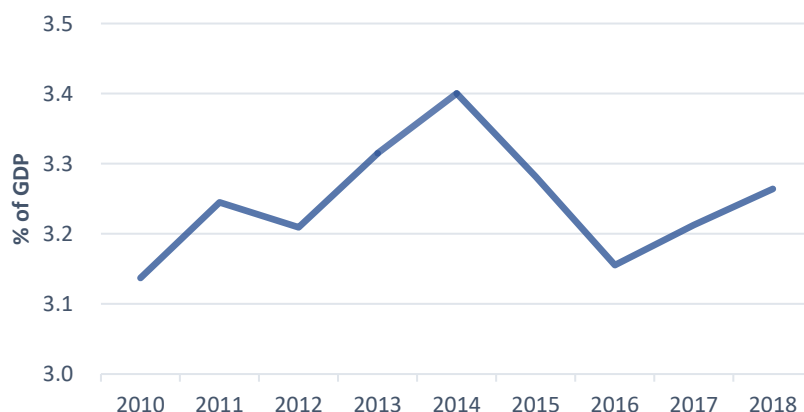


Figure 11. R&D intensity – Japan (OECD, 2020c)

As illustrated in Figure 12, the biggest share of R&D spending came from businesses, followed by higher education, government, and private non-profit institutions. In 2018, expenditures by the business sector accounted with \$138 billion for almost 80%. The higher education and government sector contributed for 12% and 7.7%, respectively, while the private non-profit sector accounted with the remaining 1.3% only for a small part of the total GERD (OECD, 2020c).

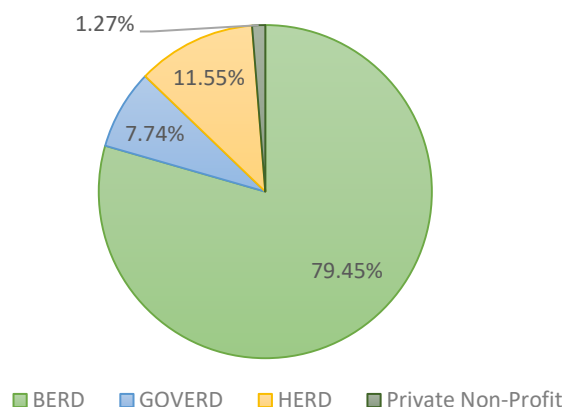


Figure 12. GERD by sector of performance (2018) – Japan (OECD, 2020c)

Following the analysis of Japan's GERD, the second indicator of innovation capacity, triadic patent families, will be studied. Data of Japan shows that annual registrations experienced a negative trend (-9.3%) between 2010 and 2015. According to the most recent nowcasts, however, after reaching a low of 17,500 patent filings in 2015, Japan recovered from this setback and patents increased to over 18,000 in 2017, accounting for over 30% of the world total. This shows that Japan not only ranks amongst the top in terms of R&D intensity, but also that Japanese entities are the number one in respect of triadic patent family registrations (OECD, 2020c).

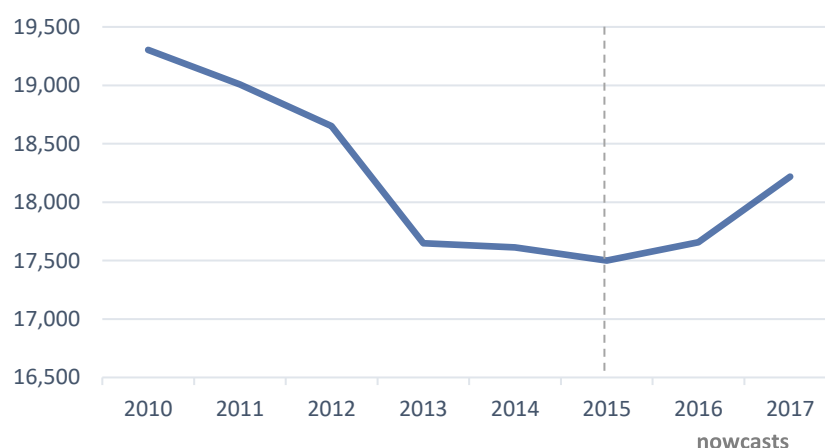


Figure 13. Triadic patent family filings – Japan (OECD, 2020c)

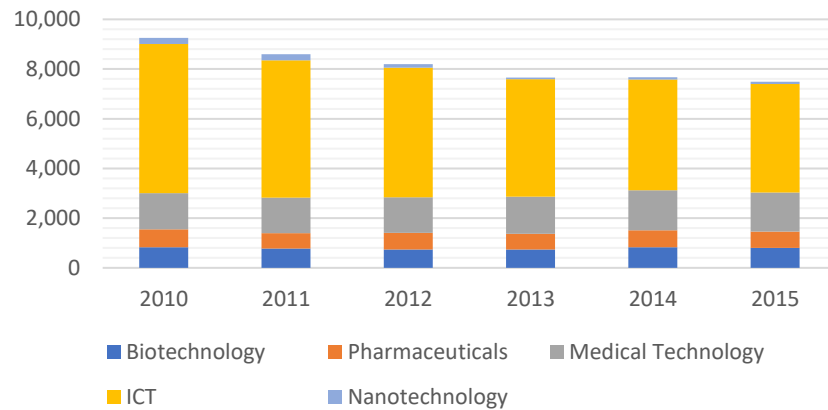


Figure 14. Triadic patent families by major technologies - Japan (OECD, 2020c)

The closer analysis of triadic patent families further showed that activities in ICT and medical technology accounted for the biggest share of filings, while the contribution of nanotechnology was rather small. Resembling the trend of total numbers, also patenting in ICT, pharmaceuticals and nanotechnology experienced a negative development between 2010 and 2015. The ICT sector for instance, suffered a decline of 27%, the registration of patents related to pharmaceuticals dropped by around 9% and the nanotechnology sector experienced a decrease of 64%. However, as the latter only accounted for a small percentage of Japan's total filings, the rapid decrease of registrations did not affect the total output greatly. Other than the ICT, the pharmaceuticals and nanotechnology sectors, the number of registrations in the biotechnology and medical technology sectors did not experience a decline between 2010 and 2015. While the biotechnology sector could maintain numbers from previous years, medical technology was the only area that experienced a rise of patent filings, with an increase of almost 8% in five years. Although the OECD does not provide data of major technologies for the years of 2016 and 2017, the nowcasts of total registrations showed an upward tendency, implying that also the major sectors such as ICT and pharmaceuticals recovered from the negative development during the years prior (OECD, 2020c).

#### 4.2.2 S&T Infrastructure

Following the analysis of the innovation capacity, the quality of the S&T infrastructure and the linkage opportunities for foreign MNEs in Japan will be explored. The latest publication of THE showed that the importance of Japanese institutes of higher education in global rankings has declined in recent years. As a result, since 2015, the number of universities amongst the top 300 has shrunk from eight to four institutions and from three to two universities in the top 150, with the University of Tokyo (36), Kyoto University (65) and Tohoku University (250-300) being Japan's top representatives. In conjunction with the overall negative development, also the top three universities were not able to hold their positions in recent rankings. This was the case, because despite not having received lower scores than in previous years, universities all around the world

had improved their quality and outpaced the performance of leading Japanese institutions. The University of Tokyo for instance, had an almost identical score in 2015 and 2020, yet, it lost 13 places over a period of just five years (THE, 2015, 2020). When we have a more detailed look at the individual results of the top three representatives, we can see that the University of Tokyo scored best in teaching and research, while it had a rather weak performance in terms of international outlook. Kyoto University achieved a low score in terms of attractiveness for international students and international university staff as well, however, they reached solid scores in teaching and research. Although clearly ranking below the two traditional universities in overall numbers, Tohoku University demonstrated the strongest linkage to the industry, and also in terms of international attractiveness it was able to compete with the two leading universities in the country, though on low levels (THE, 2020).

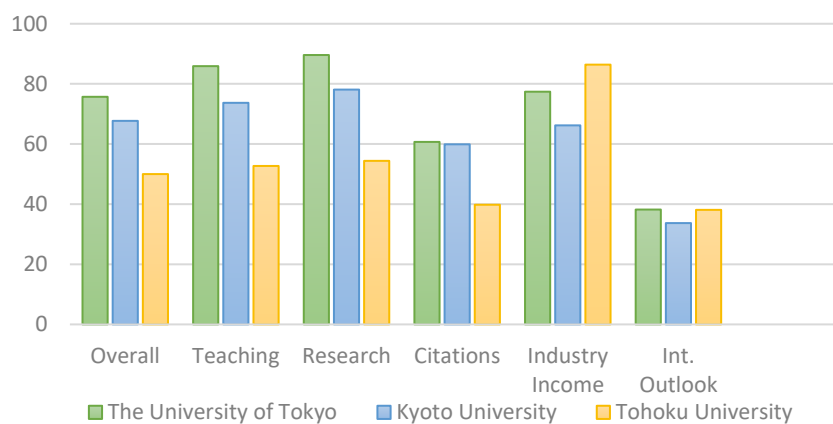


Figure 15. Top universities – Japan (THE, 2020)

Other than institutions of higher education, research facilities from the government and private sector could maintain their high levels of performance. In the latest Reuters' Top 25 Global Innovators Government ranking, four facilities from Japan were listed, elevating it to one of the top performing countries together with Germany, France, and the United States. Most remarkably here, however, was the density of high-performing research facilities in the top 15. With the Japan Science & Technology Agency (4), RIKEN (6), the National Institute of Advanced Industrial Science & Technology (7), and the National Institute of Materials Science (14), all four representatives were placed amongst the best worldwide (Reuters, 2019). Likewise, in the Nature Index, Japan established a number of government and private research facilities and in the latest publication, as many as 10 government institutions and 12 companies were placed in the global top 100. Similar to the Reuters ranking, top representatives in the government section were institutions such as RIKEN (6) and the National Institute of Advanced Industrial Science & Technology (26). In the corporate ranking, well-known companies such as NTT (10), Toyota (21) and Takeda Pharmaceutical (30) represented Japan. Of all Japanese institutions, whether they be government or

corporate, RIKEN achieved with 543 total and 127 share counts the highest score, with research primarily in physical sciences, life sciences and chemistry. The National Institute of Advanced Industrial Science & Technology, NTT and Toyota on the other hand, mainly focused on physical sciences and chemistry, whereas Takeda pharmaceutical stressed research in life sciences (Nature, 2019b).

After the analysis of the quality of research facilities in a global context, it is now necessary to evaluate if the Japanese government has implemented mechanisms that give foreign MNEs the opportunity to work together with such institutions and to integrate into domestic knowledge clusters. In Japan, most universities have established their own collaboration systems that allow them to work together with the industry, with partial funding provided by the government (Hashizume, 2012, p. 1). Furthermore, the Ministry of Economy, Trade and Industry (METI) provides tax credits for corporations that cooperate with local universities, public and private research facilities or other companies through joint or contract research. These benefits equal 30% of R&D expenses in the case of industry-university cooperation or if the partner is a national research institute. If foreign MNEs work with private research facilities or other companies, the tax credit equals 20% of the special R&D costs (METI, 2015). To supply additional funding for the collaboration between the academic, public, and private sector, and to allow partnerships in projects that exceed the scope of single actors, the Japanese government has further implemented numerous national programs that are accessible for universities and companies alike. The major actor that promotes and funds research in this agenda is the Ministry of Education, Culture, Sports, Science and Technology (MEXT). MEXT promotes innovation efforts based on the 5<sup>th</sup> S&T Basic Plan, which outlines Japan's objectives between 2016 and 2021. Within MEXT, the Japan Science and Technology Agency (JST) is mainly in charge for the promotion of S&T and it is one of the core institutions for the implementation of goals. Therefore, it is also one of the main actors when it comes to the promotion and funding of research projects between public, private and academic research facilities (JST, n.d.-a).

For industry-university cooperation, MEXT has implemented four major programs that are supervised by JST: (1) the Strategic Promotion of Innovative Research and Development (S-Innovation), (2) the Development of Advanced Measurement and Analysis Systems, (3) Collaborative Research Based on Industrial Demand and (4) the Center of Innovation (COI) Program. S-Innovation is a funding scheme that aims to support the practical application of R&D themes that have particularly high chances to be future technologies. To enable such practical application, each project is divided into three distinct stages and centered around teams that are formed by universities and companies. In the first stage, basic and foundational R&D is the focus of interest, while the attention switches to the research of component technology and the application

and commercialization of new technologies in the latter two stages. Generally, projects can last for up to 10 years and for each research team, funding of up to ¥70 million (\$657,930)<sup>4</sup> can be received. The second platform that encourages industry-university research and is supervised by JST, the Development of Advanced Measurement and Analysis Systems program, has the goal to support activities from the first collaboration scheme by developing and commercializing measurement and analysis systems. Similar to S-innovation, teams that consist of academic, public and private sectors are formed. Yet, project periods are generally shorter and vary between 2.5 to 3.5 years (JST, n.d.-b).

Other than the first two agendas, which stress the commercialization of technologies and analysis systems, the third initiative focuses on basic research that has the capacity to help overcome certain technical issues that the industry is facing. In this particular case, collaboration between the industry and research is given because such projects depend on the demand by the private sector. After the industry has identified a problem, research partners in form of universities are elected and a platform for opinion exchange is created. R&D projects within this program generally encourage long-term relationships and therefore, total funding of around ¥300 million (\$2.8 million) per technical theme for up to 10 years is provided (JST, n.d.-b). Last the COI program, which is the main funding strategy for R&D collaboration within MEXTs' Center of Innovation Science and Technology based Radical Innovation and Entrepreneurship Program. Like the first three strategies, COI is operated by JST with the goal to encourage and form industry-academia collaborative teams and aims to “tackle fundamental, multi- and interdisciplinary R&D challenges which are at high risk but with great expectations from the society” (JST, n.d.-c, para. 4). Generally, each assignment has one project leader from the industry and one research leader from the academia. Although the government generously funds COI projects for up to 9 years with up to ¥1 billion (\$9.4 million), the funding scheme differs slightly from the previous programs. This is the case, because companies must make contributions in form of financial-, human- or other resources as well (JST, n.d.-c).

Adding to the agendas supervised by JST, there are two more funding channels on the national level that need to be discussed. One is a R&D collaboration program administered and funded by the Japan Society for the Promotion of Science, which is sponsored by MEXT to support industry-university cooperation, to promote the research projects of young talents and to encourage international cooperation (Japan Society for the Promotion of Science, n.d.-a, n.d.-b). The other is the most current program established under the 5<sup>th</sup> S&T Basic Plan, the Public/Private R&D Investment Strategic Expansion Program. The former was established to promote university-industry cooperation and linkage through university-industry research committees. These

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<sup>4</sup> 1 Yen = 0,0094 USD

committees provide a platform for meetings and by doing so, they advance collaboration between academic and industrial communities. Therefore, main activities include the holding of workshops, seminars and symposiums, the fostering of young researchers and engineers as well as the promotion of joint research. Committees that focus on more general issues have terms of five years, whereas working groups that emphasize the development of future technologies are established for up to three years. Similar to the COI program, funding does not only occur by the administering body, but also through industrial members, who have to finance some of the activities listed above (Japan Society for the Promotion of Science, n.d.-b). The Public/Private R&D Investment Strategic Expansion Program is part of the government's most recent efforts to boost innovation in Japan by supporting the creation of society 5.0, "a super-smart society that seamlessly integrates cyberspace with the real world", to raise Japan's GDP to ¥600 trillion (\$5.6 trillion) and to expand R&D spending to 4% of the GDP. To achieve these goals, industry-academic partnerships especially with larger corporations in areas where the government expects high public demand, such as artificial intelligence and robotics, are promoted and funded (Cabinet Office, Government of Japan, 2017, p. 3; Fuyuno, 2017, para. 4). For the fiscal year of 2019 alone, the Japanese government allocated ¥6.3 billion (\$59.5 million) to the program, showing the significance of this new strategy (Cabinet Office, Government of Japan, 2019).

#### 4.2.3 Human Capital

After having discussed the S&T infrastructure and the national collaboration programs that have been implemented by the national government, the focus of this study will be turned to the human capital. In 2016, Japan spent a total of just over 4% of the GDP on education, from which spending in the tertiary sector accounted for 35%, or 1.4% of the GDP. Although the annual expenditure per student increased from \$17,399 in 2010 to \$19,191 (+10%) in 2016, in comparison to the GDP, spending in higher education experienced a slight decrease compared to 2010, when 1.5% were spent. In Japan, the primary to post-secondary non tertiary education received the biggest value of funding from the public sector, capital in higher education, however, came mainly from private entities (69%), while public funding accounted for 31% (OECD, 2020a, 2020d). Following the analysis of the financial contribution by the public and private sectors to tertiary education, it is now necessary to evaluate the number and level of young talents in higher education more closely by studying the gross enrollment rate, the level of graduates as well as the inbound and outbound mobility. For the second indicator used to evaluate the tertiary education sector, the gross enrollment rate, it has to be noted that information on Japan is of limited nature, and more recent numbers could not be found in national or international statistics. Therefore, other than in the case of China and the United States, for this indicator data is available until 2014 and not 2016. The gross matriculation rate in this year displayed that 63% of the official age group were registered in

higher education, with a female ratio of 61%. Although this shows a positive development since 2010 (+3%), with an enrollment rate of 63%, Japan ranked far below the average of high-income countries in that year (75%) and even if number increased in the years after 2014, the country most likely did not meet the standards of other developed nations (UIS, 2020a).

