Examining How TRIPS Implementation Affects Access to Foreign Technologies for Developing Countries

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For my family ...
who mean
the world
to me

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Abstract

By the year 2016 every member of the World Trade Organization (WTO) has to comply with its agreement on the protection of intellectual property rights (IPR), *Trade-related Aspects of Intellectual Property Rights* (TRIPS or the Agreement). This implies that each country party to this multilateral trade agreement is obliged to institutionalize the protection of intellectual property rights (IPR) into its national framework. Developed country members have few, if any, changes to make to their legislations in order to become TRIPS compliant. Most developing country members, however, would have to make significant changes in their system to accommodate this harmonized IPR protection regime.

This thesis attempts to examine how developing countries are affected by the TRIPS implementation. In particular, I examine whether compliance with the Agreement facilitates developing countries' exposure to foreign technologies.

For the first paper, I build an index that captures fifty-three developing countries' compliance with TRIPS by consulting their Trade Policy Review and TRIPS Council review reports, cross-referencing them to their national legislations. I find that most developing countries take advantage of the transition period flexibility offered by the Agreement and that these implementation efforts are relatively independent from their income levels. In addition, countries that are party to regional trade agreements that specify TRIPS protection tend to be compliant earlier than the rest.

In the second paper, I apply the TRIPS index to three channels of accessing foreign technology: trade, foreign direct investment (FDI) and licensing activities. I find that countries' compliance with the Agreement has positive impact on FDI inflows, some on inward licensing activities but none on imports. I then argue that actual enforcement of the *in-book* TRIPS compliance is important in facilitating access to foreign technologies and include an enforcement index. This enforcement proxy is not to be confused with the statutory enforcements mandated by TRIPS itself. When enforcement of the TRIPS compliance is taken into consideration, I observe that on average TRIPS implementation and its enforcement facilitate access to the foreign technologies for developing countries, depending on their level of imitative abilities.

The last paper delves further and investigates how local firms are affected by the strengthened IPR protection in using foreign technologies. Using a unique database from the *Global Entrepreneurship Monitor* on entrepreneurship, I examine how TRIPS implementation affects local entrepreneurs' exploitation of those technologies. I find significant and adverse effects of the IPR reform, which varies according to industrial sectors and categories. The results suggest that stronger IPR protection, via TRIPS implementation, raises the cost of using the foreign technology for entrepreneurs in developing countries.

Keywords: intellectual property rights, developing countries, access to knowledge

Résumé

D'ici 2016, tout pays membre de l'Organisation Mondiale du Commerce (OMC) devront se conformer aux Accord sur les *Aspects des Droits de Propriété Intellectuelle qui touchent au Commerce* (ADPIC ou l'Accord). Cet accord requiert de chaque pays membre la mise en place d'institutions nationale en charge de protection des droits de propriété intellectuelle (DPI). Peu de changements (voire aucun) sont à prévoir dans le système législatif des pays développés. Cependant, la plupart des pays en voie de développement (PVD) devront modifier leur système de façon significative pour intégrer ce nouveau régime.

La présente thèse étudie la façon dont les PVD sont influencés par la mise en œuvre des accords ADPIC. Nous regardons plus particulièrement si cette mise en œuvre facilite l'exposition des PVD aux technologies étrangères.

Dans un premier chapitre, nous examinons les rapports des Mécanisme d'examen des politiques commerciales, ADPIC Conseil et les législations nationales de cinquant-trois PVD afin de construire un indice de conformité aux ADPIC. Nous trouvons que la plupart des PVD ont profité de la périod de transition offerte par l'Accord et que les efforts d'implémentation sont relativement indépendants du niveau de revenu national. De plus, les pays signataires d'accords commerciaux régionaux, incluant des ADPIC spécifique à la protection des DPI ont tendance à être compatible avec l'Accord plus tôt que les autres.

En appliquant cet indice à trois canaus d'accés aux technologies étrangères: commerce, investissment étranger direct (IED) et activités de licence. Nous trouvons que la conformité des pays à ADPIC a un impact positif sur les IED, un peu d'impact sure les activités de license et aucun sur les commerces. Nous argumentons que la mise en application des législation des ADPIC est plus importante pour faciliter l'exposition aux technologies étrangères et inclut un index de renforcement pour justifier ceci. Nous observons ensuite que la conciliation aux ADPIC facilite généralment l'accès aux technologies étrangères pour les PVD, selon leur niveau de capacités imitatifs.

