

Intellectual Property Protection and the Brain Drain*

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Abstract

Due to the poor availability of data on migration and intellectual property rights (IPRs) protection, the relationship between IPRs and brain drain remains a blind spot in economic literature. Intellectual property is a term that refers to the creation of novel ideas. As skills are a fundamental component in producing ideas, brain drain can have a direct impact on the creation of intellectual property. But can an adequate protection of IPRs reverse the phenomenon of brain drain? A look at few existing works and the road ahead gives the impression that IPRs indeed govern the location and the magnitude of innovation activities. Better technologies, if not better institutions, can be transferred back to the migrants' country of origin through trade, FDI, return migration, and diaspora knowledge networks. If a better IPR environment in developing countries encourages the use of knowledge acquired abroad, a brain gain can mitigate the loss from the initial outflow of brains. Naghavi and Strozzi (2015) take the first initiative to provide an empirical assessment of the two effects and investigate the role of IPRs in determining the magnitude of the two effects. They argue that improving IPR institutions in sending countries can be a policy to exploit the fruits of diasporas.

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1. Introduction

The surge in the outflow of skilled emigrants from emerging and developing countries (EDC) has created controversial debates about the threats and opportunities that the outward transfer of the human capital embedded in emigrants may pose to the sending countries. On the one hand, the traditional literature on migration and brain drain presents mechanisms through which skilled emigration could be detrimental to growth.¹ On the other hand, a growing branch of contributions argues that skilled emigration need not harm the EDC and may even increase their potential for development. Remittances have long been a major debate and are the most direct way through which overseas emigrants can contribute to their home economies (Ozden and Schiff, 2005). More sustainable methods than such direct static transfers have been discussed in recent works by introducing the concept of brain gain. Brain gain can take several forms such as incentives for human capital formation due to migration prospects (Mountford, 1997; Stark et al. 2007; Beine et al., 2001, 2008), return migration (Mayr and Peri, 2009; Dustmann et al. 2011), or brain circulation, i.e. the recirculation of knowledge acquired by emigrants back to their home countries through cross-border diaspora networks (Kerr, 2008; Agrawal et al., 2011).

There is little doubt today in the role of emigration in creating potential gains for the sending country. On the latter, diaspora networks and return migration are influential economic forces that help spread ideas by fostering trust through kinship ties, speeding the flow of information, and through the return of better trained and more experienced migrants back to their home countries. Some interesting examples are Indian computer scientists in Bangalore constantly bouncing ideas off their Indian counterparts in Silicon Valley or China's technology industry being dominated by return (sea turtle) migration (The Economist, 2011). The issue came under spotlight, when on July 25, 2012, in a keynote address at the second annual Global Diaspora Forum in Washington D.C., the former U.S. Secretary of State Hillary Rodham Clinton stated her confidence in the ability of diaspora communities in solving existing problems in their home countries: "By tapping into the experiences, the energy, the expertise of diaspora communities, we can reverse the so-called brain drain that slows progress in so many countries around the world, and instead offer the benefits of the brain gain."

The objective of this analysis is to shed light on the role of skilled migration in brain circulation, and to show in turn how home country institutions can contribute to turn brain drain into gains in terms of innovation and development. The chapter touches upon questions regarding the relationship between brain drain and home country institutions and puts forward ways in which the phenomenon can be investigated. As technological progress and innovation is the focus of the

¹ See for instance Berry and Soligo (1969), Bhagwati and Hamada (1974) and Miyagiwa (1991).

analysis, the institution of interest is patent protection, or more generally the intellectual property rights (IPR) regime in the home country. The questions that this chapter aims to deal with can be divided into three categories based on the direction of the causality.

The first set of questions involves how IPR protection affects the stay or go decision of skilled workers, which comprise a country's human capital. In other words, is there a relationship between home country IPRs and the brain drain phenomenon? Does IPR protection affect the decisions of scientists, engineers, information technology specialists, and related professional about where to exercise their profession, with consequences for a country's innovative capacity and availability of knowledge? Also, to what extent does the relationship between the IPR regime and brain drain differ across EDC? Do gaps in the protection of IPRs in such countries nurture the brain drain of its most skilled workers? Looking at the question the other way around, is it also possible for skilled migrants to change and improve institutions in their home country? When emigrants consist of a country's most talented individuals, better institutional environment abroad may induce them to directly and indirectly contribute to their home country institutions. In terms of IPRs, do skilled diasporas and migrant returnees influence the effectiveness of the IP system in promoting innovation in, and technology transfer to, their home countries? The third view is taking institutions, here IPR protection in the home country, as given and examining how it can determine the impact of skilled migration on home country innovation and development. This allows us to make conclusions on whether the contribution of diasporas and the returnees to their home country innovation and development is influenced by the IPR regime.