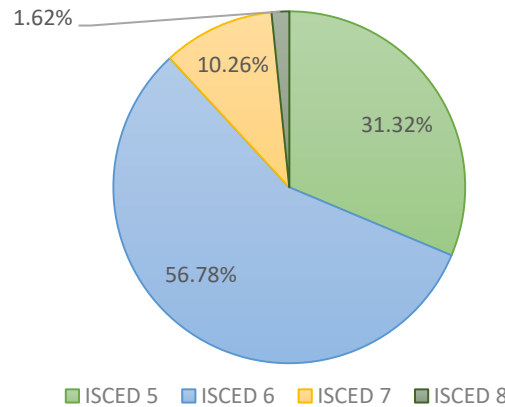


Figure 16. Graduates by level of education – Japan (UIS, 2020a)

Other than the gross enrollment rate, also the evaluation of graduation numbers is an effective way to measure the level of the human capital in a country. In 2016, Japan had 974,794 graduates in the tertiary sector. Within higher education, ISCED six level programs accounted for the biggest share, followed by short-cycle tertiary education. The most advanced programs on the other hand, accounted for a much smaller percentage and in 2016, 10% of students completed university with a master's degree and 1.6% with a PhD. The female proportion (50%) of the total number of graduates showed that there generally is a well-balance in higher education. However, a closer analysis exposed that female participation in the highest academic programs is low, and that this was compensated by a high share in short-cycle and undergraduate education. In 2016, female students in ISCED seven programs only accounted for 33%, which is severely lower than the share of women in total numbers. In ISCED eight programs, the ratio was even lower, and only 31% of all graduates with a PhD were female (UIS, 2020a). Last, the inbound and outbound mobility of students. In 2016, there was a relatively high inbound mobility rate of 3.7% in Japan and developments showed that the number of incoming foreign students increased compared to past years. The outbound mobility ratio on the other hand, was with 0.82% rather low. Furthermore, in contrast to the number of incoming foreign students, the amount of Japanese studying abroad decreased in past years and was 0.23% lower than in 2010. However, if they decided to study abroad, with an outbound rate of 0.65%, North America and Western Europe proved to be the most popular regions (UIS, 2020a).

To conclude the analysis of the human capital, after the evaluation of the tertiary education sector in form of higher education spending, the gross enrollment rate, graduation numbers and inbound and outbound mobility, the next step is the assessment of researchers, technicians and other personnel that is conducting R&D activities in the domestic labor market. Here, especially the evaluation of researchers is important, because they are key actors for innovation and are involved in numerous processes such as the product and method creation.

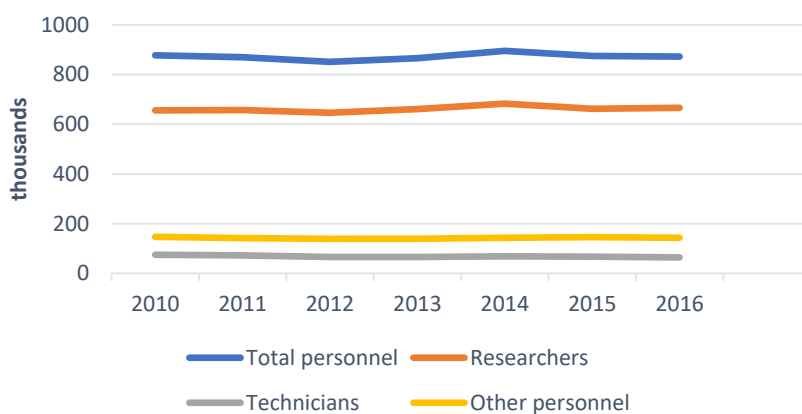


Figure 17. R&D personnel (FTE) – Japan (UIS, 2020b)

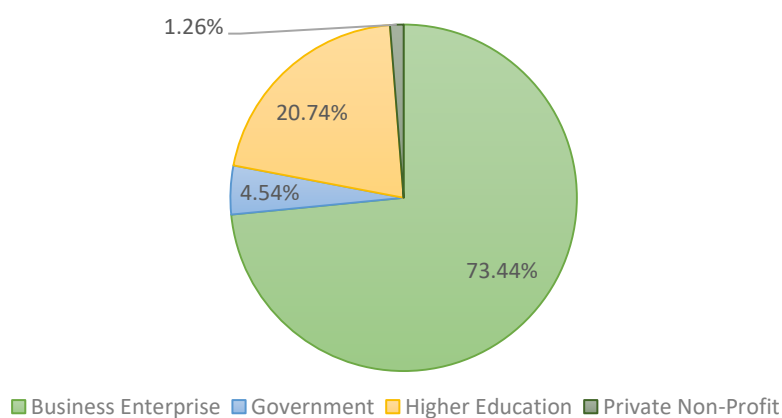


Figure 18. Researchers (FTE) by sector of employment (2016) – Japan (UIS, 2020b)

As illustrated in Figure 17, the characteristics of R&D personnel in Japan show that researchers accounted with 76% for the majority of staff, whereas technicians (7.5%) and other supporting staff (17%) made up for a much smaller proportion. The development of employment numbers between 2010 and 2016 further illustrates that the workforce experienced a slight fall of participation from 877,928 to 872,340 (-0.64%). This drop of employment numbers was primarily caused by a decrease of technicians, whereas the number of other supporting staff only decreased marginally. The number of researchers in contrast, improved compared to 2010, though being below the peak year of 2014, when the employment rate was 2.5% higher. Resembling these different development trends, also the importance of these units within the domestic labor market changed. The number

of R&D personnel as percentage of the labor force decreased to 1.3% (-0.12%), whereas the importance of researchers increased from 0.99% to 1.0% (+0.01%). From the researchers available in the domestic labor market, the majority was employed by business enterprises, followed by higher education, the government sector, and private non-profit organizations. Over the years, the distribution in these sectors was steady and only minor changes occurred. Compared to 2010 for instance, the employment in the business sector and government sectors slightly decreased, whereas the number of researchers within the higher education sector increased by 10% (UIS, 2020b).

### 4.2.4 Intellectual Property Rights

In Japan, the rights that concern industrial property are legally based on four main regulations: (1) the Patent Act, (2) the Utility Model Act, (3) the Design Act and (4) the Trademark Act. Each of these acts outline the extent of coverage as well as the length of IPR protection for the individual inventions. The Patent Act covers and regulates the protection of patents, which can be filed in a number of different technology sectors such as ICT, biotechnology, medical technology and nanotechnology. As discussed in the empirical analysis of China, they differ from utility models as they are characterized by a longer life cycle and generally have a higher level of technology. Patents that are filed in Japan are protected for 20 years, starting from the day of application. Products or technologies from the pharmaceuticals sector and agricultural chemicals are excluded from this protection mechanisms and their limit of coverage is five years. However, such patents can be extended if necessary (JPO, 2020a). The protection of utility models is with 10 years only half as long as that of patents and also trademarks underlie a protection of 10 years. The difference to utility models is that trademarks can be renewed indefinitely every 10 years, however, companies have to caution that they can be removed from the register if they are not used within three years of the date of registration and any consecutive three-year period thereafter. Furthermore, for trademark registrations, Japan has established a first come first serve system. This means that the company that files the trademark first has the rights over the mark, regardless if someone else developed it or not. Last, the Design Act, which underwent some major changes with the Patent Law amendment in 2019. With the reform, the term of protection of industrial designs was extended from 20 to 25 years. Furthermore, the scope of protection was expanded, application procedures were simplified, and the enforcement mechanisms of indirect infringement were strengthened (JPO, 2020a; METI, 2019).

Generally, the duration and costs of application can vary between intellectual property as not all inventions are created equally. However, past statistics show that for patents and utility models, an average procedure of 15 month has to be considered. For trademarks and design rights, the application process is shorter and takes around six months for the former and around seven months

for the latter. Furthermore, in terms of costs of application, a minimum of ¥115,700 (\$1087) can be expected for patent applications, however, this can increase depending on a variety of factors (e.g., application in foreign language, request for examination). For utility models, industrial designs and trademarks, however, such procedures are much cheaper (Suga, Iwase, & Takagi, 2017; JPO, 2019).

In addition to the legal base formed by Japanese authorities, as a member of numerous international agreements and treaties, Japan has adopted a minimum international level of protection and enforcement mechanism as well. It joined the WIPO in 1975 and it is a member of 21 WIPO administered treaties. This includes major agreements such as the Paris Convention, the Hague Agreement and the Patent Cooperation Treaty. The former helps creators of intellectual property to ensure that their patents and trademarks are protected in other countries. The Hague Agreement on the other hand, allows owners of industrial designs to register and to protect their designs in multiple countries or regions (including Japan), by just filing one single application with the WIPO. Furthermore, with the Patent Cooperation Treaty, inventors of new technologies can seek protection for an invention in all the signatory member countries by filing an international patent application (WIPO, n.d.-b, n.d.-c). Adding to the participation in WIPO arrangements, Japan is also active in many multilateral agreements established by the WTO and the United Nations. Like in the case of China, the TRIPS Agreement as major international arrangement on intellectual property has applied a minimum standard of IPR as well as the most favored nation principle to Japan (WTO, n.d.-b). Also, Japan has signed numerous bilateral treaties with countries mainly from the Asia-Pacific region such as Malaysia and the Philippines, but also a special bilateral agreements with China could be identified, which outlines the protection of trademarks in the two East Asian economies (WIPO, n.d.-e). Most recently, Japan has also entered the EU-Japan Economic Partnership Agreement, which does not only promote trade between the EU and Japan, but also includes a substantial chapter on intellectual property that exceeds the requirements established by the WTO. Main provisions include the implementation of longer protection periods for pharmaceutical and agricultural chemical products, a better protection of trademarks through the prohibition of preparatory acts as well as higher standards for enforcement mechanisms and standardized boarder measures (European Commission, 2017; JPO, 2020b).

Before moving on to the next chapter of analysis, with the enforcement mechanisms, one more indicator has to be discussed. In the case of intellectual property infringement, there are generally two ways to claim rights in Japan. First, it can be done through the administrative system. To ensure a proper administrative execution in the case of intellectual property infringement, the Japanese government has implemented an office that focuses on the protection of intellectual property within the METI in 2004. By doing so, the government aimed to increase the support they can give companies that deal with infringement domestically or abroad and to better coordinate the work of

other ministries as well as foreign authorities involved in the process (METI, n.d.). If administrative measures are not enough to solve the issue of infringement, an additional way are civil procedures through the Japanese court system. Here, the Japanese law distinguishes between intellectual property related civil cases and trials against the decisions of the JPO. Civil cases related to technological issues such as patents and utility models can only be handled by the District Courts in Osaka and Tokyo, whereas non-technological issues can be handled by any of the 50 District Courts. Any appeal of technological cases and all trials against decisions of the JPO automatically move to the Japanese IP High Court, whereas other cases are handled by the regional High Courts. The IP High Court was established in 2005 to increase the efficiency and to reduce the costs of court proceedings especially in cases that involve high expertise. Therefore, in addition to the designated judges, the IP High Court employs judicial research officials, technical advisers and conducts explanatory sessions to increase the accuracy of judgements made (Supreme Court of Japan, 2020). Generally, this shows that the Japan provides a good legal framework for foreign MNEs and during the analysis, only little issues could be identified. Most notably here, is the short protection terms of pharmaceutical products. Furthermore, also copyrights can be an issue for companies conducting business in Japan. However, as the focus of this analysis is on factors that are important for supply-driven R&D, this is not a major concern for such MNEs.

### **4.2.5 Government Promotion**

Following the analysis of IPR in Japan, in the last category, government promotion in form of pre-investment and aftercare services as well as fiscal and financial incentives will be discussed. Before looking at these specific incentive instruments, however, it is first necessary to discuss the major actors in charge for the promotion of foreign FDI. In the Japanese case, these are the METI and the Japan External Trade Organization (JETRO). JETRO is a government related organization that was originally founded in 1958 to promote exports abroad. However, due to developments in the global economy and the rising importance of FDI particularly since the 1990s, the focus has shifted and the promotion of FDI has become its major task (JETRO, n.d.-a). With JETRO, the Japanese government provides free access to pre-investment and aftercare services for foreign companies, which includes a variety of activities along the location process. In the initial stages, JETRO supports foreign companies through their overseas offices in over 70 countries by offering information about the Japanese market, providing research and surveys about current economic developments, business opportunities, initial cost estimations and important laws and regulations. The latter includes information about laws regarding labor, visa regulations, acts related to IP as well as the introduction to Japanese taxation laws. Once foreign companies have decided to invest in Japan, the responsibility switches from the overseas offices to the business support centers, which are located in the six major economic hubs Fukuoka, Kobe, Nagoya, Osaka, Tokyo and Yokohama.

While the task of overseas offices is to give an overview over major market developments, rules and regulations, the business culture, and expected costs of establishing a new location, the business support centers connect foreign firms directly to local service providers, local governments and the local labor force. Furthermore, access to free temporary office space as well as halls and conference rooms is provided in the six major economic hubs. To connect foreign companies with local actors, JETRO generally uses two different approaches. First, they bring together foreign companies with local governments and service providers such real estate agencies, lawyers, and tax accountants through personal meetings (JETRO, 2019, n.d.-b). Second, JETRO holds a variety of networking events and symposiums to link them with the local business community. Amongst the major opportunities provided is the Invest Japan networking event, which links foreign-affiliated companies operating in Japan with members of national and local Japanese government organizations from the 47 prefectures and municipalities. In addition to Invest Japan, special regional business conferences are executed on a regular basis to connect firms of certain industry sectors with domestic actors. Amongst these business conferences are also events dedicated to regional R&D clusters that aim to link R&D-intensive foreign companies to innovative hubs and to facilitate not only cooperation in research, but also spillovers in form of knowledge and technologies (JETRO, 2018a). In addition to this, JETRO has also executed several events that promote joint investment with Japanese small and medium sized companies. By doing so, the Japanese government tries to promote “open innovation among Japanese companies” and to expand possible market opportunities in foreign markets. Furthermore, JETRO supports the recruitment of the labor force by providing networking opportunities between foreign-affiliated companies and foreign exchange students in cooperation with major universities such as the University of Tokyo and Tohoku University. For the Japanese government, the linking of foreign exchange students and foreign affiliates is seen as a main mechanism to help businesses overcome troubles of labor shortage, which are caused by the demographic changes in the country (JETRO, 2018a, p. 44).

Yet, Japan’s efforts to attract foreign investors are not just limited to pre-investment and aftercare services, and also fiscal and financial benefits to increase inward FDI are in place. The first incentive this study would like to discuss, is the R&D tax credit system that has been implemented by the Japanese government with the goal to promote R&D investments by private companies and therefore, is of high interest for R&D-intensive foreign MNEs as well. The R&D tax credit system allows local and foreign companies to remove a percentage of their R&D expenses from their corporate tax payments and generally depends on two variables: The volume of R&D spending and the number of credit programs that are applicable. The latter can change because Japanese officials have implemented permanent and temporary measures. Permanent measures use the total R&D expenditure of a company as base line for R&D tax benefits and generally apply a rate between 6%

and 10% of the total R&D expenditure (METI, 2015). However, to induce even higher amounts of spending, as a temporary measure until the end of March 2021, tax rates have been elevated to a maximum of 14% for large corporations and 17% for small and mid-sized enterprises. In addition to this, Japan has also implemented some temporary measures in past years. This included the high R&D intensity tax credit, which was in force until March of 2019, as well as two short-term incremental tax measures which were abolished in 2017. The high R&D intensity tax credit allowed firms to deduct 20% of a reduced amount of the R&D intensity, while the two temporary incremental tax measures rewarded companies based on two different indicators of R&D spending. First, it supported companies that increased the average R&D spending from the previous three years. Depending on the increase of expenditures, companies could apply for tax credits of 5% to 30% from the increase in R&D expenses. The second measure targeted companies that had high R&D spending in relation to their sales. If the R&D expenses exceeded 10% of the company's sales, the Japanese government offered tax credits between 5% and 30% for R&D expenditure that could be applied on the amount of spending that exceeded the 10% of the company's sales numbers. However, in the case of temporary measures, companies were not eligible for both categories. Therefore, they had to pick the category that was most beneficial for them (METI, 2015, OECD, 2020b).

Adding to the R&D tax credit system, the Japanese government has also introduced incentive programs that target companies which focus on applied research and technology development processes based on the "Act on Special Measures for Productivity Improvement". This act enables the government to support companies that increase productivity by developing advanced technologies such as robots, sensors and new systems. If a foreign MNE falls into this tax system, they can choose between a special tax depreciation of 30% or a tax deduction, which can be either 3% or 5%. However, the latter can only be applied if the new technology and the resulting productivity growth causes wage increases that exceed 3% of the salary of the previous year (METI, 2020). Adding to these fiscal incentives provided to innovative companies, the Japanese government also offers inducements in form of favorable frameworks. The Regulatory Sandbox framework in Japan supports domestic and foreign firms that have invented innovative technologies which conflict with existing Japanese regulations, such as automated driving, artificial intelligence or IoT. Due to this, such technologies can be tested for a limited period of time with a limited number of participations, with the goal to promote the realization of innovative technology and business models in Japan rather than inhibiting it due to inflexible regulations and laws. Furthermore, by utilizing the data achieved by such demonstrations, regulations and laws can be adapted for the implementation of such technologies in society (JETRO, n.d.-c).

Before moving on to the empirical analysis of the host-country environment in the United States, one more measure introduced by the Japanese government has to be discussed. Other than the investment incentives above, this program supports any foreign MNE, and is not only limited to R&D-driven investments as it aims to strengthen any location outside of the metropolitan area of Tokyo. These benefits are attractive because they offer large financial support for opening branch offices or research laboratories in local areas outside of the metropolitan area through FDI, or foreign-affiliated companies relocating their headquarters from the metropolitan area to other regions. If foreign MNEs establish a facility in an area that is included in the scheme, companies can receive employment promotion taxation and capital investment tax cuts. The employment promotion taxation applies tax credits of up to ¥600,000 (\$5629) per new employee, while the capital investment tax cuts target the investment in infrastructure. For MNEs, these incentives become applicable if the acquisition price is ¥20 million (\$188,000) or higher and allow for a 15% special depreciation or 4% tax deduction on the acquisition value. If already established MNEs move their offices from Tokyo to other places, incentives are even higher and tax credits of up to ¥900,000 (\$8443) per new employee and 25% special depreciation or 7% tax deduction on the acquisition value of business facilities can be received. Furthermore, if companies relocate from Tokyo, companies may also be able to obtain exemptions or reductions on enterprise taxes and property acquisition taxes (JETRO, n.d.-d).