Le dernier chapitre examine comment les entrepreises locales sont influenées par le renforcement de la protection des DPI dan l'utilisation de technologies étrangères. En utlisant une base de donneées unique du Global Entrepreneurship Monitor sur l'entreprenariat, nous examinons comments le mise en œuvre des ADPIC affectent l'exploitation des technologies étrangères par les entrepreneurs locaux. Nous trouvons des effects important et adverses de la réforme des DPI, qui varie selon les secteurs et catégories industriels. Les résultant suggèrent que le renforcement de la protection des DPI, en passant par la mise en œuvre l'Accord, augmente le coût de l'utilisation des nouvelles technologies pour les entrepreneurs des PVD.

Mot-clé: droits de propriété intellectuelle, pays en voie de développement, l'exposition aux technologies étrangères

Contents

Chapter 1

Introduction

> In a developing country like the Philippines, what are the best institutional arrangements for gaining access to the knowledge that already exists in the rest of the world?
>
> — Paul Romer (1994)
> *The Origins of Endogenous Growth*

This collection of three research papers attempts to answer the question above by investigating if strengthened intellectual property rights (IPR) via the implementation of the *Trade-related Aspects of Intellectual Property Rights* (TRIPS) agreement facilitates access to knowledge developed elsewhere for developing countries. I ask, "[D]oes TRIPS implementation help developing countries access foreign technologies?"

1.1 Access to technology

Research work on *endogenous growth theory* underscores knowledge production as the source of sustained economic growth (see Romer, 1986, 1987, 1990, 1993; Lucas, 1988; Rebelo, 1991; Aghion and Howitt, 1992; Grossman and Helpman, 1991). The AK model, as it is generally known, is based on the usual production function model:

$$Y = K^{1-\alpha} (AL_Y)^{\alpha} \tag{1.1}$$

$$A = \delta L_A \tag{1.2}$$

where Y is output, A is productivity, knowledge or ideas, K is capital, both human and physical, and δ parameterizes the efficiency of research and development (R&D). This theory argues that countries can endeavor to economically grow at a constant and consistent rate by innovating, as proxied by the R&D efficiency parameter. Therefore, any government intervention that encourages R&D would also contribute to economic growth.

Most developing countries do not have the capacity to generate new to the world knowledge and tend to be technology importers. Fig. 1.1 highlights the skewed production of innovation

in developed countries, as measured by the count of patent application and scientific journals. By accessing foreign technologies, developing countries may be able to jump past the innovation production hurdle, and experience constant economic growth à la the endogenous model. In addition, accessing foreign technologies is beneficial for developing countries because it would reduce the duplicative R&D cost of producing the technology. Thus, access this knowledge from abroad becomes important for developing countries, as underscored by the recent World Bank's annual *Global Economic Prospects* report (World Bank, 2008).

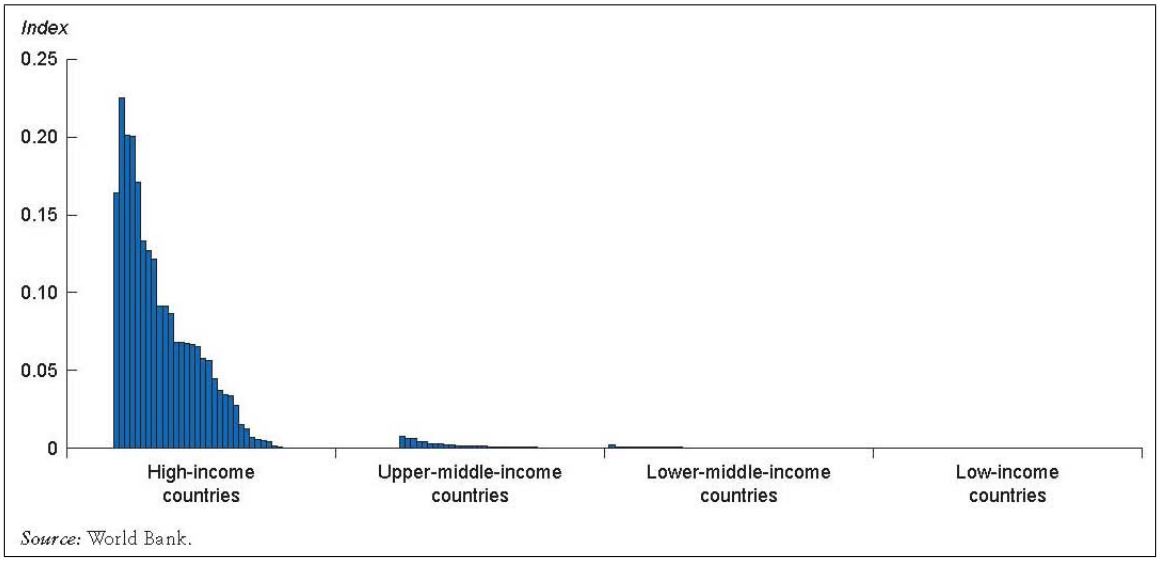


Figure 1.1: Global comparison of scientific innovation and invention across income levels