This work makes an initial attempt to collect and bring together insights from recent literature to develop a number of hypotheses regarding the above questions and propose ways in which they can be put to test. To this end, I provide a brief review of the existing theoretical and empirical literature and present potential conclusions that can be deduced from them. First, I discuss how IPRs can play a role in determining the direction of the flow, and eventually the location of, inventors and scientists. Next, I briefly discuss and explore the impact of emigration on home country institutions at large due to the lack of evidence for such phenomenon specifically for IPRs. Finally, while skilled migration can play a role in improving institutions, existing institutions can change the impact of brain drain by providing means for the transfer and the effective use of their skills in their home countries. Here I narrow down institutions to the protection of IPRs and provide recent evidence on how this can have an impact on brain circulation through the functionality of diaspora knowledge networks. Using this explanation, I provide some preliminary proposals on the role of IPRs in transforming brain drain into brain gain and making skilled migration a win-win phenomenon through the facilitation of brain gain through brain circulation.

Given the absence of literature on the relationship between IPRs and brain drain, I conclude by suggesting some initial steps for opening new avenues of research in this area.

2. Skilled Migration and Innovation at Home and Away

Skilled migration can be associated with innovation in the destination (Kerr, 2014) and the home country (Agrawal, 2014). Recent empirical studies have established a solid correlation between inward migration and its benefits in terms of innovation. The goal of this section is to first discuss these works in order to understand the relationship between migration and innovation in the receiving country. Once this is understood, I argue that looked the other way around, the phenomenon can mean forgone opportunities for the sending countries, i.e. brain drain. I then show how this is not always the case as a channel of knowledge flow can exist between brains abroad and those that remain in the home country.

Bosetti et al. (2015) indeed argue that policies aimed at attracting skilled migrants to Europe could give a boost to innovation in the European Union. They argue that the entry of skilled migrants and their employment in occupations that put their skills into use results in the creation of new knowledge measured by the number of patent applications. They model innovation as the product of the number of researchers (which clearly increases with immigration) and average researcher productivity. The second component itself depends on three factors: the stock of knowledge (stand on the shoulders of giants), decreasing returns due to congestion externalities (stepping on the toes effect), and synergies brought about by the interaction of different cultures to bring together “diverse approaches to problem solving”. The authors find a positive effect of highly skilled foreigners on innovation capacity of the destination country not only due to the presence of more skills in the country, but also because of complementarities between foreigners and natives. While the causal effect of migration is clearly stated, the analysis stops here and does not deal with the question whether the improved skills of the migrants can eventually also have any benefits for the migrants’ home country.

Miguelez and Moreno (2015) take an important step further to study whether absorptive capacity of regions that receive migrants plays a role in the effect of the latter on innovation. In other words, they study knowledge flows and conditions under which they can be put into best use by the receiving country. They also investigate the effectiveness of European policies in attracting researchers from other parts of the world by studying preconditions under which they are more likely to reach their aim of fostering EU competitiveness in innovation. They argue that absorptive capacity is a necessary intermediate step to transform extra-regional knowledge into regional innovation. The unique feature of their approach is distinguishing between the geographical

mobility of inventors and co-inventions through cross-regional technological networks. While they show a positive causal effect of both types of knowledge transmission on innovation in the receiving region, their results critically reveal that the more developed regions benefit more from the inward flow of inventors whereas the less advanced ones can have higher returns from engaging in research networks. This reveals the important role of absorptive capacity in determining the most effective way of knowledge flow as key to stimulating innovation.

Viewing these results the other way around, one would think that the departure of useful skills that now disproportionately benefit the host country would have nothing but a negative impact on the country of origin. After all, it is difficult to imagine how the flight of brains without a replacement can have any immediate benefits for the home economy. A series of contributions presented in the introduction consider ways in which diasporas promote access to foreign-produced knowledge and foster innovation by encouraging trade and foreign investments in the home country. In fact, expatriates do not even necessarily have to be entrepreneurs to invest or make financial contributions to support their home economies. They can serve as bridges, on which the (two-way) traffic of knowledge flows between regions. On the one hand, their establishment in foreign countries provides access to markets. On the other hand, they can offer the acquired knowledge and expertise to their kin in their home countries. Nevertheless, Agrawal et al. (2011) found only very modest effects regarding the role of diasporas on knowledge diffusion back for the case of India suggesting that there may be other factors at play.

