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IPR, Trade, FDI, and Technology Transfer

Abstract In this survey, we discuss how intellectual property rights (IPR) protection in the South affects trade flows, foreign direct investment (FDI) flows, and technology transfers from the North to the South. We also discuss optimal IPR policies and their effect on innovation. Our discussion covers both theoretical studies and empirical evidence. This survey is both comprehensive and critical. It aims to give readers the current state of IPR and globalization literature. Some issues have been studied more thoroughly, whereas for others the surface has only been scratched upon. This survey gives readers a clearer picture of the literature and may help them find future research topics.

Keywords IPR, trade, FDI, technology transfer

JEL Classification F0, F1

1 Introduction

Intellectual property rights (IPR) are one of the oldest institutional means in society to foster innovation and protect the interests of innovators. According to the World Trade Organization (WTO), IPR are the exclusive rights given to a person over his/her mental creations for a certain period of time. Among various categories of IPR, patents are the most essential and widely studied type in economic literature. Others include copyright, trademarks, and trade secrets.

IPR and its implications on innovation and economic development have received a great deal of attention in economic literature. However, the study of IPR in a global context is a less developed area in the literature and has only emerged more recently. Although the international dimension adds difficulties to the IPR issue, analyzing it in a global context is interesting and important. This paper aims to provide a comprehensive and critical survey of IPR on a global
scale. We review literature related to IPR in a framework where many countries conduct trade, foreign direct investment (FDI), and technology transfer. In particular, we focus on the effects of strengthening IPR protection in the South on exports, FDI flows, and technology transfers from the North to the South. We also discuss the equilibrium innovation and optimal IPR policies in an open economy. Our survey covers both theoretical research and empirical studies.

The global landscape of research and development (R&D) and innovations has been evolving. The US is undoubtedly the center of technological innovation in the world. Industrialized countries account for the majority of world innovation. However, the distribution of innovative activities worldwide has changed. According to the *World Intellectual Property Organization Indicators Report 2012*, China’s patent office received more applications than any other country in 2011. This report marks the first time that China has overtaken the US as the top-ranked office for each of the four forms of intellectual property (IP) applications: patents, utility models, trademarks, and industrial designs. The total number of patent applications worldwide rose by 7.8% in 2011, exceeding 2 million. China accounted for 72% of the world’s patent-filing growth between 2009 and 2011, whereas the US contributed 16%. The total number of worldwide patents in force grew by 6.9% in 2011 to an estimated 7.88 million based on data from 81 offices. The United States Patent and Trademark Office has the largest number of patents in force (2.1 million), and its Japanese counterpart has 1.5 million. Rapid globalization intervenes in the growth of IP worldwide, and China has been actively engaged in both activities. Hence, understanding the interactions between IPR protection and trade, FDI, technology transfer, and innovation in the global economy in general, and their implications for China in particular, is important.

A number of caveats should be noted. First, this survey focuses on patents partly because it is the most important type of IPR in international trade and FDI, and partly because most of the existing studies are directly related to it. Other forms of IPR are also very important, and we will specifically point them out in the survey below when they are discussed with the different implications of patents. Hence, we use the terms “IPR” and “patent” in this paper interchangeably without the risk of confusion.

Secondly, this paper focuses on studies in recent decades. Saggi (2002) and Keller (2009) provide two excellent surveys on IPR in the international context,
but their focus is more on technology transfer. The present survey covers more dimensions such as exports and FDI. The book by Grossman and Helpman (1991) synthesizes issues related to innovation and growth in great detail. We will not spend time discussing these issues in this paper.1

The rest of this paper is structured as follows. Section 2 briefly discusses literature on IPR and innovation in general. Section 3 outlines a general framework to study IPR in a North–South world. We then discuss the effect of strengthening IPR protection in the South on trade flows, FDI flows, and technology transfers from the North to the South in Sections 4, 5, and 6, respectively. Section 7 discusses optimal IPR protection in an open economy. Section 8 concludes and gives remarks on future research topics.

2 IPR and Innovation: A General Discussion

Economic literature on IPR and innovation can be traced back to the 1960s. In his pioneering work, Arrow (1962) presents a model of invention, R&D innovation, and imitation. He argues that society tends to underinvest because firms could not reap all the economic benefits of innovative efforts (R&D in a general sense). The patent system, which gives innovators monopoly rents, could mitigate this inefficiency problem to some extent. Nordhaus (1969) formalizes Arrow’s idea and provides a thorough theoretical analysis of the costs and benefits of patents for firms and society. He postulates the optimal length of patent protection from society’s point of view. In particular, he emphasizes the tradeoff between the dynamic gain and the static loss from patent protection: increasing the length of patent protection generates greater incentives for innovators (i.e., the dynamic gain), but it extends the monopoly power granted during the period of protection (i.e., the static loss).

Another strand of studies applies game theory to model patent race among competitors. This line of research shed light on how competitive races affect the incentives for R&D and innovation. In contrast to the classic models of Arrow (1962) and Nordhaus (1969), the game theory models predict that strong early

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1 In fact, another caveat exists. This survey only discusses research outputs published in English journals. Researchers in China have also conducted several important studies in the related topics. However, our objective is to introduce the research results from abroad to Chinese readers and provide our assessment and comments. This will help to link the research in China with the rest of the world. Such an exercise per se is an activity that clearly falls under the category of IPR, technology transfer, and spillovers.
mover advantage might lead to overinvestment, or at least no underinvestment occurs on the aggregate (Reinganum, 1982; Fudenberg et al., 1983; Dasgupta, 1988; Tirole, 1988).