For developing countries, accessing foreign technology is only a partial solution to rectifying its lack of capacity to generate sufficient innovation levels. A much more crucial matter is the spillover generated from these technologies, in particular *knowledge spillovers*.[1]

East Asian countries such as Japan, South Korea and Taiwan are examples of countries that experienced knowledge spillover when they were exposed to foreign technologies. This exposure enabled them to develop their innovative capacities through learning by doing and by using the foreign technologies (Kumar, 2002). By reverse-engineering the foreign goods acquired, these countries were able to access the technologies embodied in them to enrich their pool of knowledge, which eventually led to their technological competitiveness in the global market. But developing countries are not the only ones who "borrowed" new technologies from abroad. Historically, European countries and the United States engaged in this "borrowing" undertaking as well, as pointed out by Rosenberg (1994) and Granstrand (1999).

Research evidence show that countries have been able to *free ride* on technologies developed elsewhere, assimilate and exploit these foreign technologies to improve their economic activities

[1]Knowledge spillover takes place when firms can partake in the benefits of R&D expenditure exerted by an innovative firm without sharing the R&D costs that the innovative firm incurred. This externality is possible because of the *non-excludability* and *non-rivalry* traits of knowledge. See Branstetter (1998) for a good differentiation between spillover types, and how they relate to endogenous growth. Branstetter refers to Griliches (1992) to help explain the importance of *knowledge spillover*, Griliches' *non-pecuniary spillover*, to economic growth.

(see Granstrand, 1999; Rosenberg, 1994). This *free riding* does not bode well for social welfare. Arrow (1962) convincingly argues that under perfect competition, the level of knowledge production is well below social optimal level. He pushes for the institutionalization of incentive mechanisms that would encourage this production. An example of such mechanism is the government sanctioned monopoly rights grant of IPR protection; of which patent policy is the most controversial.

1.2 IPR protection

Machlup and Penrose (1950) lists four justifications for patent protection in the nineteenth century: (i) inventor's natural right to protection of her invention; (ii) fairness to ensure the inventor's just reward for the invention, (iii) encouragement to innovate; and, (iv) means to induce disclosure of the invention. Patent protection accords a temporary marketing monopoly to the inventor in exchange for the disclosure of that knowledge. Debate on these lines of thought, the assertions and assumptions echo today in discussions of the scope and breadth of patent protection as well as the overall contention of patent as an effective means of providing incentive to innovate.

Scholars are still uncertain as to the importance and appropriateness of patent protection in encouraging innovation even if more information is being gathered on the subject matter. Mansfield (1985) finds that even with patent protection 60% of innovations are imitated within four years of their commercialization. Foray (2004) argues that industries that face high R&D costs, imitation and reverse engineering is widespread and the final cost of production manufacturing is low can benefit from patent protection. The pharmaceutical and chemical dye industries are prime examples of where patent protection have been important for innovation in the field (Mansfield, 1986).

But for some other industries patenting is more of a strategic behavior (Cohen et al., 2000; Hall and Ziedonis, 2001). Furthermore, patent protection makes it more difficult and costly for follow-on innovations (Scotchmer, 1996). However, even if patent protection is questionable as a mechanism to generate innovation, my interest in it is whether this appropriability regime facilitates developing countries' access to foreign technologies.

Developing countries have been exposed to foreign technologies because of globalization (Archibugi and Pietrobelli, 2003a). Relatively open trading regimes and progress of the information and communication technologies (ICT) have increased the speed with which new technologies are diffused across the globe. Some developing countries have taken advantage of this globalization force, and under weak IPR regimes, have accessed, assimilated and adapted new technologies to their local markets as in the case of Taiwan and its local entrepreneurs (Yu, 1998). A telling tale of how imitation of foreign technologies can help developing countries is in the case of Romania and the development of its technology industry. The Romanian president Traian Basescu jokingly announced to Bill Gates in February 2007 that pirated versions of Gates' Microsoft software helped build Romania's technology industry (see Zoeller, 2007).