On this note, an interesting side feature of Miguelez and Moreno (2015) deals with the role of the outward migration rate on innovation. This rate consists of the ratio of the outflow of inventors to the local number of inventors and indirectly measures knowledge flows from inventors leaving a region back to their former colleagues in their firm or country. These estimates provide insights that are directly related to this chapter because a positive coefficient goes in line with the brain gain hypothesis, and a negative one instead would be consistent with reduced innovation potential of the sending region due to the post-migration lack of inventors. Their findings show that this relationship is positive and significant when the source is a high income region, and not so when it is a low income one. The authors interpret these results as outward migration of inventors being an alternative source of knowledge flow through interaction with remaining workers in their home location. The results once again highlight the crucial role of absorptive capacity by suggesting that this channel is only operational when the source region has reached a sufficient level of development to enable interaction opportunities between inventors now abroad and those still residing in their home countries.

3. The Protection of Intellectual Property Rights and the Flow of Knowledge

The question whether patent protection fosters or hinders technology transfer has been studied extensively by economists. Hall (2013) takes another look at the topic by splitting the problem. She poses two questions: whether stronger patent protection encourages (i) inward technology transfer by attracting foreign investment, and (ii) technological development in a country. Vast empirical evidence suggests a positive response to the first question suggesting that IPRs stimulate technology transfer by promoting trade (Maskus and Penubarti, 1995) and FDI (see Javorcik (2002), Branstetter et al. (2006), and Park and Lippoldt (2008) among others).² However, IPR protection could also hamper domestic innovation by blocking the adoption of new technologies through imitation. This creates a non-monotonic relationship between IPRs and development as deliberated in important contributions to the literature such as Braga et al. (2000), Maskus (2000), and Chen and Puttitanun (2005).

The role of patent protection in promoting technology transfer can be confronted in several dimensions at the micro or macro level. More recent empirical investigation at the firm-level has made it possible to distinguish international transactions according to the complexity of products. Naghavi et al. (2015) show that IPR protection nurtures technology transfer by encouraging technology-sharing outsourcing of more complex goods. Naghavi and Strozzi (2015) investigate another potential channel through which IPR protection may encourage domestic innovation and technological development. The protection of IPRs can be seen as another home country institution linking skilled migration with the innovation behavior of inventors in a particular country. They introduce the role of IPRs in determining the impact of skilled migration on innovation in terms of patenting activities in the home country. They argue that IPRs may reverse the so-called brain drain that may slow down technological progress in developing countries and instead transform the knowledge acquired by diasporas to benefits for the home economy (see Section 5.3).

The importance of the IPR institutional environment for fostering international innovative activities by emerging economies, such as China and India, can also be addressed by examining to what extent the institutional frameworks for IPR protection at home and away are relevant for the involvement of EDC firms in global innovation networks. On this front, empirical findings in Comune et al. (2011) show that stronger IPR enforcement at home increases international patenting activities by the newly industrialize economies, whereas more stringent IPR protection abroad (in advanced countries) reduces it. The convergence of global IPR standards therefore tends to

² Other modes of technology transfer not discussed here are licensing and joint ventures.

contribute to the internationalization of innovation activities that originate from the South. A recent firm-level survey by project INGINEUS was specifically designed to gather information on innovation by firms in the three sectors of agro-processing, automotive, and ICT.³ The survey results reveal India to be the only emerging economy with a strong and positive probability of being part of a global innovation network while China results amongst the least involved. At the same time, 72% of the responding firms in the Chinese ICT sector emphasized the importance of intellectual property ownership by requiring more stringent IPR regulations to appropriate innovation activities. The relative value increases if we restrict the sample to firms that are involved in global innovation networks. A smaller 54% of the Indian responding firms in the ICT sector were concerned about IPRs and at the same time resulted more open in conducting research activities with foreign partners.

4. Adding Intellectual Property Rights to the Picture of Migration

The seminal work of Helpman (1993) is arguably the benchmark of a large literature on IPRs and innovation. Its main result, contested by follow-up works of other scholars such as Lai (1998) and Yang and Maskus (2001), is that the strengthening of the patent protection system reduces technology transfer opportunities that are otherwise made possible through reverse engineering. This together with the fact that the recognition of IPRs expands the monopoly power of innovators, which are in this set up placed in the North, results in a worldwide slowdown of innovation and growth.