More recent theoretical studies have shifted the focus from optimal patent length to optimal patent breadth or scope, optimal combination of length and scope, and broader effects of patent enforcement (Gilbert and Shapiro, 1990; Klemperer, 1990).

Extensive empirical studies have been conducted on the effects of IPR protection on innovations. The empirical findings, however, are basically mixed and inconclusive. Using a unique dataset of Japanese patent reform in 1988, Sakakibara and Branstetter (2001) find no evidence of increase in either R&D expenditure or innovative output that can be attributed to patent reform. Using a unique panel dataset of 47 developed and developing countries from 1970 to 1990, Schneider (2005) finds that IPR protection affects the innovation rate at the national level, with the impact being more significant for developed countries. However, Lerner (2009) explores 177 patent policy shifts across 60 countries over 150 years and finds that the impact of strengthening the patent system on resident application is negative.

Cross-country empirical studies require the measurement of each country’s IPR protection level. Two popular indices exist: one developed by Rapp and Rozek (1990), the other by Ginarte and Park (1997). The Rapp and Rozek index measures the conformity of national patent laws in 1984 with minimum standards proposed by the U.S. Chamber of Commerce. This index is a composite (sum) of dummies that take a value of one if the criteria apply, and zero if otherwise. The Ginarte and Park index was constructed based on the unweighted average of five aspects of patent protection: the extent of coverage, membership in international patent agreements, provisions for loss of protection, enforcement mechanisms, and duration of protection. Ginarte and Park (1997) provide quinquennial data of patent protection for 110 countries from 1960 to 1990, which exhibits great variability across countries and over time. Park (2008) later extends the time coverage to 2005, which also exhibits a large variation in the real protection and enforcement of IPR across countries.

Given that our survey focuses on IPR and its relations with trade, FDI, and international technology transfer, we will not discuss articles that do not have an international dimension. For IPR and innovation that are not related to international issues, more details can be found in the most recent review by
3 General Framework

In this section, we set up a general framework (model) to discuss all existing papers within the same framework for ease of understanding and comparison.

The North and the South are the two countries included in this survey. \( n \) industries/products are produced in the North. Northern firms invest in R&D to introduce new products. They hold the IP (or patents) of these products. Perfect IPR protection exists in the North. The South only carries out imitation, and it does not conduct any innovation. IPR protection is imperfect in the South.

The North can export its patented products to the South, take FDI into the South to produce these products, or transfer the patent rights (via technology licensing) to other firms in the South.

All existing models in the literature can be viewed as variants of this framework. Considering that this framework is too large, deriving the general equilibrium from this framework and conducting comparative statics analysis is almost impossible. As a result, different models in the literature have different focuses by assuming some elements of the above framework. For example, some models only consider exports, some only consider FDI, and others allow for technology transfer. The innovation rate could be modeled as exogenously given (Helpman, 1993) or endogenously determined (Lai, 1998). The imitation rate in the South could be the same as in the North, or different (Glass and Saggi, 2002). The product market could be perfect or imperfect with asymmetric information (Che et al., 2013).

We will introduce the general empirical model later.

4 IPR and Trade

This section discusses the effects of strengthening IPR protection in the South on exports from the North to the South.

4.1 Theory

Helpman (1993) builds a dynamic model with Northern innovation and Southern
imitation. His main focus is on the effects on welfare in both regions of strengthening IPR protection in the South. He identifies four effects: (1) terms of trade, (2) interregional allocation of manufacturing, (3) product availability, and (4) the pattern of R&D investment. The effect on trade is also seen in his analysis. As the South strengthens its IPR protection, it is unable to produce many products (second effect). Thus, the North is able to export more products to the South (first effect).

Maskus and Penubarti (1995, 1997) consider a model in which a dominant exporting firm \( n = 1 \) competes with an imitative fringe industry in the South. Strengthening IPR in the South has two effects on trade. On the one hand, stronger IPR decreases the availability of local infringements, hence increasing the demand for Northern innovative products. This market expansion effect promotes exports to the South. On the other hand, stronger IPR decreases the elasticity of demand for Northern innovative products and enhances the pricing power of the exporting firm. This market power effect hampers exports. The net effect on trade hinges on the relative magnitudes of these two effects.

Ivus (2011) considers a model in which the imitation rates in the \( n \) (a continuum of) industries are different. The paper predicts that with stronger IPR in the South, Northern exports increase in industries with the highest risk of imitation, but decrease in industries with the lowest risk of imitation. Ivus shows that strengthening IPR in the South creates four potentially offsetting effects that vary across industries. First is the market power effect. In industries where the North has already exported to the South, stronger IPR limits imitation and decreases the share of Southern products within each industry that trades goods. Northern producers gain more power and thus export more (intensive margin). Second is the market expansion effect. Stronger IPR makes exporting less risky. In some industries, Northern firms switch from no-export to export and in so doing expand the range of exporting industries (extensive margin). Third is the market dilution effect. The market expansion effect promotes Northern exports, but as the range of industries that trade goods expands, a given Southern income is now spent on a wider spectrum of products. The Southern budget share spent on the products in each industry that trades goods falls. This lowers Northern exports on each traded good. Last are the terms of trade effect. Relative wages change with the above three effects combined. If the relative Northern wage falls (rises) in equilibrium, the terms of trade effect promotes (decreases) Northern
exports. If industries differ sufficiently in their imitation rates, both the Southern wage and the overall volume of Northern exports rise with stronger IPR.