The emergence of rivals from countries with weak appropriability regimes pose significant risk for innovators of new technologies, especially when these innovators target consumers in foreign markets. Competitors' blatant imitation of the new technologies reduces the innovators' returns to innovation and creates tension in the global market for trade in technological goods. Industries adversely affected by the weak global IPR protection heavily lobbied their representatives to address the matter. This successful lobbying, in addition to the tradeoff developing countries managed to negotiate during the Uruguay Round of negotiations, led to the inclusion of an agreement setting the international standard for IPR protection known as the *Trade-related Aspects of Intellectual Property Rights* (TRIPS) agreement.

1.3 TRIPS & developing countries

In 1973 Edith Penrose wrote an article in *The Economic Journal* discussing the merits of adopting the international patenting agreement known as *Convention of the Union for the Protection for the Protection of Industrial Property.* She was unable to conclusively determine whether the protection of IPR was beneficial or costly for developing countries (Penrose, 1973).[2] Developing countries tend to be technology dependent. As such, Penrose was cautious to point out that developing countries would gain little, if nothing, from its implementation. But she acknowledges that IPR protection may be important for the few inventors in these countries.

Despite Penrose's argument against global IPR protection and because of the nature of international negotiations, most of the developing countries today have to implement the TRIPS agreement. TRIPS is part of a package of agreements concluded from the Uruguay Round of negotiations in 1995, administered by the World Trade Organization (WTO) in Geneva, Switzerland. It is the first multilateral attempt at setting an *enforceable* minimum IPR protection for its member countries. Its main objective is to reduce the legal uncertainty in the multilateral trading framework and enable cross-border trade in IPR-sensitive goods, securing investments of these goods which are directed toward global markets.[3]

Previous empirical studies provide evidence that strengthened IPR protection increases countries' access to foreign technology through trade (Smith, 1999; Fink and Braga, 1999; Maskus and Penubarti, 1995; Rapp and Rozek, 1990), encourage inflow of FDI (Park and Lippoldt, 2007; Javorcik, 2004; Lee and Mansfield, 1996; Seyoum, 1996) and licensing activities (Wakasugi, 2007; Co, 2007; Yang and Maskus, 2001), with a few notable exceptions such as the findings by Kondo (1995) and Ferrantino (1993).[4] However most of these studies overlook one important factor in their analysis of the effect of strengthening IPR protection: the level of IPR protection in the

[2]This international convention was administered by the United International Bureaux for the Protection of Intellectual Property (BIRPI) in Geneva, Switzerland and has been replaced by the World Intellectual Property Organization (WIPO).

[3]Ironically in the nineteenth century free traders in Germany were the main opposers of the IPR protection, condemning the patent laws because it restricted their trading activities (Machlup and Penrose, 1950, p.4).

[4]There is also abundant literature on the effects of patent system on innovation and innovative activities. However this branch of research investigation focuses more on how IPR protection facilitates domestic innovative activities, whereas throughout this paper I focus on accessing foreign technologies. Consult the paper by Hall (2007) for a good overview of the state of the art on this subject.

countries studied are endogenously determined by the countries' economic environment (North and Thomas, 1970; Landes and Posner, 2004).

Countries with high levels of IPR protection tend to have high levels of economic development (Rapp and Rozek, 1990). And countries with high levels of economic development also tend to have high innovative capacities. Thus if we link levels of IPR protection to levels of innovative capacities, then further strengthening of these countries' IPR protection level possibly generates more innovation outputs as measured by patent applications and scientific literature.

But will the result that strengthened IPR protection lead to increased access to foreign technologies still hold if the level of IPR protection is no longer endogenously determined? Putting it differently, will developing countries' implementation of the TRIPS agreement, regardless of their levels of economic development, facilitate access to foreign technologies?

1.4 Research

My three papers examine whether developing countries' implementation of their TRIPS obligations increases their exposure to foreign technologies. In the first paper I build an index that captures countries' compliance with TRIPS by examining these countries' TRIPS review reports and their national legislations. Then I apply the index to three channels of accessing foreign technology: trade, FDI and licensing activities to investigate how TRIPS compliance influences these channels of access for the second paper. And in the last paper, I examine how implementation of the TRIPS agreement affects exploitation of foreign technologies by entrepreneurs in developing countries.