### 4.3 United States

#### 4.3.1 Innovation Capacity

Following the discussion of the host-country environments in the two East Asian countries, in this chapter the attention is turned to the United States, the benchmark of this study. Except for a minor setback in 2012, the United States experienced a moderate growth of R&D spending, and with a total GERD of \$552 billion in 2018, it was the country with the highest R&D expenditure worldwide. Between 2010 and 2018, the United States' total GERD grew by 23%, allowing it to maintain a stable R&D intensity between 2.7% and 2.8% throughout that period. From the total GERD, experimental developments (63%) explained with almost \$350 billion the majority of R&D expenditures. However, also activities in research accounted for a considerable amount and in 2018, \$91.5 billion (17%) were spent in basic research and \$109 billion (20%) in applied research. The progress of R&D expenditures further displayed that the latter received a higher priority by U.S. facilities than the former. Due to this, the expenditures in applied research rose by over 20% between 2010 and 2018, whereas the spending on basic research increased by 12% (OECD, 2020c).

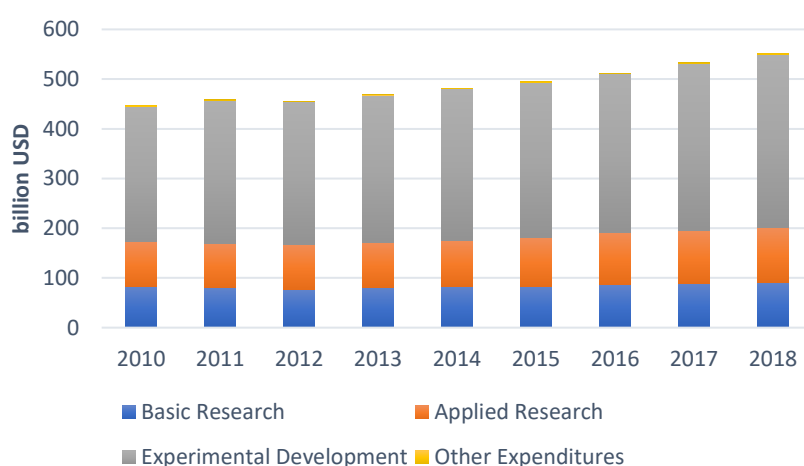


Figure 19. GERD by type of R&D – United States (OECD, 2020c)

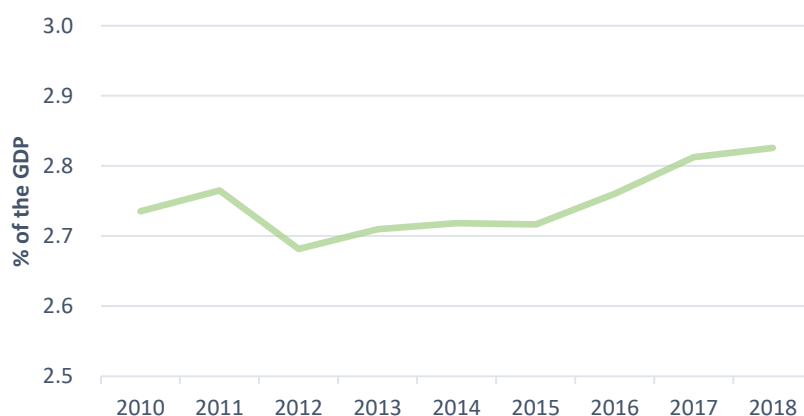


Figure 20. R&D intensity – United States (OECD, 2020c)

When we compare the R&D expenditure by sector, data illustrates that BERD explained with \$400 billion almost 73% of the total GERD. GOVERD (\$57 billion) and HERD (\$71 billion) on the other hand, accounted for 10% and 13%, respectively. Most notably, also private non-profit institutions in the United States spent a substantial amount of money in R&D, and with \$23.2 billion, the private non-profit sector accounted for 4.2% of the total expenses (OECD, 2020c).

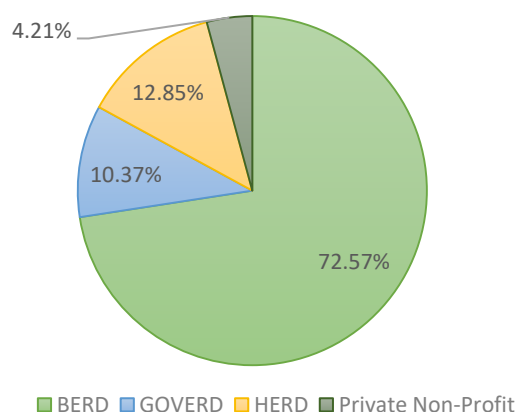


Figure 21. GERD by sector of performance (2018) – United States (OECD, 2020c)

The analysis of the second indicator for innovation, triadic patent families, showed two different pictures. The first picture portrayed a growth in patenting activities from 2010 to 2013, when total filings increased from 12,761 to 14,806. Following this upward trend, however, the United States experienced a steep drop to under 13,500 patent registrations in 2015. The most recent nowcasts indicate that this trend continued even further, and it wasn't until 2017 when the United States slightly recovered from this downward tendency. Nevertheless, the United States patent activities were still high, and with almost 12,500 filings in 2017, it was projected to contribute to 23% of all global patenting activities (OECD, 2020c).

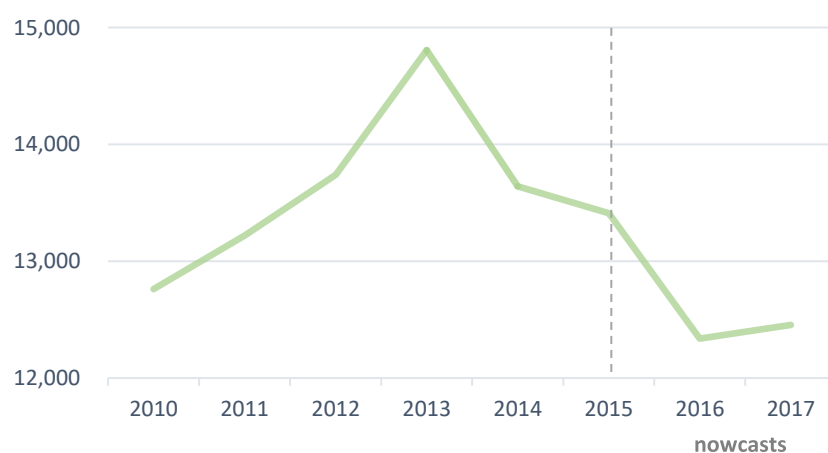


Figure 22. Triadic patent family filings – United States (OECD, 2020c)

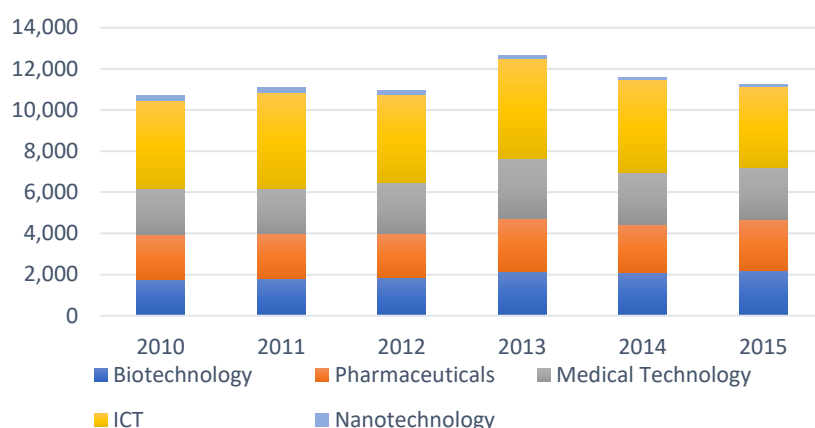


Figure 23. Triadic patent families by major technologies – United States (OECD, 2020c)

The closer analysis of registrations further displayed that patenting in the major technology sectors was well distributed. In 2015, ICT (29%) accounted for the largest number of activities, followed by medical technologies (19%) and pharmaceuticals (18%). Resembling the tendency of total patent filings, also ICT experienced a rapid rise from 2010 to 2013, followed by a drop of registrations in the succeeding years. While similar trends could be studied in the medical technology and the pharmaceutical sectors, the biotechnology sector in the United States did not experience a set-back of registrations and activities increased by 26% between 2010 and 2015, undermining its status as the global leader in biotechnologies (OECD, 2020c).

### 4.3.2 S&T Infrastructure

Following the analysis of the innovation capacity, in this chapter, the quality of the S&T infrastructure will be explored. Institutions of higher education in the United States have been very consistent at delivering high performance and in the latest THE World University ranking, 81 universities were placed in the top 300. Amongst the numerous high-quality universities, the California Institute of Technology (2), the Stanford University (4) and the Massachusetts Institute of Technology (5) were the top three representatives in the country (THE, 2020).

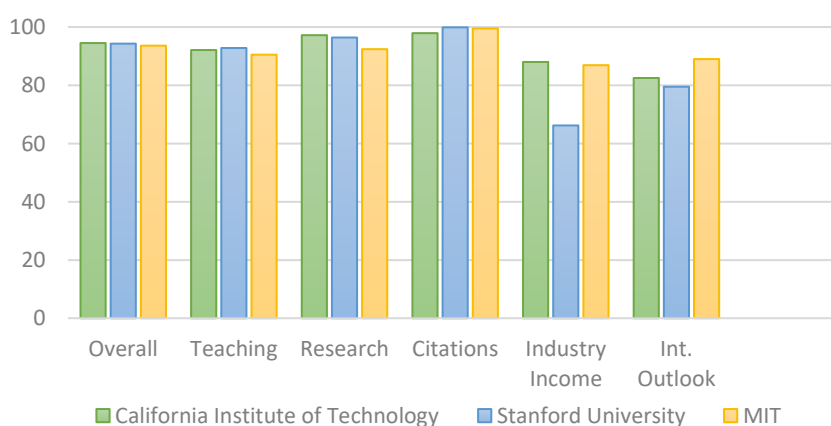


Figure 24. Top universities – United States (THE, 2020)

As they rank amongst the top universities worldwide, not many differences between them could be identified. The characteristics of all three universities displayed that they are relatively small and have a good student to teacher ratio as well as a high number of international students. As illustrated in Figure 24, the California Institute of Technology received the highest score in research, whereas Stanford university had the highest level of teaching. In the citations category, the Massachusetts Institute of Technology reached with 99.9 pts an almost perfect result, demonstrating that published works by this university are renowned and cited by scholars around the world. In terms of industrial income, which demonstrates the connection with the industry, the Massachusetts Institute of Technology and the California Institute of Technology achieved the highest scores. While the three universities reached similar results in all other indicators, in terms of industry income, Stanford University clearly trailed behind the other two (THE, 2020).

Not only the quality of institutions in tertiary education, but also the quality of corporate and government led institutes demonstrate that the United States has a well-developed S&T infrastructure. In the Reuters Top 25 Global Innovators Government ranking, the United States established four institutes in the top 25, being the second strongest country together with France and Japan. Furthermore, with the U.S. Department of Health and Human Services, the United States had the most renowned facility in the ranking (Reuters, 2019). Adding to this, in the Nature Index ranking, 23 of the top 100 were government research institutes from the United States and in the corporate ranking, U.S. businesses made up for 43% of the top 100. Amongst the best research facilities in the government sector were the National Institutes of Health (3), which is part of the Health & Human Services Laboratories, the Lawrence Berkeley National Laboratory (5) and NASA (7), while IBM (2), Merck & Co. (4), and Alphabet Inc. (6) were the top representatives in corporate research. Amongst all facilities, the National Institutes of Health had with 985 total and 394 shared counts the highest output, with a major portion coming from work in life sciences. Also Alphabet Inc. had the majority of output in this area. The Lawrence Berkeley National Laboratory, IBM and Merck & Co on the other hand, focused on physical sciences and chemistry, whereas NASA emphasized research in earth & environmental sciences (Nature, 2019b).

After having studied the level of U.S. research facilities, in the following paragraphs research linkage programs will be discussed. In the United States, the central actor that promotes and funds collaboration between the industry, universities and government research facilities is the National Science Foundation (NSF). The NSF was founded by the government in the 1950s and has the objective to keep the United States amongst the most innovative nations in the world by supporting all fields of fundamental science and engineering. To accomplish this goal, the government has allocated a budget of \$8.3 billion to the NSF in 2020 (NSF, n.d.-a). With these resources, also linkage programs that aim to connect academic, public and industry actors are supported. On the

one hand, such partnerships are reinforced through research collaboration offices of universities and colleges across the country, which receive direct funding from the NSF. On the other hand, a majority of the budget is allocated to national collaboration programs that award cooperative research across many fields. The analysis of such national research cooperation programs has shown that a variety of different channels have been implemented to promote partnerships. Amongst the numerous funding mechanisms provided, there are six programs in particular that are interesting for foreign MNEs that want to establish R&D in the United States and therefore, need to be discussed here: (1) the Industry-University Cooperative Research Centers (IUCRC), (2) the Science and Technology Centers (STCs), (3) the Partnerships for Innovation Program (5) the Grant Opportunities for Academic Liaison with Industry (GOALI) and (6) the Non-Academic Research Internships for Graduate Students (INTERN; NSF, 2020a).

The IUCRC funding program was established in 1973 with the objective to form long-term partnerships between the academia, the industry and public research in areas such as advanced manufacturing, biotechnology or civil infrastructure systems and to bridge “the gap between early academic research and commercial readiness” (NSF, 2020b, chap. 1). Generally, such centers are funded for two five-year periods. However, existing centers can also apply for an additional phase, which would provide funding for a total of 15 years. Although the amount of support from the NSF depends on a variety of factors, the anticipated funding of \$20.5 million in 2020 demonstrates the importance of the IUCRC program (NSF, 2020b). Furthermore, such partnerships are not solely sponsored by the NSF and therefore, require the participation of research partners in two different ways. First, universities and national research facilities provide the necessary infrastructure, human capital in form of researchers and the expertise in the targeted field. Industrial partners on the other hand, provide additional capital for research and give insights into technological issues the industry is facing. Although a capital investment is required for such projects, foreign MNEs can benefit from such partnerships as it is an effective way to integrate into domestic knowledge clusters, to access research infrastructures, to create new intellectual property and to benefit from the generous funding provided by the NSF. For universities, the combined funding of the NSF and the industry provides valuable assets for the advancement of major studies, but they also benefit from the deeper insight into major industry issues and from commercial experiences of their corporate partners (NSF, n.d.-b). The second major channel through which research linkages are formed and funded are the STCs. The STCs differ from the IUCRC because they are not concerned with the commercial use of inventions and focus on the basic research of new technologies in interdisciplinary fields. To solve such issues, the currently 12 STCs support partnerships between academic institutions, national research facilities and the industry for projects that require long-term capital (NSF, n.d.-c). Although subsidies may vary between STCs, the NSF generally dedicates large sums to such

projects and for the last four centers, a total of \$94 million were awarded (NSF, 2016).

The Partnerships for Innovation program differs from the two measures discussed so far as it does not focus on large-scale and long-term research collaboration but rather on projects that last for a maximum of three years. By doing so, it aims not only to speed up the transition process of a technology from basic research to commercialization, but also the creation of “new or broader collaborations with industry” is a primary objective (NSF, 2019a, p. 2). Therefore, a cooperation with industrial partners is required in most cases, and the participation of other actors from the public and private sphere is encouraged. In the fiscal year of 2019, a total funding of \$20 million was provided for the Partnerships for Innovation program. Here again, funding depends on a variety of factors, and within the funding scheme, there are two sub-programs that have different objectives and therefore, receive different amounts of subsidy. First, the Technology Translation program, which gives researchers the opportunity to receive grants for the development of technological innovations through proof-of-concepts or prototypes. Although the influence of companies in this program is of more limited nature and the research scope is of smaller scale, a partner with business experience is required. Second, the Research Partnerships track. Here, the primary focus is on issues that go beyond the capacity of one single actor and require the collaboration of multiple players including businesses, and other public research facilities. Due to the larger scope of such research projects, the funding in this scheme is higher and while the Technology Translation program only provides grants of \$250,000 for 1.5 years, the Research Partnership project provides funding of \$550,000 for three years (NSF, 2019a).

Furthermore, such subsidies can be increased through the funding mechanism GOALI. GOALI is not a separate research collaboration program per se, but it provides additional capital, which means that it can only be received if grants have already been awarded. Here again, the NSF tries to facilitate projects that evolve around a partnership with the industry. Therefore, it is only applicable if one of the three conditions outlined by the NSF are fulfilled. First, this measure can only be used as supplementary funding if the industry provides valuable input to research activities. Second, it can be awarded to students or researchers in their postdoctoral research if it helps them to gain knowledge in an “industrial setting” (NSF, n.d.-d, para. 4). Last, also scientists and engineers from corporates can receive funds, but only if they create knowledge spillovers to local universities. If eligible for such grants, additional funding of up to \$150,000 annually for three to five years can be received (NSF, n.d.-d; Soriano, 2019).

Before moving on to the next category of this study, with INTERN, one last funding channel has to be discussed. Other than the programs outlined so far, INTERN provides an opportunity for foreign MNEs to benefit from the domestic pool of exceptionally talented researchers. This is the case

because it supports the teaching of graduate students outside of the university environment. This can include trainings at national laboratories, think-tanks, government agencies, but most importantly also at research facilities of corporates. This allows foreign MNEs to directly connect with young researchers that will become available on the job market in the near future. For students on the other hand, the INTERN program expands training possibilities outside the university setting. Generally, such trainings are funded for up to six months, with a maximum of \$55,000 per student (NSF 2019b; Soriano, 2019).

### **4.3.3 Human Capital**

After having discussed the S&T infrastructure and the national collaboration programs that have been implemented by the federal government and the NSF, the focus of this study will be turned to the human capital. In the United States, 6.0% of the GDP were spent in education in 2016, from which 2.5% of the GDP were allocated to higher education and 3.5% to elementary to post-secondary non tertiary schooling. Although the amount devoted to higher education in the United States is high, the development illustrates that education in comparison to the national income lost in importance and decreased since the peak year of 2012, when 2.8% of the GDP were spent. The composition of expenditure further showed that the major share of funding came from private entities and only 35% of funds were provided by the public sector. While the overall spending in comparison to the national income declined, data measuring the expenditure per student (FTE) exposed that the capital available increased to \$30,165 (+17%; OECD, 2020a, 2020d). This growth can be understood when we have a closer look at matriculation numbers. The evaluation of tertiary education enrollment demonstrated that the United States had a high registration rate of 89%, which is far above the average of high-income countries (76%). However, the development over the past couple years generally showed a downward trend, explaining the increase of higher education expenditure per student. When we study the share of female and male students in higher education, we can tell that the ratio of female enrollment by far exceeded that of male participation. In 2016, the female enrollment rate reached over 102%, whereas male students accounted for a share of 76% (UIS, 2020a). As explained in the analytical framework of this study, gross enrollment ratios over 100% are possible, because they do not only include students of the official age group, but students of all ages. Therefore, if there is late enrollment, early enrollment, or repetition, the total matriculation can exceed the population of the age group and reach over 100% (World Bank, n.d.).