Taylor (1993) presents a model in which one Northern firm and one Southern firm engage in a leader-follower game in the market. The Southern firm imitating the Northern firm’s technology has a cost. The Northern firm may “mask” the technology to make imitation more difficult. Stronger IPR also raises imitation costs. Therefore, the appropriability regime is set endogenously and reflects both market-made and institutional barriers to imitation. Taylor shows that Northern exports to the South may increase or decrease in response to strengthening IPR in the South, depending on many cost factors (e.g., production costs, imitation costs, and masking costs).

Ethier and Markusen (1996) consider a Northern firm’s choice among exporting, FDI, and licensing to the South. However, they assume no IPR protection in the South and emphasize the effects of other factors (e.g., relative wage rates, importance of knowledge, and number of imitators in the South) on the Northern firm’s decision. An extension of the analysis is needed in order to see how strengthening IPR protection in the South affects exports, FDI, and licensing.

In summary, the theoretical models highlight various factors that affect the impact of IPR on exports, but we cannot obtain a clear conclusion from all those models.

4.2 Empirical Evidence

Given the indeterminancy of theoretical predictions, empirical research becomes especially important. Most empirical studies adopt the following gravity-type model:

\[ \ln x_{ij} = a + b \text{IPR}_j + \beta Y_{ij} + \epsilon, \]

where \( x_{ij} \) is the value of exports from country \( i \) to country \( j \); \( \text{IPR}_j \) is a measure of country \( j \)'s IPR protection; and \( Y_{ij} \) is a vector of control variables, including the distance between the two countries, the GDP of each country, trade barriers of the importing country, preferential trade agreements, and common language. Different empirical models may use different sets of control variables and different econometric approaches to estimate the IPR effects on trade.

Maskus and Penubarti (1995) are among the first to test the relationship
between IPR protection and trade using 1984 cross-section trade data from OECD countries and many developing countries. One difficulty of this type of study is the construction of an exogenous IPR index for each country. Maskus and Penubarti use an instrumental variable to avoid the endogeneity problem. They find that increasing patent protection in developing countries has a positive impact on bilateral manufacturing exports to developing countries, and the impact is larger for large developing countries.

Extending the study of Maskus and Penubarti (1995), Smith (1999) focuses on US exports to other countries and finds that an importing country’s IPR affects US exports to the country only if the importing country imposes a strong threat of imitation. The threat of imitation is severe in countries with a strong imitative ability and weak IPR protection. This condition is more apparent in middle-income developing countries because they have a good human capital base but lack IPR protection. The empirical analysis based on 1992 data confirms the author’s conjecture: US exports to countries with strong imitative threats expand after they adopt the trade-related IPR-consistent regime (TRIPS). The effect is essentially zero or even negative for the least-developed countries and the rich OECD countries. Smith also examines whether US states respond differently to the strength of IPR in the importing countries. She finds that states having high propensities to engage in R&D and/or high propensities to export in patent-sensitive industries tend to respond more positively to the strength of the importers’ IPR.

The results obtained by Smith (1999) have been reconfirmed by other countries’ data: Rafiquzzaman (2002) uses Canadian 1990 export data and Liu and Lin (2005) use Chinese Taiwan’s export data from 1989 to 2000. Co (2004) uses US export data to 71 countries from 1970 to 1992 to show that patent right regimes per se do not matter; they matter with the importing countries’ imitative abilities. For a country with an “average” imitative ability, US R&D-intensive exports increase by 4% to 9% for a unit increase in the patent rights index. A unit increase in the patent rights index leads to a drop in US non-R&D intensive exports by about 8% to 11%.

Most studies investigate the effects of IPR protection on trade flows by focusing on one Northern exporting country (or in some cases a few Northern exporting countries) trading with a large number of importing countries. Awokuse and Yin (2010) explore the case of one developing country importing
from a large number of other countries. In particular, they analyze the effect of increased IPR protection in China on its imports from both developed and developing countries. Their results suggest that increased IPR protection stimulates China’s imports at both the aggregate and detailed product categories, particularly for knowledge-intensive products. They use panel data (1991–2004) to obtain the variation of the single importing country’s IPR, unlike most other studies that use data from a single year.

Whereas the abovementioned studies focus on country-level trade, other studies focus on industry-level trade. Ivus (2010) takes on the big challenge of analyzing the effect of IPR on trade flows. Ivus utilizes data from both the pre- and post-TRIPS agreement period (spanning the 1960–2000 period) and examines export flows from the innovating North (24 OECD countries) to the potentially imitative South (55 developing countries). The empirical challenge is to credibly measure the causal effect of strengthened IPR to trade flows by accounting for several econometric and data problems. Ivus’s empirical strategy starts with a simple observation. Changes in the IPR strength of developing countries are strongly correlated with their colonial origins. From 1960 to 1990, former colonies of Britain and France increased their IPR significantly more than other developing countries, whereas the opposite is true in the post-TRIPS period (1994–2000). This difference is exogenous. Ivus then performs a difference-in-differences analysis of former colonies versus non-colonies and patent-sensitive industries versus patent-insensitive industries. The results show that strengthening IPR in developing countries raises the value of developed countries’ exports in patent-sensitive industries in both periods. The effect is the strongest for industries that rely heavily on patent protection. Thus, IPR are indeed trade relevant.