The first paper builds an IPR index based on the TRIPS agreement for the period 1994 – 2007. Unsatisfied with the available IPR indexes available, I consult national IPR legislations, various IPR-specific reports, and legal experts and practitioners, whenever possible, to construct the index for 53 developing countries. Analysis of the data shows three implementation trends. Firstly, almost all developing countries take advantage of the transition period clause of the Agreement (Art. 65), and in some cases exceed the TRIPS implementation deadline for developing countries, 2000. Secondly, implementation efforts of developing countries vary, and not necessarily because of their income levels. Lastly, countries in regional trade agreements (RTAs) that include IPR obligations tend to comply with TRIPS earlier than the rest. The results confirm that the TRIPS agreement leads to a convergence of global IPR protection across countries. It also makes the case that the Agreement's implementation is an external factor, neither strongly influenced by the country's level of economic development nor by its level of innovation capacity. This index can be used as a natural experiment to understand how IPR influences economic activities and behaviors.

The result of paper one illuminates how the TRIPS agreement changes the global IPR landscape. Countries with weak innovative capacities now find themselves enforcing strong IPR protection. This juxtaposition of full TRIPS implementation and weak capacity to innovate is likely to create an economic problem. These countries may find that the cost of implementing

and enforcing the IPR protection is higher than its benefits, especially in the short run. For example, the increase in patent applications registered by their national patent offices may reflect increase in foreign patenting rather than increase in innovative activities produced by the country.

In my second paper I endeavor to apply my newly built index on developing countries' exposure to foreign technologies. Controlling for country-specific factors, I find that developing countries' compliance with the TRIPS agreement increases access to foreign technology through foreign direct investment (FDI) and licensing. When I include an enforcement term to proxy for actual enforcement of the TRIPS obligations, I observe significant impact of the TRIPS implementation on all three channels of access to foreign technologies which varies according to their imitative abilities.

The last paper examines how TRIPS implementation affects exploitation of foreign technologies. Using the Global Entrepreneurship Monitor (GEM) database on entrepreneurship, I find significant and adverse effects of TRIPS. The level of impact changes according to the industrial sectors and categories of the entrepreneurial activities. The results show that stronger IPR protection, via TRIPS implementation, raises the cost to using new technology by the entrepreneurs in developing countries. I suggest that TRIPS' negative effect on the exploitation of foreign technologies in developing countries may be attributable to the higher cost of acquiring them.

The two papers above, paper two and paper three, are complementary and give us a better understanding of how TRIPS influences the diffusion of foreign technologies in developing countries. Most empirical literature that analyze issues related to IPR reform only consider the access to foreign technology problem but stop short of investigating how local firms are affected by this change. In short, these literature may give an over-optimistic view of the current situation.

Chapter 2

How compliant are developing countries with their TRIPS compliance?

2.1 Introduction

Arrow (1962) underscores the importance of having an incentive mechanism that would encourage innovative activities, one of which is the government sanctioned monopoly rights of intellectual property rights (IPR) protection. He argues that market failure of knowledge production justifies the institutionalization of such mechanism, encouraging activities that generate positive spillover effects. The *demandeurs* of the *Trade-Related Aspects of Intellectual Property Rights* agreement (TRIPS, or the Agreement) during the *Uruguay Round* of negotiations have contended that the lack of IPR protection in some countries hinder the free flow of goods and services worldwide, and so have pushed for global IPR protection. However research on examining the relevance of having IPR protection produce inconclusive results. Evidences compile on how IPR protection, in particular the patent system, impacts innovation (Lerner, 2002; Baldwin et al., 2001; Kortum and Lerner, 1998; Mansfield et al., 1981), innovative activities (Qian, 2008; Kanwar and Evenson, 2003; Sakakibara and Branstetter, 2001; Varsakelis, 2001; Park and Ginarte, 1997; Mansfield, 1994), composition of those activities (Moser, 2005; Mansfield, 1993), sequential innovation (Bessen and Mashkin, 2006; Green and Schotchmer, 1995), trade (Smith, 1999; Maskus and Penubarti, 1995; Ferrantino, 1993), foreign direct investments (Javorcik, 2004; Lee and Mansfield, 1996; Mansfield, 1994) and welfare (Falvey et al., 2006; Thompson and Rushing, 1999; Deardoff, 1992; Rapp and Rozek, 1990).[1] The results of these studies show mixed assessments on the impact of IPR protection on domestic economic activities. In sum,

[1]For a good overview on how patent system affects innovation see Hall (2007).

researchers have been unable to clearly establish causal relationship between IPR systems and economic development (Granstrand, 1999).

The advent of TRIPS and the near-universal influence of this global IPR system necessitates careful scrutiny of this Agreement on developing countries' economic activities. This paper builds a TRIPS-compliant index to serve this purpose by tracking developing countries' compliance with this multilateral agreement. I examine the national legislations, various IPR-specific reports and consult practitioners and legal experts, wherever possible, to achieve this goal. My research focuses on original member countries of to the World Trade Organization (WTO) who have acceded in the year 1995, and tracks how the IPR regimes in these countries change in-line with their TRIPS obligations.