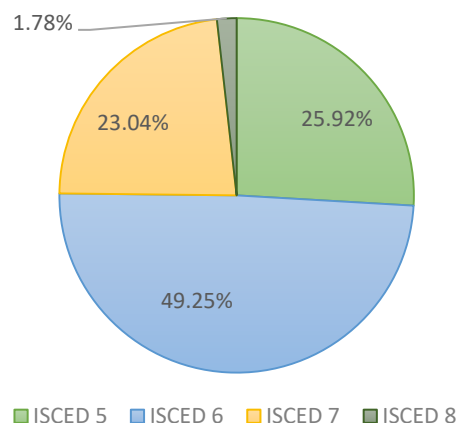


Figure 25. Graduates by level of education – United States (UIS, 2020a)

Other than the gross enrollment rate, also the evaluation of graduation numbers is an effective way to measure the level of the human capital in a country. In 2016, the United States had around 3.9 million graduates in the tertiary sector, showing a positive development since 2010 (+30%). The biggest fraction of graduates came from undergraduate programs, while students completing short-cycle education accounted for around 25%. Most remarkably, however, was the comparatively high number of graduates in ISCED seven and ISCED eight education. In 2016, 23% of all students finished with a master's degree and 1.8% with a PhD. Furthermore, female graduates did not just account for the biggest portion in total numbers (58%), but also in more advanced education the female ratio was high, accounting for 59% in ISCED seven and 50% in ISCED eight level programs (UIS, 2020a). Last, to complete the analysis of the tertiary education sector in the United States, the inbound and outbound mobility need to be studied. Compared to the OECD average, the inbound mobility rate in the United States was high in 2016. Young talents from abroad made up 5.0% of the total student body, indicating an upward trend since 2010, when the inbound mobility rate was at 3.4%. The composition of these statistics further displayed that the number of male students (6.4%) coming to the United States was higher than that of female learners (4.0%). Furthermore, when studying the net inflow by comparing the inbound to the outbound rate, data showed that there were more students visiting the United States than studying abroad in foreign countries. This was the case, because the United States had a relatively low outbound mobility ratio of 0.44% in 2016. In terms of region, universities in North America and Western Europe (0.22%) were most popular for U.S. students, but also Latin America (0.12%) explained a substantial percentage of outbound mobility (UIS, 2020a).

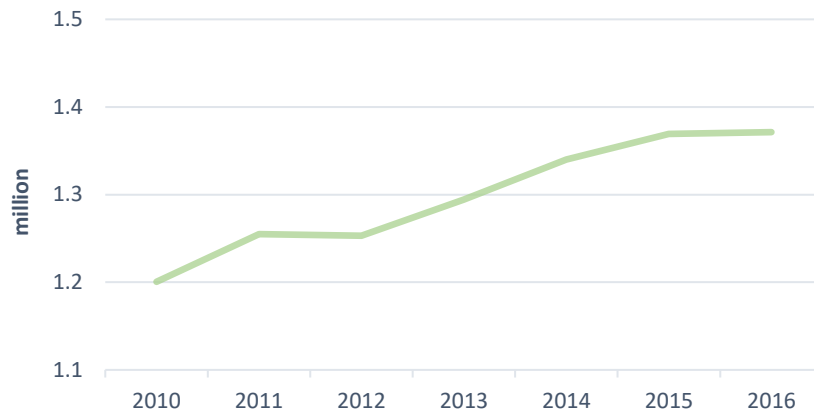


Figure 26. Researchers (FTE) – United States (UIS, 2020b)

To conclude the analysis of the human capital, after the evaluation of the tertiary education sector in form of higher education spending, gross enrollment rate, graduation numbers and inbound and outbound mobility, the next step is the assessment of researchers, technicians and other personnel that is conducting R&D activities in the domestic labor market. In the case of the United States, it has to be noted that data regarding R&D personnel is limited, and only the number of researchers is available in official statistics. However, as researchers are key actors for innovation, the limited availability of data will not impede a comparison in this category. Data showed that the United States experienced a moderate growth (+14%) of researchers between 2010 and 2016. Due to this increase of key personnel, also the share in the labor market increased from 0.77% in 2010 to 0.85% in 2016. Furthermore, as in most countries, corporates were with 71% the biggest employer. Although official statistics do not provide data for the higher education and government sectors, the high employment rate of researchers in the corporate sector implies that R&D personnel working in academic and public research only accounted for a comparatively small ratio (UIS, 2020b).

### 4.3.4 Intellectual Property Rights

After having studied the human capital, the focus will now be turned to the IPR of this study's benchmark country. For many, the United States is seen as a “global leader and standard setter for the protection and enforcement of IP rights” and in the latest International IP Index, it was ranked as the country with the strongest overall legal framework (Pugatch & Torstensson, 2020, p. 253). In the United States, patents and industrial designs are directly regulated by the constitution, which means that laws can not be changed easily and the legislature is only allowed to do so if amendments “promote the progress” of the current legal framework (WIPO, n.d.-d, para. 16). Other than China and Japan, the U.S. law does not make a distinction between more innovative patents, which are characterized by a longer life cycle and generally have a higher level of technology and utility models, which are low-tech products with shorter life cycles. If foreign MNEs want to file patents, industrial designs or patents related to plants, such goods have to be registered at the United States

Patent and Trademark Office (USPTO). Although the application procedure as well as costs related to the filing process vary between new inventions, past statistics from the USPTO show that the filing process can cost between \$5,000 to \$25,000, with an average application process of 30 month. For industrial designs, the registration procedure is on average cheaper and with 13 months also shorter. After such patents have been successfully registered, utility models and patents related to plants receive a protection of 20 years, whereas industrial designs are protected for 14 years from the filing date (Purvis, n.d.; USPTO, n.d.-a). For trademarks, the legal framework is regulated differently, and it wasn't until 1946, when the primary trademark law was implemented under the Lanham Act (WIPO, n.d.-d). Generally, protection of trademarks is given after they have first been used in the U.S. market because they are regulated under the common law. However, if registered as a federal trademark at the USPTO, additional benefits that help to provide infringement are provided. This includes protection that is not geographically limited within the U.S., as well as a listing in the official database of the USPTO, which can be accessed by other businesses and therefore, can prevent unintended infringement in the first place. Furthermore, if registered at the USPTO, trademarks are generally protected for as long as they are used in commerce (USPTO, n.d.-a).

After having discussed the extent of coverage, the duration of protection and the length and cost of the registration process, let's now turn our attention to international trade agreements. As outlined in earlier chapters, international trade agreements are important for foreign investors, because such treaties establish a basic standard of IPR and contribute to a synchronization of laws in all member states. As one of the countries with the strongest intellectual property protection mechanisms and as an attractor of highly innovative firms, the United States is also a signatory country of a variety of treaties on the multilateral, regional and bilateral level. It joined the WIPO in 1970 and since then has signed 18 WIPO-administered treaties. This includes major agreements such as the Paris Convention for the Protection of Industrial Property, the Patent Cooperation Treaty, the Hague Agreement, the Singapore Treaty on the Law of Trademarks and the Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks. Furthermore, the United States has established a basic standard of intellectual property protection as it is member of the United Nations and the World Trade Organization. To ensure additional intellectual property protection for U.S. companies and for foreign investor, the United States has further signed and ratified regional agreements such as NAFTA, but also bilateral treaties that increase the protection of intellectual property with countries that are not part of major WIPO or other multilateral treaties could be identified (WIPO, n.d.-c, n.d.-f). Furthermore, as discussed in the empirical analysis of China, as part of a trade deal, China and the United States have also worked on a bilateral intellectual property framework with the goal to better protect the interests of Chinese and U.S. firms (United States

Trade Representative, 2020).

Before moving on to the next chapter of this empirical analysis, with the enforcement mechanisms, one more indicator of IPR has to be discussed. In the case of intellectual property infringement, there are generally two ways to claim rights in the United States. First, it can be done through the legal system and second, through the administrative system. In the United States, the majority of legal procedures regarding patents and trademarks take place as civil cases at U.S. federal or state courts. This is the case, because if the holders of IPR proceed on the civil track, less burden of proof has to be provided for intellectual property infringement. For criminal cases, the success of claiming intellectual property violations is reduced drastically due to the high burden of proof that a holder of intellectual property has to provide. Adding to this, holders of patent IPR can use administrative measures to protect their intellectual property as well. This can be done in addition to legal charges or in place of civil procedures and involves a claim at the United States International Trade Commission or at the Patent Trial and Appeal Board of the USPTO. The former can prevent importations of products that infringe IPR of patents into the United States, whereas the latter deals with issues regarding trademarks (WIPO, n.d.-d).

Although the enforcement mechanisms in the United States are characterized by strong deterrence measures, a high transparency, a good coordination and solid civil and administrative procedures, the current system also provides challenges that have to be considered by foreign investors (Pugatch & Torstensson, 2020, p. 254). A major issue that has been caused by the legal framework is the patentability of high-tech inventions such as artificial intelligence, software, and algorithms. Critics argue that the U.S. enforcement system is beneficial for patents from low-tech sectors, however, it often fails to protect high-tech inventions, because other companies can challenge existing patents of such technologies using low burdens of proof in settlements out of court. This flaw in the system is often exploited by market-dominant enterprises which undermine the legal framework and challenge patents of other companies. As the questionable patentability especially concerns high-technologies, this can be a potential deterrent for investments of R&D-intensive companies (Quinn, 2017; Shore, 2018).

### **4.3.5 Government Promotion**

Following the analysis of IPR in the United States, in the last category, government promotion in form of pre-investment and aftercare services as well as fiscal and financial incentives will be discussed. Like in the cases of China and Japan, before looking at these specific incentive instruments, it is first necessary to briefly discuss the major actors in charge for the promotion of foreign FDI. In the United States these are the U.S. Department of Commerce and its International Trade Administration. In 2011 the U.S. government together with the U.S. Department of

Commerce established the nation-wide program SelectUSA, with the aim to raise investments by foreign and domestic firms and to “provide enhanced coordination of Federal activities in order to increase the impact of Federal resources”(The White House, 2011, para. 5). Since its implementation, SelectUSA has provided a variety of services for foreign companies such as the provision of information and counseling and the assistance in coping with federal and state laws and regulations. To provide information to foreign investors, SelectUSA has set up offices overseas, but also publications and surveys about the U.S. market and about specific industries, current trends and the investment environment are means to transport necessary information to potential foreign investors. Additionally, they offer online tools and resources that help firms to find important statistics, industry clusters and innovation hubs but also to estimate possible cost of setting up a business in the United States (SelectUSA, n.d.-a, n.d.-b).

The second service provided by SelectUSA supports foreign firms by connecting them with local investment support services, the Economic Development Organizations. These local offices provide support for firms in finding specific service providers that are necessary for the investment, such as legal, immigration, advisory, research and financial services (SelectUSA, n.d.-a). Furthermore, for firms that want to export from the United States, they provide additional resources in form of access to a network of trade and investment experts in more than 75 international markets and more than 100 U.S. offices (SelectUSA, n.d.-a). Adding to this, SelectUSA hosts a variety of networking events in and outside the United States that allow for investors to directly connect with federal, state, and local investment agencies such as the SelectUSA Investment Summit, international road shows, trade fair pavilions, and seminars. The SelectUSA Investment Summit for instance, is the largest event dedicated to the promotion of FDI hosted by the national investment agency. It does not just connect foreign investors with local agencies but also highlights current industry trends and new opportunities in the United States (SelectUSA, n.d.-c).

Following the discussion of pre- and aftercare services, also the availability of fiscal and financial incentives for foreign MNEs need to be discussed. In the case of the United States, incentive programs for investments on the federal level are scarce. Most incentive packages target small and mid-sized enterprises and hence, are not applicable for foreign MNEs, or they are managed on the state rather than the federal level. By following such decentralized approach, the government tries to steer capital towards certain areas or industry clusters. Therefore, foreign MNEs investing in the United States have to pay particular attention to the different regional characteristics and incentive packages offered to R&D-driven firms. On the federal level, the U.S. government offers R&D tax credits for domestic and foreign companies alike. Initially, these R&D tax credits were implemented as a temporary measure, however, in 2015 the federal government implemented it as permanent cornerstone for the promotion of innovation. The R&D tax credit can be divided into four distinct

categories: (1) the regular research credit, (2) the alternative simplified credit, (3) the credit for basic research and (4) the energy research consortium credit. For MNEs as well as small and mid-sized enterprises, the tax rate for the first category is 20% for research expenses that exceed a certain base amount. For each enterprise, this amount has to be calculated individually based on tax payments between the years of 1984 and 1988. As many companies began operations after 1988, an additional measure is provided in form of the alternative simplified credit. Other than the regular tax credit, the alternative simplified credit provides a more basic method to calculate the benefits. A tax rate of 14% can be applied by enterprises to the amount of qualified expenses that exceed 50% of the average annual qualified research expenses in the three immediately preceding tax years. If there have been no R&D expenses in any of the three preceding years, a lower credit rate of 6% can be applied. Like in the case of the regular tax credit, R&D expenses include wage costs, supply costs, contractor costs and much more (26 U.S. Code § 41.; OECD, 2019). In addition to these more general tax credit measures, companies can further apply for basic research fiscal incentives as well. Such credit is 20% of the expenses related to basic research and hence, it can only be used for research that has no objective of commercializing such technologies. Last, the energy research consortium credit. This credit is available in addition to the regular or the alternative simplified credit and the basic research tax credits. It is not incremental, which means that 20% of the expenses in energy research can be deducted. However, to be considered for this measure, an organization must primarily run energy research, and the expenses claimed need to be related to activities that are of public interest. Therefore, this credit is only applicable for a limited number of companies (26 U.S. Code § 41.; OECD, 2019). Adding to these fiscal incentives, the federal government of the United States has also implemented a loan program that is managed by the U.S. Department of Energy. The U.S. Department of Energy issues loans for companies that are located in the United States and utilize a new or significantly improved technology that has the potential to reduce or avoid greenhouse gases. This program has the goal to increase projects in this field by limiting the investment risk for companies. This means that the U.S Department of Energy aids companies with loans until their technologies have reached “commercial scale”. To provide sufficient support, the government has made more than \$40 billion available for loans and loan guarantees (Department of Energy, n.d., para. 5).

## 5 Findings

### 5.1 Innovation Capacity

The empirical analysis has shown that China, Japan and the United States have a high innovation capacity and that they belong to the most innovative states globally. In all three economies, the business sector accounted with over 70% of the total GERD for the highest amount of R&D spending, while R&D activities in the government and higher education sectors had a lower share of activities.

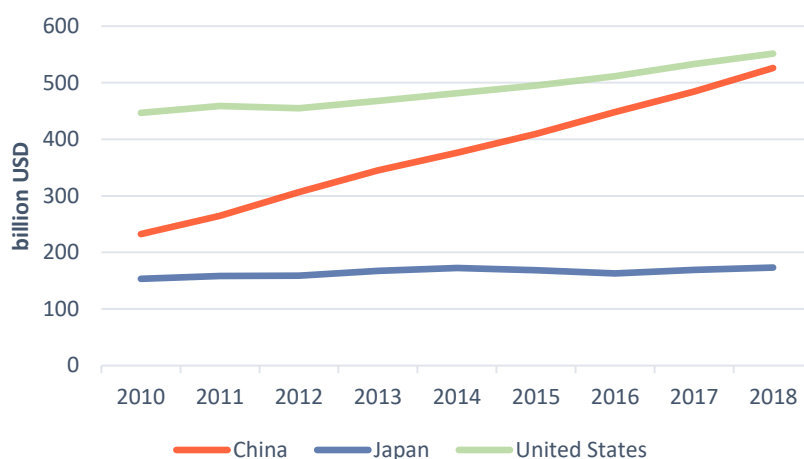


Figure 27. Total R&D spending (OECD, 2020c)

From the three countries, China has experienced the most rapid development of expenditures, whereas the developments in Japan and the United States were only moderate in nature. However, the total GERD of a country only shows a small part of the whole picture and therefore, it was also necessary to look at other indicators such as the R&D intensity and the R&D composition as well. These indicators exposed that China, despite having the second highest GERD worldwide, still trails behind Japan and the United States in terms of innovation capacity. Although having the lowest overall R&D expenditure, Japan's R&D intensity (3.3%) was over one percentage point higher than that of China (2.2%) and almost half a percentage point greater than that of the United States (2.8%). Adding to this, also the composition of R&D, which divides activities into basic research, applied research and experimental developments, showed that China was not as sophisticated as total numbers would suggest. The composition is an important indicator because not every activity has the same amount of innovative character. Basic research is work undertaken to acquire new knowledge without practical applications in mind, while applied research aims to acquire new knowledge for a specific practical use. Experimental developments on the other hand, draw on existing knowledge and aim to improve technical applications or to produce additional knowledge (OECD, 2015, p. 45). In China, the latter accounted for the highest amount of expenditures, while

spending in research activities was comparatively low. In 2018, only 5.5% and 11% respectively were spent on basic and applied research, whereas Japan devoted 13% and 19% to these areas. In the United States, spending was even higher and reached 17% in basic and 20% in applied research. This indicates that Japan and the United States emphasized the creation of new knowledge, whereas China focused more on the improvement of existing technologies.