Briggs (2013) analyzes the extensive and intensive effects of patent reform. Briggs utilizes the Helpman et al. (2008) approach to estimate the effect of patent reform on bilateral high-tech trade from 1995 to 2005 and to control potential bias in the conventional gravity model. The results indicate that the effectiveness of an importing country’s patent reform in attracting high technology goods from abroad depends on the country’s income level. Low-income and upper-middle-income countries that reform their patent systems do not attract new exporting firms into these countries (extensive margin), but do attract more high-tech exports from existing trade partners (intensive margin). Conversely, patent
reform in lower-middle income countries does see an increase in the extensive margin, but not a significant increase in the intensive margin.

In contrast with theoretical studies that are generally inconclusive because the results depend on many factors, empirical studies generally indicate a strong positive impact of strengthening a country’s IPR protection on imports, especially on R&D-intensive products. Such a conclusion is obtained based on a large number of countries and over different periods of time. Although not completely satisfactory, efforts have been made to find the exact causality by constructing exogenous change of IPR protection.

5 IPR and FDI

5.1 Theory

Many theoretical models that explicitly allow the $n$ Northern firms to make FDI in the South produce the following intuition in general. Lower wages in the South create an incentive to move production of existing varieties there, but multinationals seeking to benefit from these incur a higher risk of imitation. In most models, imitation is assumed to be a costly activity that requires a deliberate investment on the part of Southern firms seeking to copy Northern products. Stronger IPR protection in the South increases these costs, decreases imitation, and lowers the risks faced by multinationals. As a result, multinationals increase their production in the South and employ the labor resources freed up by the decline in imitative activities.

In contrast to the extensive studies on the effects of IPR protection on trade, fewer theoretical analyses on the effects of IPR protection on FDI exist. Among these studies, many focus on other issues such as the rate of innovation with the presence of FDI. In a seminal paper with a dynamic general equilibrium model, Helpman (1993) focuses on how strengthening IPR protection in the South affects innovation and welfare. He also considers the role of FDI in affecting these results. In that analysis, productions in the North and FDI in the South are exposed to the same degree of risk to imitation. Strengthening IPR in the South lowers its wage rate and allows multinationals to charge higher prices and earn larger profits. FDI increases too.

When Helpman introduces FDI into his model, he exogenously assumes the rate of innovation in the North. Lai (1998) extends the Helpman model to allow
the endogenous rate of innovation in the presence of FDI. Although Lai obtains results that are different from Helpman’s results with regard to innovation and wages, the effect of strengthening IPR on FDI is the same.

Glass and Saggi (2002) analyze FDI more directly. They consider a product life cycle model and obtain very different results from other results found in the literature. The North exports innovation products, FDI by multinationals comes to the South, and imitation by Southern firms is present in the South. The cost of imitating a multinational product is lower than that of imitating a Northern firm’s export product. Imitation, innovation, and FDI are all endogenous in this model. They find that stronger IPR protection in the South raises the cost of imitation. It does not only decrease imitation, but also decreases Northern innovation and FDI. The intuition is as follows: the rise of imitation costs crowd out FDI because less efficient imitation tightens Southern resource capacity; the contraction of FDI tightens Northern resource constraints and leads to more production activities in the North; less resources are given to innovation, and so the innovation rate falls. Thus, tightening IPR protection in the South has both an imitation-disincentive effect and a resource-wasting effect.

Different from Glass and Saggi (2002), Branstetter and Saggi (2011) show that strengthening IPR protection in the South decreases imitation in the South, but increases FDI flows from the North. The latter more than offsets the former, resulting in more production in the South.

Compared with the theoretical effect of IPR on trade flows, the effect of IPR on FDI flows is much clearer and conclusive: strengthening IPR increases FDI inflows. However, the relationship between IPR protection and FDI is more complex than the discussed link once we consider a more general model. On the one hand, a weak IPR regime increases the probability of imitation, which makes a host country a less attractive location for foreign investors. On the other hand, with the option of licensing, strong protection may shift the preference of multinational corporations from FDI towards licensing. We will discuss this in more detail in the next subsection.

5.2 Empirical Evidence

The evidence on the effects of IPR protection on FDI is presented. Lee and Mansfield (1996) are among the first researchers to empirically examine this
issue and find a positive relationship between IPR protection and FDI volume and composition in the recipient countries. Their findings are based on 1991 survey data from 100 US multinational companies. However, using the 1992 data and after controlling for industry-specific effects, Braga and Fink (1998) found no significant statistical relationship between patent protection and inward FDI inflows or stocks.

Du et al. (2008) analyze a data set of 6,288 US multinationals who invest in various regions in China from 1993 to 2001, and find that US multinationals prefer to invest in those regions that have better IPR protection. They use the patent number granted as a proxy for IPR protection strength for each province. This method is questionable because the patent number also represents the technological advancement of the location. Kawai (2009) uses the same IPR measure to study Japanese FDI in various regions in China from 1998 to 2006 and obtains the same result.