Analysis of the data shows three implementation trends. Firstly, almost all developing countries take advantage of the transition periods clause of the Agreement (Art. 65), and in some cases have exceeded the TRIPS implementation deadline for developing countries, the year 2000. Secondly, implementation efforts of developing countries vary, and not necessarily because of their income levels. Lastly, countries in regional trade agreements (RTAs) that include IPR obligations tend to comply with TRIPS earlier than the rest. The results confirm that the TRIPS agreement leads to a convergence of global IPR protection across countries. It also makes the case that the Agreement's implementation is an external factor, not entirely influenced by the country's level of economic development.

The lack of endogenous attribution of IPR level to economic development and convergence of global IPR across countries lead to the possibility of using this index as a natural experiment to understand how IPR influences economic activities and behaviors.

The rest of the paper is structured as follows. Section 2.2 provides an overview of available IPR indexes and argues in favor of a new TRIPS-compliant index. Section 2.3 describes how implementation of the TRIPS agreement changes the global IPR landscape. Section 2.4 explains how the index is constructed and discusses some drawbacks of the index. The penultimate section analyzes the results of the data collected on various IPR legislations and the final section concludes with a brief discussion.

2.2 IPR quantification

Quantification of IPR systems through an index is an imperfect method to capture the variances in IPR legislations across countries. However these indexes provide means to investigating

whether and to what extent IPR regimes explain variations in economic activities across countries.

This section underlines the need for a TRIPS-specific IPR index and discusses how currently available IPR indexes are unsatisfactory to use in studying the impact of TRIPS implementation on economic activities. I also provide an overview of some IPR indexes in detail as a few of them are used to construct the new TRIPS-compliant index in Section 2.4.

2.2.1 Need for TRIPS index

Most of the available IPR indexes are not TRIPS specific and thus fall short of my expectation to properly examine the effect of the Agreement's implementation on economic activities. The following paragraphs elaborate the reasons why.

TRIPS identifies seven categories of IPR and outlines the respective scopes and depths of protection, while the available indexes mainly focus on patent protection. If the purpose of a study is to examine the impact of IPR protection on pharmaceutical research and development (R&D), or on licensing of patented products of process, then using a TRIPS updated patent index is sufficient. However, solely focusing on patent protection ignores other IPR categories that could influence innovative activities in various sectors of the economy. For example, in most developing countries computer software is protected as literary works under copyright of TRIPS and not necessarily under patent, while circuit board is covered by layout designs of integrated circuits. In some countries, computer software and/or layout designs of integrated circuits may be patentable.

Furthermore, the services sector produces intellectual creations that usually fall outside the scope of patentability. A case in point, trademark and geographical indication protect the brand of the goods produced while copyrights protects expressions of ideas. In addition, protection of trade secrets as an IPR may be a significant factor in explaining certain types of economic activities, in concordance with the results from the famous Yale survey (Cohen et al., 2000). Therefore current emphasis on capturing patent strength relevant for activities of patent-specific industries such as pharmaceutical and chemical industries are at the expense of industries that do not rely on patent for protection of their intellectual property, limiting the scope of research to patentable economic activities.

The implementation of the seven IPR categories identified by TRIPS is usually staggered across different years. Use of the transition periods, legislative procedures, budget, expertise and

other constraints influence the implementation times of any one of the IPR types. Thus, indexes that attempt to capture TRIPS implementation effort by using WTO membership as proxy, disregarding the transition periods given to developing countries, would incorrectly identify the date when the Agreement takes full effect. This is similarly applicable to indexes that do take into consideration the transition periods accorded by the TRIPS agreement as they may overestimate the implementation efforts of the countries if they use the transition deadline dates rather than examining the national legislations themselves. Case in point, countries in this study are WTO members since 1995 and yet most of them only begin to fully comply with their TRIPS provisions from the year 2000 onwards.[2] However, there are some countries that are not fully compliant with their obligations, missing the year 2000 mark. Jamaica is a prime example of member countries that has not managed to reach full TRIPS compliance by the deadline imposed.