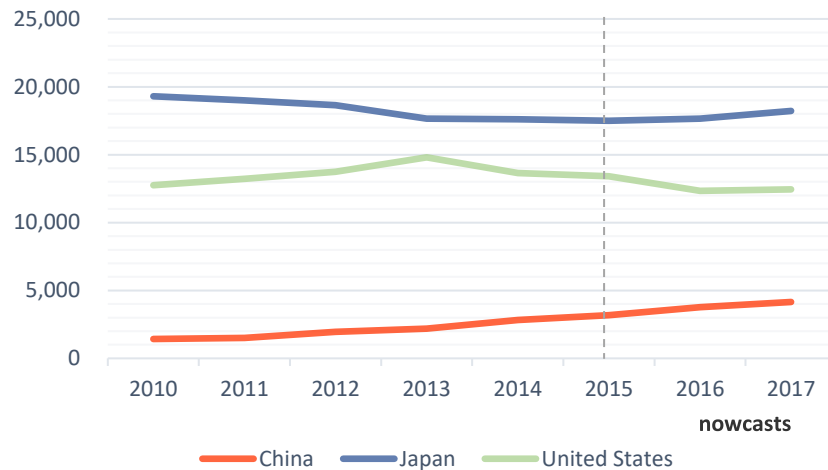


Figure 28. Triadic patent family filings (OECD, 2020c)

The analysis of the second indicator, triadic patent family registrations, confirmed that Japan and the United States have an exceptional innovation capacity. Despite negative developments in previous years, both were ranked as the two most active countries in terms of patent filings. Taking into consideration the nowcasts provided by the OECD, Japan accounted with 18,219 registrations for over 30% and the United States with 12,454 patents for around 23% of all global patenting activities in 2017. In China, the global share (7.6%) was with 4,152 filings much smaller, however, unlike Japan and the United States, patent registrations experienced a rapid development. Therefore, if China can keep up the current pace, it eventually will be able to catch up with the leading countries in this aspect. Similar to the R&D expenditure, also in the case of triadic patent families, it is important to not just look at the total numbers but also at the composition of patent filings. A closer analysis revealed that technologies from the ICT sector accounted for the highest number of patenting activities in all three countries and especially in China, the number was with 60% exceptionally high. Amongst the three economies, the United States had the most balanced share of patenting activities within the major technologies and not only ICT, but also the medical technology, the pharmaceuticals and biotechnology sectors accounted for a decent portion of patenting activities. This implies that Chinese and Japanese entities focused their innovative activities on a few areas that were most important for their economies, while the United States proofed to have strong innovative capacity in all major technology sectors.

## 5.2 S&T Infrastructure

The analysis of the S&T infrastructure has demonstrated that China has a number of high-quality research facilities in the government and corporate sectors. This is reflected by the latest Nature Index ranking, which placed eight government and 13 corporate research facilities in the top 100. Furthermore, with the Chinese Academy of Sciences, China's major national research facility was ranked as the most renowned institution for several consecutive years. In addition to the strong government and corporate research facilities, also Chinese institutions of higher education experienced a rapid quality improvement in past years and in the latest ranking published by THE, a total of five Chinese universities were ranked in the top 150, with Tsinghua and Peking University as their top representatives. Due to this increase of excellence in higher education and the stagnation of quality in Japan, China was even able to surpass it in the latest university rankings. In terms of government and corporate research, however, Japan still counts to the most renowned countries and in the latest Nature Index ranking, 10 government and 12 corporate facilities made the top 100. Most remarkably, however, was Japan's performance in the latest Reuters' Top 25 Global Innovators Government ranking. With four institutions, Japan was placed second together with France and the United States and just behind Germany. Other than France, the United States and Germany, however, all four Japanese institutions were ranked in the top 15, showing that Japan had the highest density of high-quality facilities.

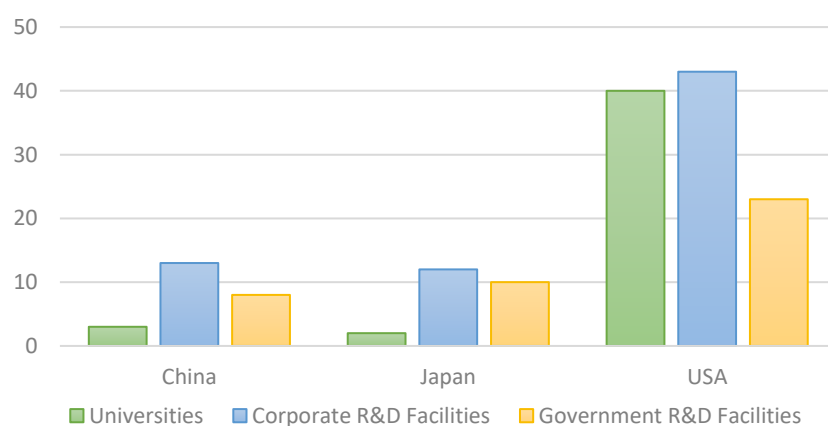


Figure 29. Research facilities in the top 100 of the THE and Nature Index rankings (Nature, 2019b; THE, 2020)

Although Chinese and Japanese research facilities belong to the most innovative institutions globally, both countries can not compete with the United States when it comes to the quantity of high-quality facilities. In the latest THE ranking, the United States had more universities in the top 20 than China and Japan together in the top 500. In the Nature Index, U.S. institutions accounted for almost 25% of all government facilities and over 40% of all corporate research institutes. Furthermore, as outlined earlier in this chapter, the United States was ranked as the second strongest country in the Reuters' Top 25 Global Innovators Government ranking and had with the U.S.

National Institutes of Health an U.S. institution ranked as the top research institute globally.

Aside from the quantity and quality of research facilities, another major consideration factor for foreign MNEs is the ease of establishing linkages with universities and government research facilities. The analysis of research cooperation possibilities in China, Japan and United States showed that these countries follow similar approaches in promoting partnerships, however, also some differences in this aspect could be identified. Governments in all three countries have clearly defined programs that aim to support their S&T development plans by organizing, supervising, and funding collaboration. In China, most universities have their own specific university-industry committees facilitating cooperation between the academe and the industry. However, the national government in form of MOST also established major national programs to promote the cooperation of universities and industries that go beyond the scope of a single university. These are the NKPs and the National S&T Mega-Projects, which support the advancement of knowledge in different sectors and different areas of research and aim to boost industrial competitiveness of Chinese businesses. All programs are accessible for China-based affiliates, and therefore a potential participation for foreign MNEs in future projects can be an important determinant for supply-driven R&D investments.

Likewise, Japan has established several permanent programs that promote cooperation on different levels of research such as S-Innovation and the COI program. Furthermore, as part of the governments most recent efforts to boost innovation efforts in Japan and to promote society 5.0, the Public/Private R&D Investment Strategic Expansion program was implemented as temporary measure from 2016-2020, emphasizing industry–academic partnerships with primarily large corporations in areas where the government expects high public demand, such as artificial intelligence and robotics. In the United States, the NSF as the major actor for building partnerships to industry research could be identified. Through a variety of funding schemes such as IUCRC and STCs, the U.S. government intends to advance technologies and to transform basic research into commercialized goods for the society. Furthermore, like China, the United States also offers a program that helps young researchers or engineers in achieving trainings from companies. In the United States, the NSF established for this particular case the INTERN program. In China, the collaboration of the industry with students from engineering is supported through the PETOE program. In Japan, such program could not be identified. Yet, it was the only country that implemented tax credits to further induce research cooperation. Companies that were eligible for such benefits could receive credits of up to 30% of R&D expenses occurring in activities together with universities or other local research facilities.

Although programs in the three economies vary in terms of funding and project length, especially

for key programs, long-term relationships seem to have a higher importance in Japan and the United States than in China, where research schemes focus on an average project period of three to five years. In terms of funding, however, the total volume of capital assigned to collaborations in Japan and the United States seems to be lower than in China, which has allocated major funds to the NKPs and the S&T Mega-Projects. Yet, the accessibility of such programs remains in some cases questionable. While there are no statistics for Japan and the United States, the acceptance rate of China-based affiliates for NKPs and S&T Mega-Projects is relatively low and only 22 out of 2,288 projects were led by international entities in 2016 and 2017 (China Innovation Funding, 2018a).

### 5.3 Human Capital

In the empirical analysis, two major categories were evaluated to define the quality of the human capital: (1) the tertiary education sector and (2) researchers, technicians, and other R&D staff. In the first category, the results showed that the United States, with 2.5% of the GDP, had the highest spending in tertiary education, more than one percentage point higher than that of China (1.4%) and Japan (1.4%). The funding scheme of tertiary education further showed that institutes of higher education in Japan and the United States received with over 60% the greater part of support from private entities, whereas public funding accounted for the majority of capital in China.

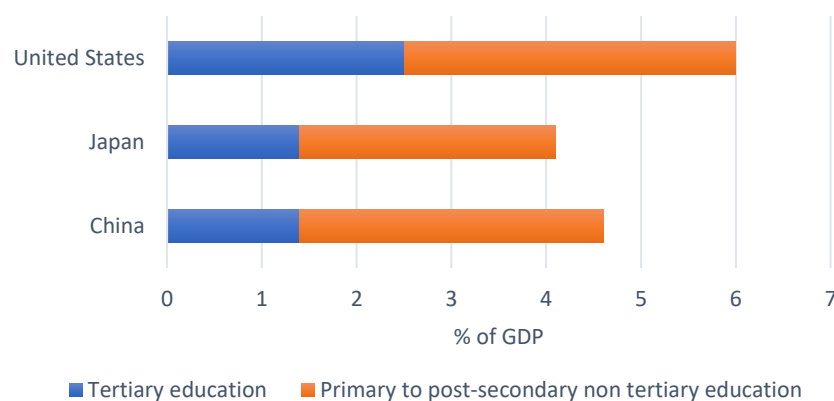


Figure 30. Education spending (Ministry of Education, 2018; OECD 2020a)

The empirical analysis of human capital also indicated that the United States was not just the country with the highest spending in comparison to the national income, but also had an exceptional quantity and quality of the student body. The gross enrollment rate in tertiary education reached 89%, far above that of the average of high-income countries (77%), Japan (64%; reference year 2014) and China (49%). Furthermore, with 23% of graduates from master's programs and 1.8% of graduates from PhD programs, the United States proved to have an exceptional level of highly qualified young people. In Japan, graduates with PhD (1.6%) almost matched the levels of the United States. However, the number of students completing a master's degree was with 10% lower and the biggest

share of degree holders accomplished undergraduate programs (57%). Furthermore, the number of female graduates with the highest level of education was particularly low in Japan, and women only explained 33% of all graduates with master's degree, and 31% with PhD. In the United States, these numbers were much higher, and female students accounted for a ratio of 59% and 50% in master's and PhD programs while in China, the proportion of women reached over 50% and 42%, respectively.

In the case of China, it has to be noted that although it had the lowest matriculation rate of all three countries, it experienced the strongest upward trend in tertiary education enrollment, elevating it to the same level as other upper- and middle-income countries. Resembling the trend of higher education enrollment, also the highest increase of graduates amongst the three countries could be registered. Yet, measured by the quality of the total student body, China was inferior to the United States and Japan. This was the case because the biggest portion of students in higher education only received a degree from short-cycle (48%) and undergraduate (46%) programs, whereas the number in master's (5.1%) and PhD (0.44%) programs was much lower.

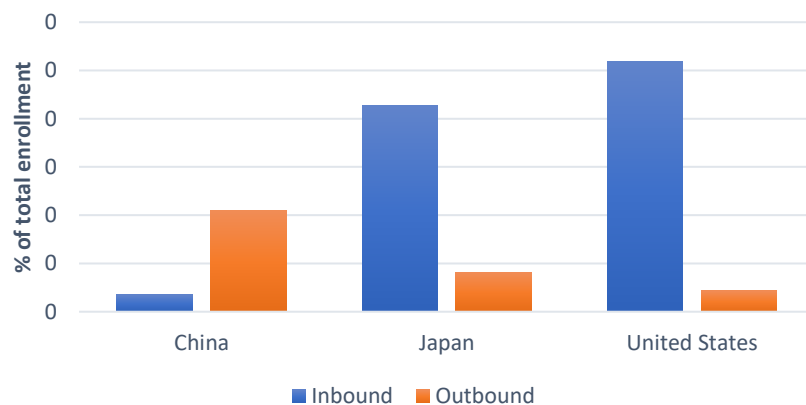


Figure 31. Student Mobility (UIS, 2020a)

Also, in the case of inbound and outbound mobility of students some similarities and differences could be identified. The results of the empirical analysis showed that Japan and the United States had a positive net inflow of students, whereas China experienced a higher ratio of outbound than inbound mobility. In Japan, an inbound mobility rate of 4.3% and an outbound mobility ratio of 0.82% could be observed. In the United States, the inbound mobility rate was with 5.2% even higher, while the outbound mobility (0.44%) was the lowest of all three countries. In China, only 0.36% of the student body was foreign, while 2.1% of Chinese students studied abroad, particularly in Western Europe and America, but also other East Asian countries were popular destinations. These results are relevant as they show that Japan and the United States are more successful in attracting foreign students than China. For foreign MNEs, a high number of students from foreign countries can be beneficial, because it allows them to draw from a larger pool of young talents when

establishing subsidiaries in such countries. Although there are a number of factors that influence the inbound mobility rate, such as cultural differences, the degree of inbound mobility can also be an indicator for the quality of education and the literature has shown that there is a positive association between a high rate of foreign students and the existence of quality assurance policies for education. Therefore, the relatively high inbound mobility in Japan and the United States and a high outbound mobility of Chinese students suggest that the perceived quality of higher education in the former two is higher than that of tertiary education in China.

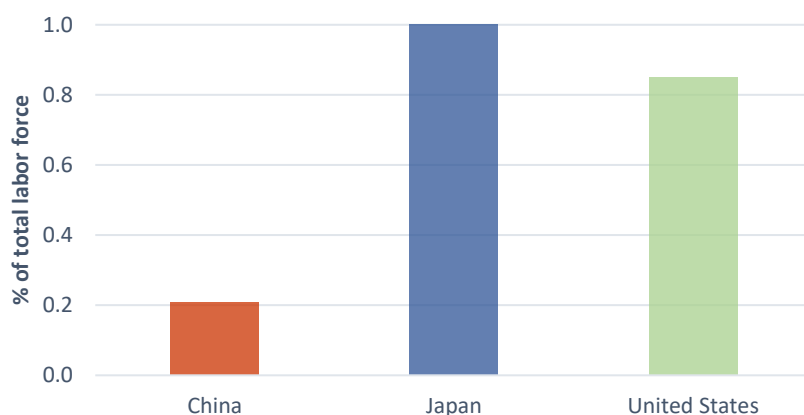


Figure 32. Researchers (FTE; OECD, 2020c)

Foreign MNEs do not only consider the quality of the tertiary education sector, but also the quantity and quality of R&D personnel before investing in a country. The analysis of R&D staff in China, Japan and the United States showed that not just the largest number of total R&D personnel, but also the biggest quantity of researchers (FTE) was available in China, followed by the United States and Japan. In 2016, almost 1.7 million researchers were employed in China, compared to 1.4 million in the United States and over 665,000 in Japan. In all three countries, the majority of this key personnel was hired in the business enterprise sector, while the higher education and government sectors accounted for a much smaller proportion. Especially China experienced a strong growth since 2010 (+40%), while the numbers in the United States (14%) grew at a more moderate pace. In Japan on the other hand, the work force composed of researchers more or less stagnated between 2010 and 2016. Although statistics show that China has the biggest pool of researchers available for foreign MNEs, due to the different sizes of the labor markets, these numbers have to be put in perspective. When doing so, it becomes apparent that Japan, despite having the lowest overall number, possesses the highest density of researchers (see Figure 32). In China and the United States, the ratio of researchers within the domestic labor force was lower and especially in the case of China, these calculations show that there is still much potential left to develop their highly qualified R&D staff.

### **5.4 Intellectual Property Rights**

Following the discussion of findings in human capital, in this chapter, the strength and weaknesses identified in the legal frameworks of China, Japan and the United States will be discussed. The empirical analysis has shown that all three countries have identified the protection of IPR as important means to facilitate foreign investments of R&D-intensive companies. They have implemented main elements of protection in their legal frameworks and as members of the WTO and WIPO, all of them have adopted their domestic laws to general principles and a minimum of international standards. This is reflected through a number of administrative measures that had to be implemented by signatory members of such agreements, but also through important legal elements such as the length of protection for the different types of patents and enforcement mechanisms. Due to this, when comparing the term of protection for patents, utility models, industrial designs and trademarks, only some differences could be identified. In Japan and China, patents are valid for 20 years and utility models are covered for 10 years. Also trademarks have a protection of 10 years if registered, however, other than utility models, they can be extended further if necessary in both countries. In the United States not only patents, but also utility models enjoy a protection of 20 years. This is the case, because other than Chinese and Japanese law, the U.S. law does not make a distinction between more innovative patents and utility models and therefore, grants such relatively long standards to lower technology inventions as well. In the case of industrial designs, Japan applied with 25 years the longest protection to the appearance of products and items, whereas China (10 years) and the United States (14 years) implemented a lower standard of protection. Even though all three economies are member of the WTO and hence, have adopted the TRIPS Agreement, such differences are possible because international treaties only require adapting to a minimum of standards, which is usually tailored to the least-developed members. Furthermore, it does not prevent member states from providing additional protection in their national laws and therefore, in Japan, more comprehensive protection of industrial designs could be found than in China and the United States.

Although some of the findings discussed so far imply that the three case countries share similar legal frameworks, especially in the case of China, many differences could be identified and some issues in the Chinese IPR have for long been a problem for foreign enterprises. Such concerns have been caused by flaws in the Chinese Trademark Law, which allowed companies to conduct bad faith filing of marks and signs, but also forced intellectual property transfers, trade secret theft and issues with inconsistencies in the enforcement mechanisms, especially in cases that involved innovative technologies, could be identified. The government has realized that a strong and transparent IPR is needed to become a technology leader and to attract innovative activities from foreign MNEs. Therefore, it has increased efforts to remove some of the issues in the IPR. It has

reformed the enforcement mechanisms by implementing specialized intellectual property courts in three major cities, by setting up tribunals in additional regions and by establishing an intellectual property branch within the Supreme People's Court. Furthermore, in 2019 a new Patent Law was drafted, the Trademark Law was amended to fix the problem of bad faith filing and a new Foreign Investment Law was introduced with the goal to deter trade secret theft as well as forced transfers of intellectual property. Japan and the United States in contrast, are constantly ranked amongst the countries with the strongest IPR internationally. This is not only characterized by strong and transparent enforcement mechanisms, but also by the protection of industrial property and the synchronization of legal and administrative measures to international standards. Therefore, only minor issues in the legal systems could be identified. In Japan, the short term of protection of pharmaceutical products remains a point of criticism. In the United States, the patentability issue of new software and algorithms has to be highlighted. This problem is caused by the enforcement mechanisms, as they allow market-dominant enterprises to challenge existing patents of such technologies by using low burdens of proof in settlements out of court.