Nunnenkamp and Spatz (2004) analyze the IPR-FDI issue in a number of dimensions using disaggregate industry FDI data of US multinational firms in a large number of host countries. First, Nunnenkamp and Spatz (2004) find that stronger IPR protection not only raises the FDI inflow quantity but also improves the FDI quality. Secondly, the results hold for three alternative measures of FDI quality: local R&D expenditure of US affiliates; the value added by US affiliates in the host country; and the exports of the US affiliates in the host country. Thirdly, the results depend mostly on industry characteristics, such as technology intensity and human capital intensity. They use both the Ginarte and Park index and the World Economic Forum index to measure IPR protection.

McCalman (2004) points out that the traditional thinking about IPR suggests that as a country strengthens its IPR standards, firms will move their governance structures away from equity-based institutions (such as FDI) towards more market-based relations (such as licensing agreements). To test this hypothesis, he uses a unique dataset regarding Hollywood studios’ entry to 40 foreign markets. He finds a non-monotonic relationship between IPR and FDI. In particular, increasing IPR from a relatively low base tends to increase the licensing potential relative to FDI. However, beyond a point, further increases in IPR are associated with an increase in the likelihood of FDI. In addition, while a moderate IPR protection level is associated with more licensing cases, both very strict and very weak IPR protection are involved with integrated firm behavior, such as FDI.
Javorcik (2004) also examines the IPR impact on FDI. A number of interesting features of the paper are found. The paper uses firm level data, as opposed to others, which use country level data, from Eastern European countries and the former Soviet Union, as the host countries in 1995. Two IPR indicators are used, i.e., the Ginarte and Park index, which is derived from the laws based on books, as well as an enforcement index constructed by the author. Moreover, Javorcik (2004) analyzes not only the FDI volume, but also the FDI composition. Javorcik finds that a weaker IPR regime deters FDI inflows in technology-intensive industries that rely heavily on IPR protection. In addition, foreign investors are more likely to engage solely in distribution activities rather than in local production.

In summary, fewer empirical studies on the IPR effects on FDI are available than those on trade. Although the theoretical predictions are clear, the empirical conclusions are not because in addition to IPR, many important factors that affect IPR-FDI relations are found. In addition, we can isolate the IPR effects on FDI in theory; however, obtaining this data through empirical analysis is difficult.

6 IPR, Licensing, and Technology Transfer

6.1 Theory

Technology transfer from the North to the South can have many different forms. All types of entry to the South by Northern firms will bring technology to the South. However, licensing is the most explicit and direct form of technology transfer. In this section, we review the IPR protection effects on technology transfer, with particular attention given to licensing.

Yang and Maskus (2001) develop a dynamic general-equilibrium, product-cycle model to study the effects of stronger IPR in the South on the incentives of firms in the North to innovate and license advanced technologies. Innovation and licensing are random processes that require resources. Stronger IPR increases the licensor’s share of rents and reduces the costs of licensing contracts. Thus, the returns to both licensing and innovation will increase, and additional resources will be available for R&D. In consequence, innovation and technology transfer will subsequently increase with stronger IPR protection.
Yang and Maskus (2009) develop a model to analyze an interesting mechanism under which stronger IPR protection may improve the ability of firms in developing countries to break into export markets. Based on local IPR policy a Northern firm with a superior process technology chooses either exports or technology transfer through licensing as its mode of supplying the Southern market. Given this decision, the Northern and Southern firms engage in Cournot competition in both markets. They find that stronger IPR would enhance technology transfer through licensing and reduce the Southern firms’ marginal production costs, thereby increasing their exports.

Vishwasrao (1994) incorporates asymmetric information in a screening game with all three modes of entry. In particular, the Northern firm may license a new product at arm’s length to a firm in the South, or export this product or license it to a subsidiary (FDI). Subsidiary production avoids imitation risk; however, this production involves higher costs. The weak IPR protection may induce the strategic behavior by the Northern firm who opts for technology transfer via a subsidiary or monopoly production.

Che et al. (2013) consider two types of imperfection that a Northern firm faces when entering the South. On the one hand, asymmetric information about the quality of the firm’s product is noted. On the other hand, imperfect IPR protection is found in the South. Two periods are noted. The firm can enter through licensing only in the first period, but can enter through licensing or FDI in the second period. The firm chooses the degree of licensing (more specifically in the model, the fraction of the regions in the South that the firm enters with licensing) to signal its product quality. Che et al. show that improving IPR protection encourages the Northern firms to enter (via licensing).

Technology transfer may go through the formal channels. It may also go through informal changes, for example, through imitation. Taylor (1993) presents unintentional technology transfer in which the firm in the South can perform reverse engineering. Therefore, the Northern firm responds by “masquing” product technology to make imitation more difficult. In such a setting, the Southern reverse-engineering effort (or the unintentional technology transfer) may increase or decrease in response to IPR strengthening in the South, which depends on many cost factors (such as production costs, imitation costs, and masquing costs).

As discussed in Section 4, Ivus (2011) considers the four IPR protection effects in trade and innovation. The theory also predicts that strengthening IPR
does not necessarily reduce imitation (informal technology transfer) by the South, because as the Northern firm brings more technology to the South, imitation becomes more likely to increase.

Dinopoulos and Segerstrom (2010) develop a North–South product cycle model, which incorporates multinational firm’s technology transfer decisions. The key assumption is that the Northern firms engage not only in innovative R&D to develop high-quality goods, but also engage in adaptive R&D to learn how to transfer their existing products from the high-wage North to the low-wage South. This process is a semi-endogenous growth model because of its assumption that innovation becomes more difficult as product quality improves and becomes more complex. The steady state analysis reveals that stronger IPR protection in the South leads to a permanent increase in the technology transfer rate to the South within multinational firms, and a temporary increase in the Northern innovation rate. Gustafsson and Segerstrom (2011) have a similar model setup and derive similar predictions.