No international IPR agreement is as enforceable as the TRIPS agreement. The Paris and Berne Conventions set the standards for IPR protection worldwide. However they are considered weak because of the lack of proper enforcement of these agreements at the international level. Members of the TRIPS agreement, on the other hand, have recourse to the WTO's effective dispute settlement proceedings, thus allowing any one member to ensure that another member is fully compliant with its TRIPS obligations. In the dispute case *India—Mailbox*, the United States complained that India had not established the *mailbox filing system* from the 1st January 1996, inconsistent with its obligations under Art. 70.8 and 70.9 of the TRIPS agreement (WTO, 1997).[3] The appellate body found in favor of the United States and required India to enact the *mailbox filing system* retroactively. Therefore, IPR indexes that use membership to pre-TRIPS international IPR agreements as proxy IPR systems should be used with caution; particularly because the implementation and the enforceability of the international IPR agreements may differ significantly from country to country. Section 2.3 elaborates on this further.

Diverse coverage of IPR categories, bindingness of the Agreement and staggered implementation dates of the TRIPS agreement by developing countries allow for a natural experiment, investigating how this global minimum IPR standard may affect economic activities in these countries. Thus, a new TRIPS-specific index is required to properly study whether this inter-

[2]The year 2000 is the TRIPS implementation deadline established by the Agreement for most developing countries.

[3]Under the *mailbox* system, a mechanism is set up to allow for the filing of patent applications of pharmaceutical or agrochemical products. The patent application would be reviewed from the date on which patenting in the field of pharmaceutical and agrochemical products are allowed. Once an application is subject to the mailbox application and it has obtained marketing approval then that product will be granted exclusive marketing rights (EMR) for five years, a right that is similar to patent protection (Watal, 2001).

national agreement affects local economic activities in developing countries.

2.2.2 Available IPR indexes

Most available IPR indexes are built through a set of criteria that establishes an *ideal* or *adequate* IPR legal system. Based on how these criteria are satisfied, I classify the indexes according to three types: legislation- and survey-based approaches, and combination of the two. When the criteria are satisfied via examination of the country's rules and regulations, I refer to them as legislation-based, while those that require the responses of experts are categorized as survey-based. Each of these approaches, on its own, has its weaknesses. The legislation-based approach is criticized for overestimating the level of protection accorded because it does not take into consideration the actual enforcement of those rights.[4] On the other hand, the survey-based approach can be subjective, relying on the way the questions are posed and possibly reflecting some "ideological tendencies" as mentioned by Kauffman et al. (2004). Using a combination of the two approaches of building an index through examination of countries' IPR legislations and interacting with expert assessment of actual enforcement of the IPR law would rectify the weaknesses in either one of the approaches, legislation- and survey-based.

Gadbaw and Richards (1988) constructs the first legislation-based patent index, which is extended by Rapp and Rozek (1990). This type of index construction notes whether a country's IPR legislation is in conformity with the minimum standards of IPR as proposed by the U.S. Chamber of Commerce Intellectual Property Task Force (1987), ranging from 0 (absence of IPR protection) to 5 (full compliance with the minimum standards). Rather than focusing on national legislations, Ferrantino (1993) builds an index using membership in World Intellectual Property Organization (WIPO) basic conventions as an input measure of IPR strength for 75 countries. Later, Ginarte and Park (1997) produces the most widely used IPR-index to date, basing their index on collection of both national patent legislations and membership to international IPR conventions. The index covers large number of countries over the period 1960 — 1990 and allows for variations in cross-country patent laws, making it desirable for cross-country studies (Maskus, 2000). Criteria to measure the strength of a country's patent regime are: (i) membership in international treaties, (ii) extent of patent coverage, (iii) restrictions on patent rights, (iv) enforcement and (v) duration of the patent protection. In 2008, Park (2008) updates the Ginarte-Park index to include TRIPS membership and extends its country and

[4] I use the term "actual enforcement" to refer to the country's practice of protecting their IPR rules. For example, a country may have strong IPR legislation but lack the budget or political will to ensure that its IPR is fully protected. Here, I refer to means that the government can fully enforce, e.g. custom control of pirated goods. Other means of enforcement, such as the injured party taking the possible violator to court is not considered here; this is a case between private parties and thus outside government control.

year coverage. Lastly, Park and Lippoldt (2007) uses two indexes, in addition to the patent index by Park (2008), on copyright and trademark to investigate the economic impact of these IPR types. These two IPR categories of copyright and trademark follow similar set of rules as those set in Ginarte and Park (1997) such that they cover issues related to coverage, usage, enforcement and membership to international IPR treaties but are specific to copyrights and trademark respectively.