These differences in the quality of IPR show, that China has to increase its reform efforts if they aim to raise R&D investments and if they want to develop a level of domestic IPR that can match that of Japan and the United States. Although the government has highlighted that the improvement of the domestic framework of intellectual property has been put on the list of top priorities, many concerns in the legal environment still remain and if most recent changes have successfully eliminated problems such as bad-faith filing, forced intellectual property transfers, and the different enforcement standards between the East and the more underdeveloped regions has yet to be seen. Furthermore, other than Japan and the United States, China has yet to enter some of the key WIPO treaties regarding industrial property. This includes the Hague Agreement Concerning the International Registration of Industrial Designs, the Patent Law Treaty and the Singapore Treaty on the Law of Trademarks.

### **5.5 Government Promotion**

Following the discussion of findings in IPR, the last chapter of the analysis will deal with the outcomes identified in government promotion policies. All three countries have realized that the promotion of FDI plays a significant role for the attraction of investments aside from the host-country environment provided. Therefore, in each country promotion agencies that support the work of the respective ministries could be identified. These organizations provide a variety of pre- and aftercare services, ranging from consultations regarding business opportunities, market developments and important laws and regulations over support in labor recruitment and business registrations. For this, all agencies are in close connection with their overseas as well as local branch offices to provide optimal guidance to investing firms. Adding to this, another similarity that could be identified was the promotion of FDI and the information about relevant investment potentials and domestic service and business partners through networking events such as trade fairs or seminars. In China, the government promotion agency CIPA has established three major trade events targeting different regions and industries. In Japan, Invest Japan is the major networking event that links foreign-affiliated companies with members of Japanese government organizations from the 47 prefectures and municipalities. Furthermore, specific business venues that help foreign companies to link with the labor force, such as matchmaking events with foreign students in cooperation with major universities, or business conferences that highlighted regional R&D clusters could be identified. Also in the United States, through the SelectUSA program, a variety of networking events such as the SelectUSA Investment Summit, international road shows, trade fair pavilions, and seminars are conducted in and outside the country to connect potential investors with federal, state and local investment agencies.

While the indicators associated with pre- and aftercare service showed a great homogeneity amongst the three countries, the use of incentive packages in form of fiscal and financial measures exhibited mixed results. Although regional incentives are not part of the analysis, it has to be noted that local governments in all three countries provide a number of incentives that add to the benefits on the national level. As such incentive packages can vary significantly between regions, foreign firms investing in these countries must consider such incentives in addition to national level programs. On the national level, fiscal measures in form of tax credits or tax deductions are the most used methods, and financial tools such as loans or grants only make up for a small share of support. The Chinese government for instance, provides four different incentives related to investments in R&D that are accessible for domestic and foreign firms alike. First, it has implemented a R&D tax allowance for all companies. Second, China offers a reduced corporate income tax for high-new-technology enterprises. Requirements for this tax benefit, however, are strict and even though it is open to all companies regardless of the location of the headquarters, prerequisites such as the

possession of IPR to the key technologies or a certain ratio of R&D expenditures have to be met. Adding to this, the government has provided an additional incentive for enterprises developing advanced technologies since 2017, which has reduced the corporate income tax to 15% and allows companies to deduct employee education expenditure of up to 8% of its total wages for corporate income tax purpose. Most notably, however, is a new investment incentive that was introduced in 2018 to provide tax exemptions for profits that are re-invested in the domestic market and is only accessible for foreign investors. In Japan and the United States, investment incentives that exclude domestic actors from subsidies could not be identified and in all cases, domestic and foreign actors alike had access to fiscal or financial assistance. Similar to the Chinese case, in Japan, tax incentives are the most popular benefits for R&D-intensive firms. However, they differ not only in the degree of subsidies, but also in terms of eligibility. Furthermore, the Japanese government provides incentives to firms that work on innovative technologies not only through money related assistance, but also through beneficial legal frameworks. Through the Regulatory Sandbox framework for instance, firms that invent technologies which conflict with existing laws and regulations can test such innovations for a limited period of time. By doing so, the Japanese government tries to support the realization of new technology and business models rather than inhibiting it due to inflexible regulations and laws. Furthermore, other than China, Japan provides permanent investment incentives on the national level that are not only connected to high innovation efforts, and therefore can also be accessed by firms with a more moderate amount of R&D activities. Such incentive is provided if firms relocate from the major economic hub, the Tokyo Metropolitan Area, to any other region in the country and includes profits such as employment promotion taxation or capital investment tax credits.

Amongst the three countries analyzed, the United States demonstrated to be the one with the most decentralized incentive measures, and only two benefits on the federal level could be identified for MNEs. Although such decentralized approach can be an effective tool to steer investments towards certain areas or industry clusters, a wide gap between state incentives could also lead to foreign investments accumulating in regions with strong measures and to underrepresentation of foreign activities in some other areas. As discussed in the empirical analysis, the measures implemented by the federal government included R&D tax credits as well as a loan program for companies in the green energy sector. This differs from the Chinese and Japanese approach as they have not implemented a loan scheme for innovative activities in their incentive programs. However, the green energy loan initiated by the U.S. Department of Energy is just provided for companies that need support in a new or significantly improved technology that has the potential to reduce or avoid greenhouse gases and therefore, it is only accessible for a limited number of companies.

### 6 Conclusion

For economies, the promotion of innovation plays a key role in their development plans because it has the potential to expand domestic knowledge clusters, to integrate into global value chains and to increase productivity levels. An effective way to facilitate innovative activities is to raise R&D investments by foreign MNEs. This is the case, because foreign multinationals are generally characterized by higher R&D intensities than their domestic counterparts and they can contribute to the national innovation system by facilitating knowledge and technology spillovers to domestic firms, universities, and other research institutions. In view of the importance of such investments for the development of national innovation systems and for increasing productivity levels, the aim of this master's thesis was to investigate and critically compare China's and Japan's host country environment for the attraction of supply-driven R&D. Furthermore, to study the competitiveness of these countries in an international environment, the United States was incorporated as benchmark.

The primary research question asked for the similarities and differences of Chinese and Japanese location-specific characteristics and for the approaches both governments take in promoting foreign investments and in linking the domestic infrastructure to foreign MNEs. To conduct such comparative analysis, following the discussion of the state of the art, an analytical framework was created based on five distinct categories: (1) innovation capacity, (2) S&T infrastructure, (3) human capital, (4) IPR and (5) government promotion. The first category has demonstrated that China and Japan belong to the strongest R&D spenders worldwide. However, developments in recent years appeared to be quite contrary. In Japan, most indicators stagnated on prominent levels and in some areas such as triadic patent family registrations, activities even declined. Yet, Japan remains a major R&D destination, having one of the highest R&D intensities worldwide and ranking as the top country in terms of triadic patent family registrations. In contrast China, which has experienced a remarkable development of innovation activities in recent years. All indicators related to this category have improved, and it was able to maintain its position as the second biggest R&D spender worldwide. However, a closer analysis of characteristics also showed that despite high total numbers, China still has a lot of potential to increase important quality measures such as the R&D intensity, and also in basic and applied research efforts were not as strong because the country mostly relied on activities related to experimental developments.

The second category, which evaluated the S&T infrastructure, showed that China and Japan take similar approaches in integrating foreign MNEs into domestic knowledge clusters. Both governments have clearly defined programs that aim to support their S&T development plans by organizing, supervising, and funding collaborations between enterprises, universities, as well as public research and by doing so, they allow foreign MNEs to integrate into local innovation pockets.

In terms of the quality and quantity of domestic actors, however, some differences could be identified. In China, research institutions from the academic, public and private sector have not only increased in terms of quantity but also in quality. In Japan, especially universities experienced a stagnant development in recent years and therefore, China was able to surpass it in the latest THE World University Ranking. Other than in the case of universities, however, Japanese institutions in public and corporate research could maintain their high class and still rank amongst the global innovation leaders. Highly connected to the S&T infrastructure and the quality of research is a country's human capital. The analysis of this category displayed that China and Japan dedicated the same amount of capital to higher education when put into perspective to the GDP, though with two distinct funding schemes. In terms of graduates from tertiary education and R&D staff, China experienced the greatest development in recent years and accounted for the highest quantity, whereas Japan had the higher density. This was illustrated by the inbound mobility rate of students, the share of master's and PhD graduates and the significance of researchers in relation to the labor force.

The analysis of the fourth category displayed that the Japanese legal framework has introduced an efficient system to protect the industrial property of foreign MNEs. This was illustrated not only by protection and enforcement mechanisms in place, but also by the fact that Japan has adapted its legal framework to international standards and regulations as signatory member of all major international IP treaties. China on the other hand, has for long been criticized for its weak IPR and its inefficient mechanisms. The Chinese government has realized the relevance of this issue and therefore, implemented a number of reforms in past years. Yet, some major issues in the legal system still remain, and additional efforts are needed to remove potential factors that deter foreign MNEs from establishing innovative activities in the Chinese market. While the empirical analysis of IPR exposed some differences in the legal environment, in terms of government promotion policies, China and Japan follow a similar approach because both have realized that the promotion of investments can be an important secondary factor for foreign MNEs. Therefore, in both countries, agencies that provide pre-and aftercare services could be identified. Furthermore, both governments relied on incentives to further increase investments in R&D by foreign MNEs, with particular focus on fiscal measures in form of tax credits or tax deductions. Here, however, differences in the amount of benefits and the requirements to qualify for such assistance could be found.

After having answered the first research topic, it is now time to conclude on the second question of this master's thesis. This research question's objective was to determine the competitiveness of China and Japan in comparison to the United States. Results of the empirical analysis demonstrate that both countries can compete with the United States in several areas that are key to attract supply-driven R&D. China experienced the strongest development of all three countries in recent years, it

is the second biggest R&D spender, it has the highest number of researchers and graduates from tertiary education and its research facilities rank amongst the top worldwide. Adding to this, as the only developing country in this analysis, China has the most potential for further developments in these areas. Japan on the other hand, though lagging behind China and the United States in total numbers, had the strongest R&D intensity of all three countries and also the density of researchers in comparison to the labor force was the highest. Furthermore, the largest number of patent registrations could be identified in Japan and its government research facilities rank amongst the strongest worldwide. However, when we do not pick specific indicators but evaluate the host-countries as a whole, the United States demonstrated to have the strongest and most balanced environment amongst the three. It is the global leader in R&D spending, it has high numbers of triadic patent family registrations, and its expenditure in basic and applied research in proportion to experimental developments is the highest. Adding to this, the United States has the greatest quantity of top-class universities, government and corporate research facilities, it spends the largest share of money on tertiary education, and it develops the highest percentage of students with master's degree and PhD. Also, it provides a strong legal framework for the protection of IPR, which has been constantly ranked amongst the best globally.

In conclusion, the analysis of this study has shown that China and Japan already possess a strong environment to attract supply-driven R&D. Yet, it also demonstrated that adjustments in some areas have to be made if they aim to increase activities of foreign MNEs even further and want to take advantage of the benefits that come with the investments of highly innovative firms. While mismatches in the legal framework and in government linkage and promotion programs can be fixed rather quickly, other factors in the system can only be improved over a longer time period. However, if done successfully, such long-term changes do not only lead to an increased activity of foreign MNEs, but at the same time strengthen the national innovation system and increase the ability of domestic actors to benefit from knowledge and technology spillovers. As the scope of this study was limited to the analysis of determinants that were essential for supply-driven R&D, only a specific set of indicators was incorporated into the research of this paper. To get a more complete picture of the Chinese and Japanese host-country environment and to allow for an even better comparison, additional indicators need to be included in future studies. This can be done by incorporating factors related to demand-driven R&D, but also an evaluation on the regional level could provide further insights into this matter.

## References

- Abramovsky, L., Harrison, R., & Simpson, H. (2007). University research and the location of business R&D. *The Economic Journal*, 117(519), pp. 114-141.
- Adedeji, O., & Campbell, O. (2013). The role of higher education in human capital development. (*SSRN Paper*). Retrieved December 20, 2019, from <https://ssrn.com/abstract=2380878>
- Ambos, B. (2005). Foreign direct investment in industrial research and development: A study of German MNCs. *Research Policy*, 34(4), pp. 395-410.
- Athukorala, P.-C., & Kohpaiboon, A. (2010). Globalization of R&D by US-based multinational enterprises. *Research Policy*, 39(10), pp. 1335-1347.
- Atsushi, H. (2012). Industry & university collaboration in Japan. Retrieved April 23, 2020, from <https://www.britishcouncil.jp/sites/default/files/edu-atsushi-hashizume-session1-en.pdf>
- Bania, N., Calkins, L. N., & Dalenberg, D. R. (1992). The effects of regional science and technology policy on the geographic distribution of industrial R&D laboratories. *Journal of Regional Science*, 32(2), pp. 209-228.
- Belderbos, R., Van Roy, V., Leten, B., & Thijs, B. (2014). Academic research strengths and multinational firms' foreign R&D location decisions: Evidence from R&D investments in European regions. *Environment and Planning*, 46(4), pp. 920-942.
- Blomström, M., & Kokko, A. (2003). The economics of foreign direct investment. (*NBER Working Paper No. 9489*). Retrieved October 01, 2019, from <https://www.nber.org/papers/w9489>
- Bloom, N., Griffith, R., & Van Reenen, J. (2002). Do R&D tax credits work? Evidence from a panel of countries 1979–1997. *Journal of Public Economics*, 85(1), pp. 1-31.
- Bohain, P. (2018). Effectiveness of innovative policies to enhance university-industry collaboration in developing countries. Towards technical university-industry links in Ghana. *British Journal of Education*, 6(2), pp. 54-70.
- Bothwell, E. (2019, September 02). World university rankings 2020: Methodology. *The Times Higher Education*. Retrieved April 21, 2020, from <https://www.timeshighereducation.com/world-university-rankings/world-university-rankings-2020-methodology>
- Bradsher, K. (2019, October 17). China's economic growth slows as challenges mount. *New York Times*. Retrieved December 20, 2019, from <https://www.nytimes.com/2019/10/17/business/china-economic-growth.html>
- Branstetter, L., Fisman, R., & Foley, C. F. (2006). Do stronger intellectual property rights increase international technology transfer? Empirical evidence from U.S. firm-level data. *The Quarterly Journal of Economics*, 121(1), pp. 321-349.
- Buckley, P., & Casson, M. (1976). *The future of the multinational enterprise*. London: Macmillan.

- Cabinet Office, Government of Japan. (2017). Comprehensive strategy on science, technology and innovation for 2017. Retrieved April 10, 2020, from [https://www8.cao.go.jp/cstp/english/doc/2017ststrategy\\_main.pdf](https://www8.cao.go.jp/cstp/english/doc/2017ststrategy_main.pdf)
- Cabinet Office, Government of Japan. (2019). 官民研究開発投資拡大プログラム (PRISM) [Public/Private R&D Investment Strategic Expansion Program (PRISM)]. Retrieved May 12, 2020, from [https://www5.cao.go.jp/keizai-shimon/kaigi/special/reform/wg7/20191101/shiryou1\\_part7.pdf](https://www5.cao.go.jp/keizai-shimon/kaigi/special/reform/wg7/20191101/shiryou1_part7.pdf)
- Cantwell, J., & Mudambi, R. (2000). The location of MNE R&D activity: The role of investment incentives. *Management International Review*, 40(1), pp. 127-148.
- Center for Strategic and International Studies. (2019). Is China a global leader in research and development? Retrieved December 10, 2019, from <https://chinapower.csis.org/china-research-and-development-rnd/>
- China Innovation Funding. (2017). Interim measures for the management of national key R&D programmes. Retrieved March 26, 2020, from [http://chinainnovationfunding.eu/dt\\_testimonials/interim-measures-for-the-management-of-national-key-rd-programmes-2/](http://chinainnovationfunding.eu/dt_testimonials/interim-measures-for-the-management-of-national-key-rd-programmes-2/)
- China Innovation Funding. (2018a). National key R&D programmes. Retrieved March 26, 2020, from <http://chinainnovationfunding.eu/national-key-rd-programmes>
- China Innovation Funding. (2018b). National S&T megaprojects. Retrieved March 26, 2020, from <http://chinainnovationfunding.eu/national-st-megaprojects/>
- China Innovation Funding. (2019). Shanghai's 2019 national high- and new-technology enterprise (HNTE) recognition. Retrieved April 28, 2020, from <http://chinainnovationfunding.eu/project/shanghai-2019-hnte-recognition/>
- Chung, W., & Alcácer, J. (2002). Knowledge seeking and location choice of foreign direct investment in the United States. *Management Science*, 48(12), pp. 1534-1554.
- Cincera, M., Cozza, C., & Tübke, A. (2010). The main drivers for the internationalization of R&D activities by EU MNEs. (*IPTS Working Paper No. 02/2010*). Retrieved October 14, 2019, from [https://www.academia.edu/5444367/The\\_main\\_drivers\\_for\\_the\\_internationalisation\\_of\\_R\\_and\\_D\\_activities\\_by\\_EU\\_MNEs](https://www.academia.edu/5444367/The_main_drivers_for_the_internationalisation_of_R_and_D_activities_by_EU_MNEs)
- Cohen, W. M., Nelson, R. R., & Walsh, J. P. (2002). Links and impacts: The influence of public research on industrial R&D. *Management Science*, 48(1), pp. 1-23.
- Credit for increasing research activities, 26 U.S. Code § 41.. Retrieved May 15, 2020, from <https://www.law.cornell.edu/uscode/text/26/41>
- Cunningham, P., & Gök, A. (2006). The impact and effectiveness of policies to support collaboration for R&D and innovation. (*Nesta Working Paper No. 12/2006*). Retrieved November 03, 2019, from <https://media.nesta.org.uk>