Leahy and Naghavi (2010) presented how the IPR regime of the host country affects a multinational’s entry decision of serving the market via green field FDI or joint venture with a local firm. Joint venture, which is a more direct means of technology transfer than green field FDI, is the equilibrium choice when R&D intensity is moderate and IPR protection is strong.

In summary, if we focus on licensing as the method of technology transfer, all models predict that strengthening IPR protection results in more technology transfer. However, if we also consider imitation as an informal form of technology transfer, the results are not clear. If we further consider technology transfer associated with exports and FDI, the analysis becomes more complicated. This discussion suggests that measuring all forms of technology transfer becomes formidable; therefore, focusing on licensing alone is better.

6.2 Empirical Evidence

As pointed out in the previous section, based on Hollywood studios’ entry to 40 foreign countries, McCalman (2004) finds that more licensing (relative to FDI) is associated with median IPR protection and increasing IPR from a relatively low level encourages more licensing. The reason behind this finding is that FDI
involves governance problems, whereas licensing is just a market transaction.\(^2\)

In examining how IPR protection strengthening in developing countries affects technology transfer, Kanwar (2012) finds that stronger IPR protection is associated with higher royalty and license payments. To obtain this result, he deals with a number of issues. He focuses on the post-TRIPS period to avoid a potential endogeneity bias. His paper explores six sub-indices of IPR protection measures to observe how each aspect of the IPR protection and enforcement (such as whether a country’s laws provide for preliminary injunctions, contributory infringement, and burden-of-proof reversal, and the legal enforcement of contracts, judicial independence, impartial courts, integrity of the legal system, protection of property rights, restrictions on the sale of physical property, and military interference) affects different modes of technology transfer. In particular, Kanwar (2012) identifies that patent coverage (rather than patent duration, enforcement, or implementation) is the driving force behind IPR’s positive impact on technology transfer.

Nicholson (2007) examines how the impact of IPR protection on a multinational’s choice between FDI and licensing varies among industries. With stronger IPR protection, firms with high R&D investment are more likely to engage in licensing, as well as firms with high capital costs.

Branstetter et al. (2006) use detailed firm-level data to study how US multinational firms adjust their technology transfer to affiliates in response to IPR reforms in sixteen developing countries from 1982 to 1999. Their firm-level analysis reveals that royalty payments made by affiliates for technology transfer to parent multinational enterprises (MNEs) increase in the process of strengthened patent regimes. Furthermore, affiliate R&D expenditures and foreign patent applications experience an increasing pattern in the post-reform period. These two additional indicators reaffirm that IPR protection strengthening is associated with a real increase in technology transfer within multinational firms. The increase in royalty payments and R&D expenditures are concentrated among the affiliates, which make an extensive use of US patents prior to the reform. Therefore, these affiliates are expected to value IPR reform the most.

Nair–Reichert and Duncan (2008) analyze the impact of stronger patent protection on all three entry modes in the same model, i.e., exports, local affiliate

\(^2\) McCalman (2005) uses Hollywood movie releases in other countries as new product or technology diffusions, and analyzes the effects of a host country’s IPR on the diffusions. However, he does not distinguish the modes of diffusions, i.e., export, FDI, or licensing.
sales, and licensing activities. Their empirical results based on US multinationals (from 1992 to 2000) show that increased patent protection generally increases licensing, and reduces unaffiliated exports. Smith (2001) also obtains the same results for US multinationals in her earlier study.

- **In summary, all empirical studies confirm the theoretical prediction, i.e., stronger IPR protection leads to more technology transfer with licensing.**

## 7 Innovation and Optimal IPR in an Open Economy

### 7.1 Theory

Since the study conducted by Arrow (1962) was performed, economists have devoted much effort in searching for optimal IPR protection. The central idea is that the optimal IPR protection is determined by the balance between the dynamic efficiency (encouraging innovation) and static inefficiency (monopoly power). However, in a closed economy, all benefits and costs are confined within a country. Whereas among open economies, the benefits and costs are shared with different countries, thereby making the non-cooperative optimal IPR (i.e., each country setting its IPR policy for its own interests) very different from that obtained in a closed economy. In addition to focusing on the optimal IPR derived from welfare maximization, a very important branch in the literature is examining the IPR effects on economic growth, innovation rate, and trade terms in open economy settings.

In his influential work, Helpman (1993) finds that IPR strengthening in the South may have a negative effect on the innovation rate when export is the only channel of production transfer from the North to the South. In particular, he shows that IPR tightening initially raises the innovation rate. However, the innovation rate subsequently declines. The main reason is due to resource competition. If the rate of innovation is exogenous, Helpman (1993) shows that the South stands to lose from stronger IPR, since both the terms of trade and efficiency effects are against the welfare of the South. By incorporating FDI as another channel of production transfer, Lai (1998) demonstrates that the opposite welfare result is observed.