Mondal and Gupta (2008) is the first attempt to bring migration into a model of IPRs and does so by introducing international labor mobility in Helpman (1993). In their model, the international movement of workers is based on differences in per capita real spending between regions. The steady state results suggest that strengthening IPR enforcement in the South decreases the share of products being imitated in the South, shifting labor from the South to the North. Incorporating migration prospects into Helpman's model thereby makes the effect of IPRs on innovation (which in this set of models only takes place in the North) positive. Putting the findings in the context of this chapter, the model suggests that IPRs would reinforce the positive impact of skilled migration on the host country discussed in Bosetti et al. (2015) and Miguelez and Moreno (2015). But does IPR protection in the South in any way help foster innovation and development, in particular through migration, in the South?

³ INGINEUS (Impact of Networks, Globalisation, and their Interaction with EU Strategies) is an international research project funded by the European Commission that studies global innovation networks. It involves 14 research institutes and universities in seven European countries plus Brazil, China, India and South Africa. For further information on INGINEUS project please see <http://www.feemdeveloper.net/ingineus>.

An important shortfall of this strand of literature is the lack of innovation prospects in the South. While this may have been a plausible assumption decades ago, it is no longer reasonable to neglect this possibility in the increasingly diverging EDC economies that now include both low-income countries where innovative capacity is still limited and more developed middle-income countries that have already acquired certain pockets of innovation excellence. While Mondal and Gupta (2008) simply introduce international labor mobility into Helpman's product development framework of IPRs, Naghavi and Strozzi (2014) build an occupational choice model to single out the different effects of IPRs on the losses and benefits brought about by skilled migration. They focus on developing countries and explore a concept referred to as "intellectual diaspora", which deals with the connection of professionals abroad to scientific and technological activities at home under different IPR environments. This, they claim, is a positive force caused by emigration that can counteract brain drain by generating a flow of ideas and inventions back to the migrants' countries of origin. They aim to study whether and how the effectiveness and the realization of this flow can be determined by the strength of IPR institutions in the home country.

In Naghavi and Strozzi (2014), emigration results in a direct loss of the most talented individuals in the extensive margin, but also creates a diaspora channel through which the knowledge acquired abroad can flow back to upgrade the skills of the remaining workers in the home innovation sector in the intensive margin. IPR protection prevents imitative activities and renders working in the innovation sector more profitable. It therefore attracts workers from other sectors into the innovation sector and discourages migration of skilled workers. The latter has two opposing effects on the level of human capital in the home country. On the one hand, IPRs increase the number of skilled workers in the home innovation sector. This in turn enhances the absorptive capacity of the South, the importance of which was emphasized in Miguelez and Moreno (2015). On the other hand, IPRs also reduce the size of the diaspora, thereby limiting in absolute terms the potential gains that can be acquired through migration.

The key effect of IPR protection that is revealed in the analysis is its role in increasing the size of the innovation sector in the South, making it possible for potential gains coming from the diaspora to fall on a larger range of workers active in the innovation sector. The authors show conditions under which this effect can create net gains from diasporas despite causing a reduction in the number emigrants. This occurs as long as the intensity of international knowledge flows between the two countries is large and the IPR regime is strong. Looking at the problem from a broader perspective, skilled migration results in a drain of brains that can be used in the innovation sector, but provides developing economies with a chance to learn and send back superior knowledge back to the home economy. A sound IPR environment in the South makes it more likely for the second effect to dominate. The results are compatible with and complement alternative

hypotheses on the positive roles of migration for the sending country. Considering the Beine et al., (2001) model of human capital development, one can think of IPR protection as a channel of brain gain as it encourages education and entry into the innovation sector of the home country. Adding IPRs in the Mayr and Peri (2009) context of return migration, the protection of ideas would induce return migration of workers with enhanced skills back into their home innovation sector.

5. Revisiting the Questions on Intellectual Property Rights and Brain Drain

5.1 The Impact of IPR Protection on the Mobility of Scientists and Inventors

The only paper to our knowledge that studies how IPRs influence international migration of skilled workers is the theoretical contribution of McAusland and Kuhn (2011). In their model, IPR protection is endogenous. Governments use IPR policy as a tool to attract the creators of intellectual property, a concept referred to as “bidding-for-brains”. They also detect an opposing effect that reduces the incentives of IPR protection in a country when a significant share of its intellectual workforce has already departed to another country. This occurs because the marginal innovations produced by its brains living abroad are less relevant to the source country. The so-called “expatriate brains” effect is active when innovations are heterogeneous in their practicality across different countries. The assumption is taken from Diwan and Rodrik (1991) that North and South may have differing technological needs. The paper interestingly also explores conditions under which each of the two effects described above prevail. They show the negative effect of brain drain on IPRs to dominate for small or less developed economies as they have no hope of contesting the outflow of their skills through a strong intellectual property system. Conversely, the positive effect through a bidding war takes significance in more advanced countries, where innovative capacity has reached a sufficient level for IPR laws to have a meaningful effect on the outflow of their brains.