- Dachs, B., & Zahradnik, G. (2017, October 9). Recent trends in the internationalisation of business R&D. *The London School of Economics and Political Science*. Retrieved January 19, 2020, from <https://blogs.lse.ac.uk/gild/2017/10/09/recent-trends-in-the-internationalisation-of-business-rd/>
- Davis, L. N., & Meyer, K. E. (2004). Subsidiary research and development, and the local environment. *International Business Review*, 13(3), pp. 359-382.
- Demirbag, M., & Glaister, K. W. (2010). Factors determining offshore location choice for R&D projects: A comparative study of developed and emerging regions. *Journal of Management Studies*, 47(8), pp. 1534-1560.
- Dernis, H. (2007). Nowcasting patent indicators. (*OECD STI Working Paper No. 03/2007*). Retrieved March 02, 2020, from [https://www.oecd-ilibrary.org/science-and-technology/nowcasting-patent-indicators\\_055888673307](https://www.oecd-ilibrary.org/science-and-technology/nowcasting-patent-indicators_055888673307)
- Dernis, H., & Khan, M. (2004). Triadic patent families methodology. (*OECD STI Working Paper No. 2/2004*). Retrieved December 05, 2019, from [https://www.oecd-ilibrary.org/science-and-technology/triadic-patent-families-methodology\\_443844125004](https://www.oecd-ilibrary.org/science-and-technology/triadic-patent-families-methodology_443844125004)
- Doh, J. P., Jones, G. K., Mudambi, R., & Teegen, H. (2005). Foreign research and development and host country environment: An empirical examination of U.S. international R&D. *Management International Review*, 45(2), pp. 121-154.
- Driffield, N., & Menghinello, S. (2010). Location patterns and determinants of MNT knowledge intensive activities in OECD countries: An empirical study based on an international commercial database. Retrieved November 17, 2019, from <http://www.oecd.org/cfe/regional-policy/45256902.pdf>
- Dunning, J. H. (1979). Explaining changing patterns of international production: In defence of the eclectic theory. *Oxford Bulletin of Economics and Statistics*, 41(4), pp. 269-296.
- Dunning, J. H. (1988). The eclectic paradigm of international production: A restatement and some possible extensions. *Journal of International Business Studies*, 19(1), pp. 1-31.
- Dunning, J. H., & Narula, R. (1995). The R&D activities of foreign firms in the United States. *International Studies of Management & Organization*, 25(1-2), pp. 39-74.
- Ernst & Young. (2018). China further relaxes restrictions on foreign direct investment. (*China Tax & Investment News No. CTIN2018002*). Retrieved April 10, 2020, from [https://www.ey.com/Publication/vwLUAssets/EY-ctin-2018002-en/\\$FILE/EY-ctin-2018002-en.pdf](https://www.ey.com/Publication/vwLUAssets/EY-ctin-2018002-en/$FILE/EY-ctin-2018002-en.pdf)
- European Commission. (2017). EU-Japan Economic Partnership Agreement: Texts of the agreement. Retrieved May 15, 2020, from <http://trade.ec.europa.eu/doclib/press/index.cfm?id=1684>

- European Commission. (2020). Report on the protection and enforcement of intellectual property rights. (SWD No. 452/2). Retrieved May 15, 2020, from [https://trade.ec.europa.eu/doclib/docs/2020/january/tradoc\\_158561.pdf](https://trade.ec.europa.eu/doclib/docs/2020/january/tradoc_158561.pdf)
- Faeth, I. (2009). Determinants of foreign direct investment – A tale of nine theoretical models. *Journal of Economic Surveys*, 23(1), pp. 165-196.
- Falk, M. (2004). What drives business R&D intensity across OECD countries? (*WIFO Working Papers No. 236*). Retrieved November 15, 2019, from <http://hdl.handle.net/10419/128787>
- Florida, R. (1997). The globalization of R&D: Results of a survey of foreign-affiliated R&D laboratories in the USA. *Research Policy*, 26(1), pp. 85-103.
- Florida, R., & Kenney, M. (1994). The globalization of Japanese R&D: The economic geography of Japanese R&D investment in the United States. *Economic Geography*, 70(4), pp. 344-369.
- Fors, G., & Zejan, M. (1996). Overseas R&D by multinationals in foreign centers of excellence. (*IUI Working Paper No. 458*). Retrieved November 05, 2019, from <http://www.ifn.se/wfiles/wp/wp458.pdf>
- Fuyuno, I. (2017, August 15). Japan's strategy for growth highlights innovation. *Nature Index*. Retrieved April 23, 2020, from <https://www.natureindex.com/news-blog/japans-strategy-for-growth-highlights-innovation>
- Garcia-Herrero, A. (2018, September 04). Japan must boost R&D to keep rising Chinese rivals at bay. *Nikkei Asian Review*. Retrieved December 11, 2019, from <https://asia.nikkei.com/Opinion/Japan-must-boost-R-D-to-keep-rising-Chinese-rivals-at-bay>
- Gassmann, O., & Han, Z. (2004). Motivations and barriers of foreign R&D activities in China. *R&D Management*, 34(4), pp. 423-437.
- Gerybadze, A., & Reger, G. (1999). Globalization of R&D: Recent changes in the management of innovation in transnational corporations. *Research Policy*, 28(2), pp. 251-274.
- Granstrand, O. (1999). Internationalization of corporate R&D: A study of Japanese and Swedish corporations. *Research Policy*, 28(2), pp. 275-302.
- Guimo'n, J. (2009). Government strategies to attract R&D-intensive FDI. *The Journal of Technology Transfer*, 34(4), pp. 364-379.
- Guimo'n, J. (2011). Policies to benefit from the globalization of corporate R&D: An exploratory study for EU countries. *Technovation*, 31(2-3), pp. 77-86.
- Guimo'n, J. (2013). Global trends in R&D-intensive FDI: Opportunities and challenges for developing countries. *Journal of Current Issues in Globalization*, 6(3), pp. 383-402.

- Guimón, J., Chaminade, C., Maggi, C., & Salazar-Elena, J. C. (2018). Policies to attract R&D-related FDI in small emerging countries: Aligning incentives with local linkages and absorptive capacities in Chile. *Journal of International Management*, 24(2), pp. 165-178.
- Guo, G. (2020, April 13). China: looking back at 2019's main IP developments and looking forward at what 2020 may bring. *JDSupra*. Retrieved May 15, 2020, from <https://www.jdsupra.com/legalnews/china-looking-back-at-2019-s-main-ip-93099/>
- Hakanson, L., & Nobel, R. (1993). Determinants of foreign R&D in Swedish MNCs. *Research Policy*, 22(5-6), pp. 397-411.
- Hernández, H., Grassano, N., Tübke, A., Amoroso, S., Csefalvay, Z., & Gkotsis, P. (2019). The 2019 EU industrial R&D investment scoreboard. (*EUR 30002 EN*). Retrieved May 05, 2020, from <https://op.europa.eu/s/n4LJ>
- Hernández, H., Grassano, N., Tübke, A., Potters, L., Gkotsis, P., & Vezzani, A. (2018). The 2018 EU industrial R&D investment scoreboard. (*EUR 29450 EN*). Retrieved October 15, 2019, from [https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113807/eu\\_rd\\_scoreboard\\_2018\\_online.pdf](https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113807/eu_rd_scoreboard_2018_online.pdf)
- Ilieva, J., Killingley, P., & Tsiligiris, V. (2019). The shape of global higher education: International comparisons with Europe. (*The Shape of Global Higher Education No. 5*). Retrieved January 10, 2020, from [https://www.britishcouncil.org/sites/default/files/k006\\_02\\_the\\_shape\\_of\\_global\\_higher\\_education\\_in\\_europe\\_final\\_v5\\_web.pdf](https://www.britishcouncil.org/sites/default/files/k006_02_the_shape_of_global_higher_education_in_europe_final_v5_web.pdf)
- Japan External Trade Organization. (2018a). Invest Japan report 2018. Retrieved March 10, 2020, from [https://www.jetro.go.jp/ext\\_images/en/invest/reports/report2018/pdf/report2018\\_1.pdf](https://www.jetro.go.jp/ext_images/en/invest/reports/report2018/pdf/report2018_1.pdf)
- Japan External Trade Organization. (2019). JETRO IBSC. Retrieved March 10, 2020, from [https://www.jetro.go.jp/ext\\_images/en/invest/ibsc/pdf/JETRO\\_IBSC\\_201912.pdf](https://www.jetro.go.jp/ext_images/en/invest/ibsc/pdf/JETRO_IBSC_201912.pdf)
- Japan External Trade Organization. (n.d.-a). Activities. Retrieved March 10, 2020, from <https://www.jetro.go.jp/en/jetro/activities.html>
- Japan External Trade Organization. (n.d.-b). Support for foreign-affiliated companies. Retrieved March 10, 2020, from [https://www.jetro.go.jp/en/invest/foreign-affiliate\\_support/](https://www.jetro.go.jp/en/invest/foreign-affiliate_support/)
- Japan External Trade Organization. (n.d.-c). New regulatory sandbox framework in Japan. Retrieved April 02, 2020, from [https://www.jetro.go.jp/ext\\_images/en/invest/incentive\\_programs/pdf/Detailed\\_overview.pdf](https://www.jetro.go.jp/ext_images/en/invest/incentive_programs/pdf/Detailed_overview.pdf)
- Japan External Trade Organization. (n.d.-d). Incentive programs. Retrieved April 10, 2020, from [https://www.jetro.go.jp/en/invest/incentive\\_programs/](https://www.jetro.go.jp/en/invest/incentive_programs/)

- Japan Patent Office. (2019). Fee information. Retrieved April 03, 2020, from <https://www.jpo.go.jp/e/system/process/tesuryo/hyou.html#Application>
- Japan Patent Office. (2020a). System of industrial property rights. Retrieved April 03, 2020, from <https://www.jpo.go.jp/e/system/patent/gaiyo/seidogaiyo/index.html>
- Japan Patent Office. (2020b). JPO status report 2020. Retrieved May 10, 2020, from <https://www.jpo.go.jp/e/resources/report/statusreport/2020/document/index/all.pdf>
- Japan Science and Technology Agency. (n.d.-a). About JST. Retrieved March 25, 2020, from <https://www.jst.go.jp/EN/about/>
- Japan Science and Technology Agency. (n.d.-b). Creating a platform for dialogue to drive innovation. Retrieved March 25, 2020, from <https://www.jst.go.jp/tt/EN/platform.html>
- Japan Science and Technology Agency. (n.d.-c). Industry-academia collaborative R&D programs: Center of Innovation (COI) program. Retrieved March 25, 2020, from <https://www.jst.go.jp/tt/EN/platform/coi.html>
- Japan Society for the Promotion of Science. (n.d.-a). About us. Retrieved March 25, 2020, from <https://www.jsps.go.jp/english/aboutus/index2.html>
- Japan Society for the Promotion of Science. (n.d.-b). University-industry research cooperation societally applied scientific linkage and collaboration. Retrieved March 25, 2020, from <https://www.jsps.go.jp/english/e-soc/index.html>
- Jian, L., Yu, S.-W., Sunyu, W., & Weifeng, Q. (2015). PETOE: A new multi-sector collaboration mechanism for engineering training in China. *International Journal of Chinese Education*, 4(2), pp. 234-249.
- Karlsson, C., & Andersson, M. (2005). The location of industry R&D and the location of university R&D: How are they related? (*Working Paper Series in Economics and Institutions of Innovation No. 38*). Retrieved November 16, 2019, from <https://econpapers.repec.org/paper/hhscesisp/0038.htm>
- KPMG. (2017). China to boost foreign direct investment: Service outsourcing tax incentives. (*China Tax Alert No. 27*). Retrieved April 21, 2020, from <https://assets.kpmg/content/dam/kpmg/cn/pdf/en/2017/08/china-tax-alert-27.pdf>
- Kuemmerle, W. (1999). Foreign direct investment in industrial research in the pharmaceutical and electronics industries - Results from a survey of multinational firms. *Research Policy*, 28(2), pp. 179-193.
- Kumar, N. (2001). Determinants of location of overseas R&D activity of multinational enterprises: The case of US and Japanese corporations. *Research Policy*, 30(1), pp. 159-174.
- Lall, S. (1979). The international allocation of research activity by US multinationals. *Oxford Bulletin of Economics and Statistics*, 41(4), pp. 313-331.

- Le Bas, C., & Sierra, C. (2002). 'Location versus home country advantages' in R&D activities: Some further results on multinationals' locational strategies. *Research Policy*, 31(4), pp. 589-609.
- McKinsey Global Institute. (2015). The future of Japan: Reigniting productivity and growth. Retrieved April 01, 2020, from <https://www.mckinsey.com>
- Ministry of Commerce. (2014). Invest in China. Retrieved April 28, 2020, from <http://img.project.fdi.gov.cn/21/1800000121/File/201409/201409181050140718365.pdf>
- Ministry of Commerce. (n.d.). Brief introduction of investment promotion agency of Ministry of Commerce. Retrieved April 20, 2020, from [http://www.fdi.gov.cn/1800000121\\_10000183\\_8.html](http://www.fdi.gov.cn/1800000121_10000183_8.html)
- Ministry of Economy, Trade and Industry. (2015). Outline of the R&D tax credit system. Retrieved March 25, 2020, from [https://www.meti.go.jp/english/policy/economy/Technical\\_Promotion/pdf/01.pdf](https://www.meti.go.jp/english/policy/economy/Technical_Promotion/pdf/01.pdf)
- Ministry of Economy, Trade and Industry. (2019). Cabinet decision on the bill for the act of partial revision of the Patent Act. Retrieved May 15, 2020, from [https://www.meti.go.jp/english/press/2019/0301\\_003.html](https://www.meti.go.jp/english/press/2019/0301_003.html)
- Ministry of Economy, Trade and Industry. (2020). コネクテッド・インダストリーズ税制 [Connected industries tax system]. Retrieved April 03, 2020, from [https://www.meti.go.jp/policy/it\\_policy/data-katsuyo/iot-zeisei/iot-zeisei.html](https://www.meti.go.jp/policy/it_policy/data-katsuyo/iot-zeisei/iot-zeisei.html)
- Ministry of Economy, Trade and Industry. (n.d.). What is the Office of Intellectual Property Protection? Retrieved May 12, 2020, from <https://www.meti.go.jp/policy/ipr/eng/office/index.html>
- Ministry of Education. (2018). MOE releases education spending statistics for 2017. Retrieved April 15, 2020, from [http://en.moe.gov.cn/News/Top\\_News/201805/t20180510\\_335508.html](http://en.moe.gov.cn/News/Top_News/201805/t20180510_335508.html)
- Ministry of Science and Technology. (n.d.-a). Missions of the ministry of science and technology. Retrieved March 26, 2020, from <http://www.most.gov.cn/eng/eng/organization/Mission/>
- Ministry of Science and Technology. (n.d.-b). S&T programmes. Retrieved April 15, 2020, from <http://en.most.gov.cn/eng/programmes1/index.htm>
- Ministry of Science and Technology. (n.d.-c). Key technologies R&D program. Retrieved April 15, 2020, from [http://en.most.gov.cn/eng/programmes1/200610/t20061009\\_36224.htm](http://en.most.gov.cn/eng/programmes1/200610/t20061009_36224.htm)
- Morikawa, M. (2019, May 19). Japan's low labor productivity: The gap with the U.S. and complex causes. *RIETI*. Retrieved March 16, 2020, from <https://www.rieti.go.jp/en/papers/contribution/morikawa/12.html>
- Morris, E. M. (2016). The irrelevance of nanotechnology patents. *Connecticut Law Review*, 49(2), pp. 499-552.