This part discusses the methods on how to reconcile the opposite results in the above statements. In the absence of FDI, two counteracting effects of enforcing stronger IPR in the South are noted. First, enforcing stronger IPR lowers the
imitation rate and prolongs the expected monopoly duration of each Northern innovator. This process raises the returns to innovation. Secondly, since firms produce in the North, enforcing stronger IPR raises the demand for Northern labor and Northern wages; hence, raising the cost of innovation. Eventually, the second effect dominates the first one, and the innovation rate declines. In the presence of FDI, Northern firms move production to the South to maximize the lower wage, which they balance against the probability that they will lose their monopoly to imitators. A stronger IPR in the South increases the innovation rate in two stages. First, stronger IPR increases the expected lives of monopolies. However, because the resulting increase in demand for labor falls entirely in the South, the return to innovation rises without a rise in cost. Secondly, since the return to FDI increases, firms will move more quickly to the South, thus further increasing the returns to innovation.

As discussed in Section 5, Glass and Saggi (2002) emphasize the resource crowding by imitation. They show that stronger IPR protection in the South reduces imitation and FDI, and reduces Northern innovation.

As the weak IPR protection in the South generates negative externalities in the North, international coordination of IPR protection is desirable. The TRIPS agreement, which was introduced on January 1, 1995 with the establishment of the WTO, is currently the most comprehensive multilateral agreement on intellectual property. The agreement sets out the minimum standards of protection to be provided by each member and makes trade disputes related to IPR protection subject to the WTO’s dispute settlement procedures. Intense debate on TRIPS is found since the industrialized countries had brought TRIPS to the WTO negotiation table in the late 1980s. TRIPS proponents, which are largely located in developed countries, claim that the lack of IPR protection in developing countries has violated the IPR of their firms and caused a huge loss. Requiring the developing world to adopt some level of “reasonable” IPR protection, which is argued by the North to alleviate the infringement problem and increase the incentives to innovation. However, the TRIPS opponents, which are mostly found in developing countries, are quite worried about the side effects of strengthening IPR protection. One of the central concerns is that increased IPR protection may curtail the ability of the Southern firms to imitate the North, and thus potentially curb industrial development in the South. In addition, the developing countries are also concerned that patented products (especially some
life saving drugs) will become too expensive if they adopt more stringent IPR protection standards. After all, as reported by Maskus (2000), the burden of policy adjustments are placed on the responsibilities of developing countries because the developed ones already have a higher IPR protection level. Moreover, despite 20 years of debate and post-agreement experience, the issue of TRIPS remains contentious even today.

Lai and Qiu (2003) analyze the TRIPS issue explicitly in a formal model. They introduce a game theory model to analyze the setting of government policy. They ask the following questions: what are the Nash equilibrium IPR policies of the North and South, and should we ask the South to raise its IPR protection to the Northern level? They show that the Northern level is higher than the Southern level in Nash equilibrium. By asking the South to raise its level affects the South, but both countries can benefit from IPR harmonization with the Northern standard if the North could open its market to the Southern products in other sectors, such as agriculture.

Lai and Qiu (2003) are among the first to assume that both the North and the South have innovative capabilities, and to consider optimal degrees of IPR protection for the North, the South, and the entire world. Their study is also among the first few studies to analyze the merits of raising the Southern IPR protection in a broader context of multi-sectoral (or multi-issue) negotiations, such as in the GATT or WTO. Grossman and Lai (2004) obtain similar results as Lai and Qiu (2003) in a more general setting with regard to the innovation process, demand function, and IPR protection coverage. They also provide more intuitive discussions on the results.

In contrast to Lai and Qiu (2003) and Grossman and Lai (2004), Chin and Grossman (1990) and Deardorff (1992) examine the welfare effects of extending IPR protection from the North to the South, using a model that assumes that the South does not have innovative capability and the South has either full or no IPR protection at the beginning. These assumptions are less realistic than those in Lai and Qiu (2003) and Grossman and Lai (2004). Diwan and Rodrik (1991) also consider various degrees of IPR protection in the North and the South. Interestingly, they find that to maximize the global welfare, which is the equally weighted sum of Northern and Southern welfare, patent protection rates in the two regions must be identical.

More recently, Boldrin and Levine (2009) introduce more details to the
Grossmand and Lai (2004) model to quantify the optimal IPR levels. They conclude that IP protection for patents in the world is probably too high. Lai and Yan (2013) introduce firm heterogeneity together with trade barriers in the Grossman and Lai (2004) framework. These two features reduce the cross-border externality in patent protection; thus bringing the national patent policy closer to the global optimal level. However, with consideration given to political lobbying, the national IPR policy can be above the global optimal level. The bottom line is that requiring all countries to adopt the protection standard of the most protective country does not lead to global IPR over-protection. The calibration exercise confirms that TRIPS improves global welfare.

While the above studies take the view point of global welfare, Chen and Puttitanun (2005) focus on the optimal IPR protection choice from a developing country’s point-of-view. They model the trade-off between imitating foreign technology and encouraging domestic innovation. By introducing innovation activity in the South, the optimal IPR level and economic development exhibit a U-shaped relationship. Their empirical analysis confirms this relationship.

He and Maskus (2012) allow for higher-cost Southern innovation with possible reverse spillovers to Northern firms. They found that reduced imitation resulting from strengthening IPR protection in the South is associated with greater global innovation.

In the presence of information imperfection (i.e., asymmetric information about multinational’s quality) and institutional imperfection (i.e., weak IPR protection), Che et al. (2013) show that as IPR protection improves in the South, the Northern firm’s innovation incentive exhibits an inverted-U shape.