The above analysis by McAusland and Kuhn (2011) suggests that IPR differential between two countries has the potential to attract internationally mobile knowledge workers, but if a country loses the bid for brains, it falls in an intellectual property trap and resorts to a low level of IPR protection. As a result, incentives for IPR protection increase with innovative capacity and occur when bidding for brains complements the protection of locally produced intellectual property, creating more gains than intellectual free-riding. The hypothesis supports findings in the IPR literature mentioned in the previous sections, that IPRs could only be beneficial once a country passes a certain stage of development. Here, a country can only attract international scientists and inventors or prevent the outflow of brains through IPR protection after reaching a critical level of

innovation capacity. Therefore, the impact of IPRs on the stay or go decision of skilled workers can theoretically go both ways and remains an empirical question.

It is important to mention that IPRs are one of many factors that can influence the global flow of skills. Market size, foreign direct investment, and returns to human capital are among other factors that determine decisions concerning skilled migration. In addition, IPRs being one of many home country institutions (some of which are presented in the next subsection) makes it difficult to single out its effect on the decisions of scientists, engineers, information technology specialists, and related professional about where to exercise their profession. Indeed what lacks with regards to this particular question is a study that shows whether the protection of IPRs can truly influence the international mobility of workers. We will discuss below how recently made available data in Miguelez and Fink (2013) on inventor mobility can be a potential avenue to test the predictions provided in this theoretical argument.

5.2 The Impact of Emigration on Home Country Institutions

We saw in Section 2 that immigrant communities play an important role in reinforcing the relationship between domestic and foreign actors and creating a mutually beneficial economic exchange. The re-involvement of diasporas in the home country through investment and integration in networks to transform it to a channel of gain is however not trivial. While the strength and magnitude of the talent abroad is important, the capacity of home country institutions to absorb and diffuse the acquired talent is also critical. Countries with strong institutions manage to efficiently utilize brain drain to their favor, whereas others fail to take advantage of the outflow of their talent. Skills abroad can help formulate successful innovation projects, but only if home country organizations are capable of implementing them. In environments with weak organization, activities by emigrants abroad are sometimes expected to be a substitute for backward institutions. However, the healthy approach requires the simultaneous functioning of diaspora networks together with strong home country organizations. On the one hand, learning from better norms and institutions is instrumental in strengthening home country institutions. On the other hand, capacity building through favorable home country institutions is deemed as a necessary step for developing countries to exploit potential benefits from diasporas.

Migration can work as a force that can affect institutions at home by providing an *exit* option. Using the terminology in Hirschman (1970), exit refers to emigrating to a country with better institutions. The alternative is *voice*, that is, protesting against political repression to improve existing institutions. In an environment where those who exit can no longer express their voice, emigration reduces the probability of change and reform. Given that migrants are typically

positively self-selected with respect to education, and that more educated individuals tend to have a higher degree of political participation, their leave is likely to hurt the quality of home country institutions. However, emigrants abroad can engage in economic and political activities to reform institutions in their home country. They may put pressure on international institutions and foreign states to stimulate change in their home country or actively achieve economic and political power abroad to reinforce internal change. In this case, emigration can increase the probability of an enhancement of home country institutions.⁴

Recent theoretical frameworks have been developed to explain this phenomenon. Mariani (2007) looks at how emigration may reduce corruption in the home country where agents can choose between rent-seeking and productive activities. Those engaged in the productive sector have the choice to move to a rent-free foreign country. The prospects of migration here reduce the relative return to rent-seeking, therefore decreasing the fraction of skilled workers who select into such activities. Peng (2009) extends this framework to one with heterogeneous agents and shows the brain gain effects of migration in a rent-seeking environment can be due to a reallocation of talent into the productive sector. He shows that regardless of the depletion of productive resources, the possibility of migration could create incentives for more talented individuals to switch from engaging in rent-seeking activities to productive activities.