- Mudambi, R., & Mudambi, S. M. (2005). Multinational enterprise knowledge flows: The effect of government inward investment policy. *Management International Review*, 45(2), pp. 155-178.
- National Bureau of Statistics of China. (2012). *China Statistical Yearbook 2012*. Retrieved April 15, 2020, from <http://www.stats.gov.cn/tjsj/ndsj/2012/indexeh.htm>
- National Bureau of Statistics of China. (2018). *China Statistical Yearbook 2018*. Retrieved April 15, 2020, from <http://www.stats.gov.cn/tjsj/ndsj/2018/indexeh.htm>
- National Natural Science Foundation of China. (2016). National nature Science Fund guide to programs. Retrieved April 6, 2020, from <http://www.nsf.gov.cn/Portals/0/fj/english/fj/pdf/2016/111.pdf>
- National Science Foundation. (2016). NSF awards \$94 million to create four new Science and Technology Centers. Retrieved May 13, 2020, from [https://www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=189782](https://www.nsf.gov/news/news_summ.jsp?cntn_id=189782)
- National Science Foundation. (2019a). Partnerships for Innovation. Retrieved May 13, 2020, from <https://www.nsf.gov/pubs/2019/nsf19506/nsf19506.pdf>
- National Science Foundation. (2019b). Non-Academic Research Internships for Graduate Students (INTERN) supplemental funding opportunity. Retrieved May 13, 2020, from <https://www.nsf.gov/pubs/2018/nsf18102/nsf18102.jsp>
- National Science Foundation. (2020a). National Science Foundation presents FY 2021 budget request. Retrieved May 13, 2020, from [https://www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=299995&WT.mc\\_id=USNSF\\_51&WT.mc\\_ev=click](https://www.nsf.gov/news/news_summ.jsp?cntn_id=299995&WT.mc_id=USNSF_51&WT.mc_ev=click)
- National Science Foundation. (2020b). Industry-University Cooperative Research Centers Program (IUCRC). Retrieved May 13, 2020, from <https://www.nsf.gov/pubs/2020/nsf20570/nsf20570.htm>
- National Science Foundation. (n.d.-a). About the National Science Foundation. Retrieved March 26, 2020, from <https://www.nsf.gov/about/>
- National Science Foundation. (n.d.-b). About the IUCRC program. Retrieved March 26, 2020, from <https://iucrc.nsf.gov/about>
- National Science Foundation. (n.d.-c). Science and Technology Centers (STCs): Integrative partnerships. Retrieved May 13, 2020, from <https://www.nsf.gov/od/oia/programs/stc/index.jsp>
- National Science Foundation. (n.d.-d). Grant Opportunities for Academic Liaison with Industry (GOALI) proposal. Retrieved May 13, 2020, from <https://www.nsf.gov/eng/iip/goali.jsp>
- Nature. (2016). Nature Index global top 100. Retrieved February 10, 2020, from <https://www.natureindex.com/annual-tables/2016>

- Nature. (2019a). A guide to the Nature Index. *Nature*, 569(7756), p. 31.
- Nature. (2019b). Nature Index global top 100. Retrieved February 05, 2020, from <https://www.natureindex.com/annual-tables/2019>
- Odagiri, H., & Yasuda, H. (1996). The determinants of overseas R&D by Japanese firms: An empirical study at the industry and company levels. *Research Policy*, 25(7), pp. 1059-1079.
- Organisation for Economic Co-operation and Development. (1997). *National innovation system*. Paris: OECD Publishing.
- Organisation for Economic Co-operation and Development. (2005). *Measuring Globalisation: OECD Economic Globalisation Indicators 2005*. Paris: OECD Publishing.
- Organisation for Economic Co-operation and Development. (2008). The OECD compendium of patent statistics. Retrieved March 22, 2020, from <http://www.oecd.org/science/inno/37569377.pdf>
- Organisation for Economic Co-operation and Development. (2010). *Measuring globalisation: OECD economic globalisation indicators 2010*. Paris: OECD Publishing.
- Organisation for Economic Co-operation and Development. (2015). *Frascati Manual 2015: Guidelines for collecting and reporting data on research and experimental development*. Paris: OECD Publishing.
- Organisation for Economic Co-operation and Development. (2017). Japan policy brief: Innovation. (*OECD Better Policies Series*). Retrieved March 23, 2020, from <https://www.oecd.org/japan/japan-strengthening-innovation-for-productivity-and-greater-wellbeing.pdf>
- Organisation for Economic Co-operation and Development. (2018). *Japan: Promoting inclusive growth for an ageing society*. Paris: OECD Publishing.
- Organisation for Economic Co-operation and Development. (2019). *Education at a Glance: OECD Indicators*. Paris: OECD Publishing.
- Organisation for Economic Co-operation and Development. (2020a). Education spending. Retrieved March 10, 2020, from <https://data.oecd.org/eduresource/education-spending.htm>
- Organisation for Economic Co-operation and Development. (2020b). OECD compendium of information on R&D tax incentives, 2019. Retrieved December 10, 2019, from <http://oe.cd/rdtax>
- Organisation for Economic Co-operation and Development. (2020c). Science, technology and patents. *OECD Statistics*. Retrieved April 27, 2020, from <https://stats.oecd.org/>
- Organisation for Economic Co-operation and Development. (2020d). Spending on tertiary education. Retrieved March 10, 2020, from <https://data.oecd.org/eduresource/spending-on-tertiary-education.htm#indicator-chart>

- Organization for International Investment. (2019). International companies fuel U.S. innovation. Retrieved December 02, 2019, from [http://ofii-docs.ofii.org/dmfile/2019-RD-Factsheet\\_Final.pdf](http://ofii-docs.ofii.org/dmfile/2019-RD-Factsheet_Final.pdf)
- Patel, P., & Vega, M. (1999). Patterns of internationalisation of corporate technology: Location vs. home country advantages. *Research Policy*, 28(2), pp. 145-155.
- Pearce, R. D. (1999). Decentralised R&D and strategic competitiveness: Globalised approaches to generation and use of technology in multinational enterprises (MNEs). *Research Policy*, 28(2-3), pp. 157-178.
- Pugatch, M., & Torstensson, D. (2020). U.S. Chamber International IP Index. *The U.S. Chamber of Commerce*. Retrieved May 13, 2020, from [https://www.uschamber.com/sites/default/files/023881\\_gipc\\_ip\\_index\\_2020\\_fullreport\\_final.pdf](https://www.uschamber.com/sites/default/files/023881_gipc_ip_index_2020_fullreport_final.pdf)
- Purvis, S. A. (n.d.). Basics of patent protection. Retrieved May 15, 2020, from [https://www.uspto.gov/sites/default/files/about/offices/ous/Cooper\\_Union\\_20130604.pdf](https://www.uspto.gov/sites/default/files/about/offices/ous/Cooper_Union_20130604.pdf)
- Quinn, G. (2017, May 21). America's patent system favors low tech, not groundbreaking innovation. *IP WatchDog*. Retrieved May 14, 2020, from <https://www.ipwatchdog.com/2017/05/21/americas-patent-system-favors-low-tech-not-groundbreaking-innovation/id=83391/>
- Reuters. (2019). Methodology: Top 25 global innovators. Retrieved January 12, 2020, from <https://graphics.reuters.com/AMERS-REUTERS-RANKING-INNOVATIVE-INSTITUTIONS/0100B2B01D5/index.html>
- Rodríguez-Pose, A., & Wilkie, C. (2016). Context and the role of policies to attract foreign R&D in Europe. *European Planning Studies*, 24(11), pp. 2014-2035.
- Sanyal, P. (2004). Intellectual property rights protection and location of R&D by multinational enterprises. *Journal of Intellectual Capital*, 5(1), pp. 59-76.
- SelectUSA. (n.d.-a). Service for companies. Retrieved March 24, 2020, from <https://www.selectusa.gov/services-for-companies>
- SelectUSA. (n.d.-b). Resources. Retrieved March 24, 2020, from <https://www.selectusa.gov/resources>
- SelectUSA. (n.d.-c). Events. Retrieved March 24, 2020, from <https://www.selectusa.gov/events>
- Serapio Jr., M. G., & Dalton, D. H. (1999). Globalization of industrial R&D: An examination of foreign direct investments in R&D in the United States. *Research Policy*, 28(2-3), pp. 303-316.
- Shore, M. (2018, March 21). How Google and big tech killed the U.S. patent system. *IP WatchDog*. Retrieved May 15, 2020, from <https://www.ipwatchdog.com/2018/03/21/how-google-and-big-tech-killed-the-u-s-patent-system/id=95080/>

- Siedschlag, I., Smith, D., Turcotte, C., & Zhang, X. (2013). What determines the location choice of R&D activities by multinational firms? *Research Policy*, 42(8), pp. 1420-1430.
- Soriano, J. V. (2019). National Science Foundation: Industrial Innovation and Partnerships (IIP). Retrieved May 13, 2020, from [https://nsfepscor2019.org/wp-content/uploads/2019/12/jesus\\_soriano\\_molla\\_slides\\_sbir\\_sttr\\_workshop.pdf](https://nsfepscor2019.org/wp-content/uploads/2019/12/jesus_soriano_molla_slides_sbir_sttr_workshop.pdf)
- Suga, H., Iwase, H., & Takagi, K. (2017). Country comparative legal guides Japan: Intellectual property. *The In-House Lawyer*. Retrieved March 15, 2020, from [https://www.jurists.co.jp/sites/default/files/tractate\\_pdf/en/47374.pdf](https://www.jurists.co.jp/sites/default/files/tractate_pdf/en/47374.pdf)
- Supreme Court of Japan. (2020). Intellectual Property High Court. Retrieved May 11, 2020, from [https://www.ip.courts.go.jp/eng/vc-files/eng/file/full\\_setugusiryo.pdf](https://www.ip.courts.go.jp/eng/vc-files/eng/file/full_setugusiryo.pdf)
- The Department of Energy. (n.d.). Title XVII. Retrieved April 28, 2020, from <https://www.energy.gov/lpo/title-xvii>
- The Hong Kong Trade Development Council. (2020, January 03). China extends VAT exemption for domestic R&D equipment. *HKTDC RESEARCH*. Retrieved April 29, 2020, from <https://hkmb.hktcdc.com/en/1X0AJEEG/hktcdc-research/China-Extends-VAT-Exemption-for-Domestic-RD-Equipment>
- The White House. (2011). Executive order 13577: SelectUSA initiative. Retrieved April 28, 2020, from <https://obamawhitehouse.archives.gov/the-press-office/2011/06/15/executive-order-13577-selectusa-initiative>
- Thomson, R. (2013). National scientific capacity and R&D offshoring. *Research Policy*, 42(2), pp. 517-528.
- Thursby, J., & Thursby, M. (2006). *Here or there? A survey of factors in multinational R&D location*. Washington, D.C.: National Academies Press.
- UNESCO Institute for Statistics. (2012). International standard classification of education (ISCED) 2011. Retrieved March 16, 2020, from <http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf>
- UNESCO Institute for Statistics. (2020a). Education. *UIS Statistics Database*. Retrieved March 23, 2020, from <http://data.uis.unesco.org/>
- UNESCO Institute for Statistics. (2020b). Science, technology and innovation. *UIS Statistics Database*. Retrieved March 15, 2020, from <http://data.uis.unesco.org>
- UNESCO Institute for Statistics. (n.d.). UIS glossary: Net enrolment rate. Retrieved March 16, 2020, from <http://uis.unesco.org/node/334718>
- United Nations Conference on Trade and Development. (1992). *World investment report 1992: Transnational corporations as engines of growth*. New York: United Nations.

- United Nations Conference on Trade and Development. (2019). *World investment report 2019: Special economic zones*. New York: United Nations.
- United States Patent and Trademark Office. (2019). China intellectual property rights. Retrieved May 15, 2020, from [https://www.uspto.gov/sites/default/files/documents/China\\_IPtoolkit\\_FINAL.pdf](https://www.uspto.gov/sites/default/files/documents/China_IPtoolkit_FINAL.pdf)
- United States Patent and Trademark Office. (n.d.-a). Protecting intellectual property in the United States: A guide for small and medium-sized enterprises in the United Kingdom. Retrieved May 15, 2020, from [https://www.uspto.gov/sites/default/files/documents/UK-SME-IP-Toolkit\\_FINAL.pdf](https://www.uspto.gov/sites/default/files/documents/UK-SME-IP-Toolkit_FINAL.pdf)
- United States Trade Representative. (2020). Economic and trade agreement between the government of the United States and the government of the People's Republic of China. Retrieved May 15, 2020, from [https://ustr.gov/sites/default/files/files/agreements/phase%20one%20agreement/Economic\\_And\\_Trade\\_Agreement\\_Between\\_The\\_United\\_States\\_And\\_China\\_Text.pdf](https://ustr.gov/sites/default/files/files/agreements/phase%20one%20agreement/Economic_And_Trade_Agreement_Between_The_United_States_And_China_Text.pdf)
- Velde, D. W. (2001). Policies towards direct investment in developing countries: Emerging best-practices and outstanding issues. (*ODI Working and Discussion Paper*). Retrieved October 10, 2019, from <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/5543.pdf>
- Vernon, R. (1966). International investment and international trade in the product cycle. *Quarterly Journal of Economics*, 80(2), pp. 190-207.
- Vernon, R. (1979). The product cycle hypothesis in a new international environment. *Oxford Bulletin of Economics and Statistics*, 41(4), pp. 255-267.
- Von Zedtwitz, M., & Gassmann, O. (2002). Market versus technology drive in R&D internationalization: Four different patterns of managing research and development. *Research Policy*, 31(4), pp. 569–588.
- Wei, Y. (2016). National Natural Science Foundation of China: Funding excellent basic research for 30 years. Retrieved April 10, 2020, from <http://media.nature.com/full/nature-cms/uploads/ckeditor/attachments/8485/nsfc.pdf>
- Wong, F. K.-H. (2019, November 14). Intellectual property in China: Laws and registration procedures. *China Briefing*. Retrieved May 15, 2020, from <https://www.china-briefing.com/news/intellectual-property-china-laws-registration-procedures/>
- World Bank. (2019a). Labor force, total - China. Retrieved March 17, 2020, from <https://data.worldbank.org/indicator/SL.TLF.TOTL.IN?locations=CN>
- World Bank. (2019b). *Innovative China: New drivers of growth*. Washington, DC: World Bank.
- World Bank. (n.d.). How can gross school enrollment ratios be over 100 percent? Retrieved March 16, 2020, from <https://datahelpdesk.worldbank.org/knowledgebase/articles/114955-how-can-gross-school-enrollment-ratios-be-over-10>

- World Intellectual Property Organization. (2014). Outline of the legal and regulatory framework for intellectual property in the People's Republic of China (PRC). Retrieved April 03, 2020, from <https://wipolex.wipo.int/en/info/outline/CN>
- World Intellectual Property Organization. (n.d.-a). China. Retrieved April 03, 2020, from <https://wipolex.wipo.int/en/legislation/profile/CN>
- World Intellectual Property Organization. (n.d.-b). WIPO-administered treaties. Retrieved April 03, 2020, from <https://www.wipo.int/treaties/en/>
- World Intellectual Property Organization. (n.d.-c). Summary table of membership of the World Intellectual Property Organization (WIPO) and the treaties administered by WIPO, plus UPOV, WTO and UN. Retrieved April 03, 2020, from <https://www.wipo.int/treaties/en/summary.jsp>
- World Intellectual Property Organization. (n.d.-d). Outline of the legal and regulatory framework for intellectual property in the United States of America. Retrieved April 03, 2020, from <https://wipolex.wipo.int/en/info/outline/US>
- World Intellectual Property Organization. (n.d.-e). Japan. Retrieved April 03, 2020, from <https://wipolex.wipo.int/en/legislation/profile/JP>
- World Intellectual Property Organization. (n.d.-f). United States. Retrieved April 03, 2020, from <https://wipolex.wipo.int/en/legislation/profile/US>
- World Trade Organization. (n.d.-a). What are intellectual property rights? Retrieved November 20, 2019, from [https://www.wto.org/english/tratop\\_e/trips\\_e/intel1\\_e.htm](https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm)
- World Trade Organization. (n.d.-b). Overview: The TRIPS Agreement. Retrieved May 15, 2020, from [https://www.wto.org/english/tratop\\_e/trips\\_e/intel2\\_e.htm](https://www.wto.org/english/tratop_e/trips_e/intel2_e.htm)
- World Trade Organization. (n.d.-c). Uruguay Round Agreement (TRIPS): Preamble. Retrieved May 15, 2020, from [https://www.wto.org/english/docs\\_e/legal\\_e/27-trips\\_02\\_e.htm](https://www.wto.org/english/docs_e/legal_e/27-trips_02_e.htm)
- Xuequan, M. (2017, December 28). China unveils tax exemption to attract foreign investment. *Xinhua*. Retrieved April 28, 2020, from [http://www.xinhuanet.com/english/2017-12/28/c\\_136858149.htm](http://www.xinhuanet.com/english/2017-12/28/c_136858149.htm)
- Yao, K. (2018, September 30). China widens income tax exemption for foreign investors. *Reuters*. Retrieved April 28, 2020, from <https://www.reuters.com/article/us-china-economy-investment-tax/china-widens-income-tax-exemption-for-foreign-investors-idUSKCN1MA0DI>

## **Appendix**

### **Abstract (English Version)**

For states, the advancement in science and technology (S&T) plays a vital role because it allows their economies to further integrate into global value chains, to expand domestic knowledge clusters and to increase productivity levels. An effective means of enhancing this innovation process is the promotion of investments in research and development (R&D) by foreign multinational enterprises (MNEs). This is the case, because foreign MNEs are not just characterized by a higher R&D intensity than their domestic counterparts, but also because they can create knowledge and technology spillovers to domestic firms, universities, and other research facilities. To expedite foreign direct investments (FDI), states need to become more sensitive to the factors that MNEs are looking at when rating locations for potential R&D activities. Therefore, the aim of this master's thesis is to determine and compare the attractiveness of China and Japan for supply-driven R&D activities by applying an analytical framework based on five categories: (1) innovation capacity, (2) S&T infrastructure, (3) human capital, (4) intellectual property rights and (5) government promotion policies. Furthermore, to analyze the competitiveness of the two East Asian economies in a more international context, the United States is used as benchmark country.

Results from the empirical analysis show that China and Japan have developed an environment that allows them to compete with the United States for supply-driven R&D investments. However, the closer evaluation also exposed that there are still some differences between the three countries, most notably in terms of innovation capacity, human capital, and the quality of intellectual property rights.

**Abstract (German Version)**

Der Fortschritt in Wissenschaft und Technologie spielt für Länder eine wichtige Rolle, da es ihnen ermöglicht sich weiter in globale Wertschöpfungsketten zu integrieren, regionale Wissenscluster zu erweitern und die Produktivität des Marktes zu steigern. Ein effektives Mittel zur Verbesserung dieses Innovationsprozesses ist die Förderung von Investitionen in Forschung und Entwicklung (F&E) durch multinationale Unternehmen (MNU) aus dem Ausland. Der Grund dafür ist das ausländische MNU eine höhere Intensität in F&E aufweisen, und das nationale Firmen, Universitäten und andere Forschungseinrichtungen von einem potentiellen Technologie- und Wissenstransfer profitieren können. Um ausländische Direktinvestitionen zu beschleunigen müssen Staaten mehr denn je die Faktoren berücksichtigen, die MNU bei der Bewertung von Standorten für potenzielle F&E Aktivitäten in Erwägung ziehen. Ziel dieser Masterarbeit ist es daher, die Attraktivität von China und Japan für angebotsorientierte F&E Aktivitäten zu ermitteln. Dies geschieht mithilfe eines analytischen Konzepts bestehend aus fünf Kategorien: (1) Innovationskapazität, (2) Wissenschafts- und Technologieinfrastruktur, (3) Humankapital, (4) geistige Eigentumsrechte und (5) nationale Förderpolitik für Auslandsinvestitionen. Weiters, um das Umfeld der beiden ostasiatischen Volkswirtschaften in einem internationaleren Kontext zu analysieren, werden die USA als Vergleichswert herangezogen.

Die Ergebnisse der empirischen Analyse zeigen, dass China und Japan ein Umfeld entwickelt haben, das es ihnen ermöglicht mit den USA um angebotsorientierte Investitionen in F&E zu konkurrieren. Die genauere Auswertung ergab jedoch auch dass zwischen den Ländern noch einige Unterschiede bestehen, insbesondere in Bezug auf die Innovationskapazität, der Qualität des Humankapital und der geistigen Eigentumsrechte.