In summary, the theoretical studies present clear trade-offs of raising IPR protection in the South in an open-economy setting. The idea that raising IPR protection in the South can always result in more innovations is not agreed by all studies. The cross-country externalities of IPR are emphasized by all papers, but the debate on what should be the optimal IPR protection is not clearly concluded.

7.2 Empirical Evidence

Although the majority of the studies in this literature (i.e., the effect of IPR on innovation and optimal IPR) are theoretical in nature, some empirical studies
have attempted to examine the IPR effects on innovation. Based on a small sample and interviews in India, Lanjouw (1998) and Lanjouw and Cockburn (2000) argue that less developed countries’ patent protection on drugs may induce more research throughout the world, on treatments for diseases that are prevalent in the developing world. Lerner (2002) examines the impacts on innovation by 177 IPR policy changes across 60 countries over a 150-year period. He finds that strengthening patent protection has few positive effects on patent applications by entities in the country performing the policy change. However, foreign patent applications in countries executing the policy changes increase.

As a complement to Lerner’s (2002) study, Qiu and Yu (2010) use cross-country, time-series data to examine the effects of foreign IPR reforms on innovation in the US. The data include successful patent applications in the US for over 33 years and major IPR reforms in 21 countries. This information is in addition to the patent reforms in the US and the TRIPS agreement of the WTO. Qiu and Yu (2010) found that the TRIPS agreement has a significant impact on innovation in the US, which highlights the importance of international cooperation in patent protection. However, the effects of strengthening patent protection by individual countries are not statistically significant. This finding seems to imply that the US market is already sufficiently large and profitable enough to provide innovation incentives in the US. Therefore, further strengthening of foreign patent protection simply increases the rents to US innovators, but not their innovation.

While most studies focus on multinational R&D activities performed in their home countries, some researchers examine their R&D investments in foreign countries, called foreign R&D. As mentioned in section 6, Branstetter et al. (2006) use detailed firm-level data of US multinational firms in their study, and show that in the process of strengthened patent regimes in developing countries, the multinational affiliate R&D expenditures and foreign patent applications experience an increasing pattern in the post-reform period.

Park (2012) uses a comprehensive microdatabase on R&D spending by US multinational firms and their foreign affiliates in developed countries. Park finds that patent protection in the South has statistically insignificant effects on the R&D of these firms. However, the patent regimes of developed countries matter significantly to the R&D of these firms. Developing countries constitute a relatively small share of the world market; therefore, variations in the patent
rights of developing economies have contributed marginally to Northern incentives for R&D.

Akers and Ecer (2009) examine the level of country-specific R&D spending by foreign affiliates of US-owned multinational companies between 1989 and 2003, as a function of whether the host country has adopted patent protection within 20 years (in general) and patent protection for pharmaceuticals (in particular). They find that providing the 20-year general patent protection has positive effects on R&D spending, but providing the specific patent protection for pharmaceuticals does not impact R&D spending.

Based on data of large European multinationals from 1996 to 1997, Belderbos et al. (2008) find that European firms make more foreign R&D investments in host countries that have strong IPR protection. Their foreign R&D investments are also affected by other factors, such as the host countries’ market competition, market size, and local knowledge pool.

While most other studies focus on innovation or R&D done by firms from the North, Chen and Puttitanum (2005) study the evidence from the South. Using data from 62 developing countries, they find that strengthening IPR protection in the South encourages Southern firm innovation.

In summary, the literature does not offer systematic evidence to support the statistical significance and positive effects of IPR protection in the South regarding the innovation in the North or the entire world. A common difficulty is accurately measuring innovation. Some studies use innovation activities, which are represented by R&D spending. In addition, others use innovation outputs, which are captured by patents.

8 Concluding Remarks

In this survey, we first set up a general framework, and subsequently discuss all papers under each branch of the framework. Our focuses are on how IPR in the South affects trade flows, FDI flows, and technology transfers from the North to the South. We also discuss papers regarding optimal IPR policies and their effects on innovations. In each branch, we divide the studies into theoretical and empirical. Some issues have been studied more thoroughly, and others have only been discussed lightly. In general, IPR protection in the past, especially before the TRIPS agreement and in developing countries, was not sufficiently strong. We also observe that strengthening IPR protection (especially in the South) helps
increase trade, FDI, technology transfers, and innovation.

However, we are far from obtaining a clear and systematic conclusion. Research in the following directions will be useful to further enhance our understanding of IPR in open economies. Firstly, we should analyze all issues (i.e., trade, FDI, licensing, and innovation) in a unified theoretical framework in which a multinational makes all these decisions. Analyzing these issues separately is likely to produce misleading results, because strengthening IPR may affect all of these frameworks in the same direction when they are considered separately. However, some forces are stronger than others, and hence, the firm may increase one activity and reduce another if they are substituted, which is mostly the case.

Secondly, a large data set is perhaps needed to conduct a more systematic empirical analysis within one model. This analysis will allow us to have better control for country fixed effects and industry fixed effects. As firm level data are becoming available, more direct evidences can be obtained.

Thirdly, more effort should be given to constructing more accurate measurements of IPR protection and enforcement in various countries and industries. When we work with country level data, we should execute a more careful job to avoid the endogeneity problem.

Fourthly, almost all existing studies exclusively focus on patent protection. Studying other types of IPR, such as copyright, trademarks and trade secrets, will be of great significance.

References


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