In a recent study, Spilimbergo (2009) uses a seminal empirical strategy to observe institutions from a general perspective and assess the impact of foreign-educated emigrants on their home country. The study strikingly finds that emigrants educated in democratic countries contribute to enhancing democracy in their home country by increasing the home country population's exposure to democratic values and norms. The follow up empirical conclusions have however been at best mixed. Docquier et al. (2015) uses the same strategy to investigate the impact of emigration on democracy and economic freedom in the home country. They find that total emigration rate indeed has a positive effect on the quality of these institutions in the home country, while the results are ambiguous for high-skill migration. These findings give way to interesting new hypotheses. One explanation for these results could be that the impact of emigration on home country institutions is only present when the skilled remain in their country of origin. Perhaps more interestingly, they conclude from the results that the channel at play here is the incentive effect of migration prospects on human capital formation rather than the transfer of norms and institutions. Beine and Sekkat (2013) however obtain more favorable results for the latter line of reasoning and once again confirm the feedback effect of values and norms from the diaspora to natives of the original country. Their focus is the quality of "market friendly" institutions as measured by Kaufmann et al. (1998), namely voice and accountability, government

⁴ See Docquier et al. (2015) for anecdotal evidence in Mexico, Haiti, Cuba, Northern Ireland, and Croatia.

effectiveness, regulatory quality, and control of corruption. Using a similar empirical strategy as in Spilimbergo (2009), they find that an increase in the quality of home country institutions depends positively on the quality of institutions in the host country where emigrants reside. In the light of these findings and in contradiction to Docquier et al. (2015), they also find that the level of education of emigrants plays an important role for this effect to take place.

While in the above analysis we analyzed the impact of skilled migration on several types of institutions in the home country, we devote the remainder of this section to make some preliminary analysis on how specific technology-related home country institutions can change the impact of emigration on economic and innovative activities.

5.3 The Role of Intellectual Property Rights on Brain Circulation

The final question dealt with in this research is whether diasporas' and returnees' effects on home country innovation and development is influenced by their IPR regimes. Here, we are talking about an indirect effect of an exogenous shift in the IPR regime in the sending country on the potential impact skilled migrants abroad could have on innovative activities in their home country. The first empirical paper that directly tackles this issue is Naghavi and Strozzi (2015), which shows that diaspora networks may generate positive knowledge flows, but only to the extent that there is enough absorptive capacity in the home country. IPR protection creates favorable conditions in the innovation sector, in terms of either industrial development or foreign direct investment, employing workers into skilled occupations that can benefit from diasporas. Their results discussed below show that the strength of IPR protection is a moderating factor to enable gains from diaspora networks.

Naghavi and Strozzi (2015) argues that a potential diaspora channel through which knowledge acquired by emigrants abroad can flow back into the sending country enhances skills of workers in the innovation sector of developing and emerging economies. Recall from Section 4 that the protection of IPRs increases returns to skills, attracting workers into the innovation sector. This increases the fraction of the population active in the innovation sector who can gain from skills acquired abroad and sent back by emigrants. As a consequence, the protection of IPRs stimulate domestic innovation by creating the right environment to absorb potential gains from international migration. This reveals for the first time a relationship between emigration and IPR protection in determining the evolvement of skills and innovation in the sending country. It points at this opportunity provided by emigration for the sending country and suggests that the benefits can best be realized under a sound IPR environment.

The empirical analysis is based on a sample of 34 emerging and developing countries (for which data on both migration and patents exist) with data ranging from 1995 to 2006. The measure of domestic innovation is the number of resident patents taken from WIPO, which represents the number of patents granted by the local national patent office in each country to its residents. Data on emigration stocks are derived by summing up available bilateral immigration stocks by country of origin into 27 OECD countries. The original annual bilateral migration has been collected by Mariola Pytlikova from different statistical offices of the world and supplemented by published OECD statistics from “Trends in International Migration” publications and Eurostat data.⁵ The measure of the stringency of IPR protection is the index compiled by Park (2008), which in the sample under consideration ranges from a minimum of 1.08 up to a maximum of 4.54. The results of the paper indeed find a direct negative and significant effect of emigration on innovation activities performed in the home economy, suggesting that the depletion of skills can initially result in a brain drain. However, a positive interaction effect between emigration and IPR protection suggests that emigration can be supportive for innovation in the country of origin when IPRs are sufficiently strong.

It is worth noting that in Eastern Europe, Latin America, and China, high levels of IPR protection have only been reached since 2005 (see Park, 2008). As the results in Naghavi and Strozzi (2015) show that a relatively strong level of IPR enforcement is required to realize the gains from diasporas, the potential role of IPRs in achieving brain gain through brain circulation is a new phenomenon. The findings shed light on the joint role of institutions and migration in promoting innovation, by showing that political instruments such as IPR protection could perhaps be used to make a win-win game out of emigration by fostering diaspora knowledge networks. More precisely, the superior knowledge of diasporas can compensate for the missing innovation capacity in the sending country that can potentially be exploited with strong IPR enforcement. In other words, emigration has a favorable effect on establishing a solid link between IPR protection and innovation by providing domestic workers with the missing source of knowledge required for IPRs to be effective in triggering inventions.

Naghavi and Strozzi (2015) also put the causality of their estimations into test using the first-difference technique and an instrumental variable approach. The paper uses two sets of instruments to mitigate endogeneity concerns. The first set of instruments exploit information on the determinants of migration used in the gravity literature to derive a measure of predicted emigration stocks. These include variables on geography, common culture, and past bilateral migration stock in 1960. The paper then builds an alternative instrumental variable using

⁵ For a more comprehensive description of earlier versions of the same dataset, see Pedersen et al. (2008) and Palmer and Pytliková (2015).

information on exogenous shocks to emigration that emerge from immigration policy changes. This is done by measuring the stringency of entry laws in destination countries relevant for each country of origin to account for migration costs. The results validate the importance of IPRs in transforming skills learned abroad into successful domestic innovation. Finally, the authors propose a check to establish the principle channel of knowledge flow by putting the hypothesis of brain circulation against the possibility that such benefits could arise from migration-induced trade or FDI. To do this, they build a measure in the light of Spilimbergo (2009) to investigate the link between domestic innovation in the sending country and innovation potential in the host country. The results suggest that emigrants contribute to innovation in their countries of origin when their host country is more technologically advanced in terms of their R&D or patents they possess. Trade and FDI do not lead to similar results, in the sense that moving to countries with whom migrants' home country has more bilateral trade or FDI relations with the destination does not significantly affect innovation.

5.4 The Way Forward

Due to the poor availability of data on migration flows and IPR protection, the literature has been rather silent on the relationship between IPRs and brain drain. Only recently a small number of theoretical and empirical works mentioned in this chapter have started to explore the issue. The empirical investigation of Naghavi and Strozzi (2015) is a first step to connect IPRs with migration. The first view obtained for IPR protection in the emerging and developing world regarding its potential effects on migration is positive. One should also recall McAusland and Kuhn (2011), who claim IPRs to be an obstacle to the international flow of brains. They make the theoretical argument that if brains are emigrating, a country may as well loosen its IPR regime to free ride on brains that have moved elsewhere. Note however that their study does not consider any channels through which the skills acquired abroad can be transferred back into the country of origin, which is explicitly what Naghavi and Strozzi (2015) aim to study.

Due to the scarcity of data on IPRs, most of the existing empirical studies implicitly treat intellectual property as a unidimensional policy variable, missing out on many important aspects of IP policy. First, while the overwhelming majority of countries in the world now have an IP law including patent rights for inventions, there are certainly differences in the way these rights are administered and enforced. For example, many less developed economies may have weaker institutions for administering and enforcing IPRs. However, there are also less developed economies with well-functioning institutions, where the patent system still plays a marginal role in the innovation system either due to their limited innovation capacity or their preference for using the USPTO or the EPO for patenting their valuable inventions. It is therefore important to

investigate in future research which dimension of IP policy matters most for brain drain/gain outcomes – is it the details of the intellectual property laws, the way IPRs are administered, how they can be enforced, or whether the intellectual property system is compatible with the international exploitation of IPRs through, for example, the patent cooperation treaty (PCT) system?

Indeed, the concept of how and why different dimensions of IPRs should be related to brain drain is of great importance in today's growing knowledge-based economies and deserves attention in the economic literature. Brain is the producer of intellectual property, therefore the direct link between the two could be the translation of brain drain into intellectual property drain. Evidence and stylized facts provided in this chapter have stressed the importance of international collaboration when it comes to innovation activities and engagement in the global markets to acquire knowledge. This can therefore transform skilled migration into intellectual property gains for the individual and with the right institutions in place also for the country of origin. It is important whether the protection of IPRs results in a net push or pull of intellectual property in a country. Empirical work to investigate this phenomenon is still at its infancy and is yet to be developed.

For a start, the empirical strategies used in the related works mentioned in sections 5.2 and 5.3, namely Spilimbergo (2009), Beine and Sekkat (2013), Docquier et al. (2015), and Naghavi and Strozzi (2015) can be used to study the two-way causality between migration and home country institutions. Scientists and high-skilled professionals can decide where to exercise their profession, driving consequences for a country's innovation capacity and the availability of knowledge. International differences in the level of IPR protection may influence this decision and have an impact on the flow of migration. The other way around, outward migration of skilled workers can induce changes in the effectiveness of the IPR regime in achieving innovation and technology transfer. Below we list some initial strategies to conduct a few preliminary investigations of this linkage in the light of available data:

- (i) One can study whether the protection of IPRs causes a direct flight of skills and scientists. Here it would be interesting to see how emigration is impacted with IPR protection in the home and the prospective destination country, using the newly available data on the international mobility of inventors presented in Miguelez and Fink (2013) to test the theoretical findings of McAusland and Kuhn (2011). This is possible as the new data set exploits the fact that PCT patent applications in a majority of cases record both the residence and the nationality of an inventor. This can be used as a direct tool to point out inventions by skilled migrants in their destination country. Looking at the IPR protection level in the origin and the destination of an emigrant inventor,

valuable information could be provided on whether gaps in the protection of IPRs nurture the brain drain of scientists and inventors. A more specific test of McAusland and Kuhn (2011) would include the interaction of IPR strength and the development rate (using GDP figures) to show whether and to what extent IPRs work to attract brains depending on a country's stage of development.

- (ii) Following the strategy of Naghavi and Strozzi (2015), it is interesting to extend the argument to see whether skilled migration flows increase international scientific collaboration between developed and developing countries and explore how IPR protection in the home country relates to this. This can be performed by directly measuring co-patenting as in Miguelez (2014) to study technology collaboration between local and foreign inventors in producing cross-country PCT patent applications, as an alternative to using the number of resident patents in the home country (domestic innovation).
- (iii) Applying Beine and Sekkat (2013) to IPRs as the institution of interest, one can study the impact of the IPR regime in the destination country of emigrants on IPR protection in their home country. This is parallel to the concept in Spilimbergo (2009) that foreign-trained individuals promote democracy in their home countries if they study in democratic countries. In order to capture the heterogeneity among different destinations, an emigration index defined as the weighted average of emigration flows can be constructed the weight of which would depend on the IPR regime in each host country.
- (iv) A variant of the methodology in (iii) could be to combine it with (ii) and assess international collaboration as a function of emigration weighed by the strength of the IPR regime in the host country, the IPR regime in the home country, and the interaction between the two. This allows the study of the effect of international differences in the protection of IPRs on bilateral international collaboration between countries.

6. Conclusion

Researchers have begun to rename the brain drain phenomenon as brain circulation in recognition of the fact that many skilled workers who settle in their host country remain connected with their country of origin. Others return to their home countries with new skills and abilities. Saxenian (1999) was one of the first studies to identify the potential for mitigating brain drain through brain circulation. This realization has led to a global movement toward knowledge

networks: formal and informal networks that comprise expatriates and others who directly and indirectly contribute in the development of their home country. Migrant communities abroad engage in a broad set of activities such as investments, knowledge transfer, or simply intellectual connection with their homelands.

Talent is the root of innovation activities and the creation of knowledge, and its location and institutional surroundings can determine the geographical boundaries of its effectiveness. To capitalize on talent, newly knowledge-based economies are designing new organizational forms to enhance the efficacy of talents in their development. Diaspora networks of expatriate talent are one such new organizational form of the emerging global, knowledge-based economies. Institutions such as the protection of intellectual property can have a significance in the realization of such intentions by its impact on the location and mobility of scientists, and the location and mobility of the knowledge embodied in them, which need not coincide with their physical entity. By attracting knowledge back to the home economy and creating ways in which the knowledge can be put into better use, IPR protection may indeed play a role in the transformation of brain drain into brain gain by materializing the potential gains from diasporas. Connecting to global innovation networks, another decisive phenomenon that determines the ability of catch-up economies to play a part in the world economy can thus be their IPR regime its distance to the world IPR frontier.

Research in the joint field of IPR protection and skilled migration is however still at its very early stages and needs to establish theoretical and empirical regularities in order to confirm and elucidate the above explanations. Some interesting ways forward can at this point be drawn from the current review. New data from Miguelez and Fink (2013) can help measure the impact of the differential in IPR regimes across countries in determining the decision of scientists where to practice their profession. However, it is important to remember that IPR policy is multidimensional and that it is one of many factors that can influence the international mobility of talent. A more in-depth study of international scientific collaboration and its relationship with IPRs can make it possible to see whether these institutions can truly mobilize diaspora back towards the country of origin or if the acquired skills are simply put into use abroad. It is also possible to see whether emigration (skilled or total) causes a direct drain of voice or whether they can help improve home institutions by transferring the IPR norms of more advanced economies. Or do poor institutions reflected in bilateral differences in IPR protection levels simply result in the flight of skills and scientists? Moving to innovation and patenting activities, it would be interesting to expand the work of Naghavi and Strozzi (2015) and see if home country institutions impact the sign and the magnitude of the effect of brain drain on patents and innovation in the home country. If IPRs truly manage to transform brain drain into brain gain, more research must be devoted to see how such improvements are feasible and can be directed towards the facilitation of brain circulation.

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