Lee and Mansfield (1996) conducts the first survey-based IPR index. The survey asks 100 major U.S. multinational firms how a country's IPR regime affects its investment strategy in the host country, i.e. transfer of technology to wholly owned subsidiaries, investment in joint ventures with local partners or licensing of technology, and averages the responses for 14 developing countries. Seyoum (1996) builds a similar survey-based index but bases his questionnaire on the U.S. Chamber of Commerce (1987) guidelines, and later sends them to IPR experts or practitioners in 27 countries. These indexes were oftentimes for a specific and limited time period, making it difficult to asses the dynamic impact of IPR protection. The ongoing surveys on the strength of IPR across different countries by the World Economic Forum (WEF) and the IMD correct this time limitation problem. The WEF questionnaire asks market participants of both developing and developed countries a question on the strength of IPR protection in their respective countries. It queries, "Intellectual property protection in your country is: (1=weak or non-existent, 7=equal to the world's most stringent)" to professionals residing in those countries. The result of the survey is published in their annual *Global Competitiveness Report*. The IMD questionnaire, on the other hand, inquires whether IPR "are adequately enforced" to senior business leaders in those respective countries, ranging from 1 to 10 with 10 being the highest achievable score.[5] These survey-based indexes capture the perceived IPR strengths of countries but are highly subjective to the questions posed and the experts selected.

The problems associated with the legislation- and survey-based indexes may be addressed by using the two approaches together, as Kondo (1995), Sherwood (1997), Ostergard (2000) and Javorcik (2004) have done. Kondo builds his index on a similar criteria as Ginarte and Park (1997) but weights each subcomponent of the patent regime using results from market practitioners' input on the enforcement level. Sherwood (1997) probably offers the most extensive coverage in determining the strength of nations' IPR regime by examining issues of copyright, patents, trademarks, trade secrets, life forms in addition to enforceability, administration, public commitment and international treaties signed of the IPR regime. However, his IPR index only covers 18 developing countries and the weights assigned to the components of IPR regime are

[5]A simple Pearson pairwise correlation shows that the IMD and WEF survey results are strongly correlated.

based primarily on his personal knowledge and personal interviews with professionals from those countries. Ostergard (2000) examines the legislations of patent, copyright and trademark laws using the US Chamber of Commerce's guidelines and supplements this legislative information with enforcement assessment from the US State Department's *Country Reports on Economic and Trade Practices.* Javorcik (2004) builds on the Ginarte and Park (1997) index but adds the element of enforcement by accounting for countries that have been flagged by the United States' *Special 301* as countries that have weak IPR regimes. Lastly, Lesser (2002) constructs an index using secondary data to build a TRIPS compliant patent-specific index, and adds an actual enforcement component captured by the Transparency International's *Corruption Perception Index* (CPI). He then runs factor analysis to determine the importance of each criterion and weighs each of them in his construction of the IPR index by the aggregate factor values. He further cross-references the criterion with responses from a survey sent to patent attorneys and licensing executives of agricultural and pharmaceutical firms in the United States and Europe.

Table 2.1 on page 15 summarizes the three approaches to constructing IPR indexes. It highlights the different IPR categories captured by the indexes, the international agreements under consideration, whether the indexes have an actual enforcement component, country and years coverage, update frequency and the index sources. The legislation type indexes, Park (2008) and Park and Lippoldt (2007), are mainly built on the countries' IPR rules and regulations.[6] The survey type indexes, Lee and Mansfield (1996) and Seyoum (1996), emphasize the expert opinions over the countries' legislations. And lastly, the indexes that include both legislation- and survey-approaches, Ostergard (2000) and Lesser (2002) utilize both the countries' legislations and actual enforcement to construct indexes that capture both the legal rules and the enforcement of those rules.

The table shows how the IPR indexes available today fall short of capturing IPR legislative changes due to the TRIPS agreement. The indexes here neither cover all seven IPR categories nor the different time periods of implementation for each of the IPR types. Park and Lippoldt (2007) and Lesser (2002) come close to capturing TRIPS elements in their indexes. However Park and Lippoldt (2007) falls short of being TRIPS-compliant mainly because it covers three of the seven IPR categories set by TRIPS and double-counts the importance of international treaties. The TRIPS agreement references both the Paris and Berne convention and incorporates main elements of those treaties. Therefore tracking a country's membership of both the Paris and Berne convention in addition to the TRIPS agreement is redundant. Lesser (2002) on the other

[6]Park and Lippoldt (2007) includes an actual enforcement component,however this enforcement component is used as a separate explanatory variable from the IPR indexes.Thus, I consider the indexes discussed in this paper as only legislation-based.

hand, focuses solely on the implementation of patents at the expense of other IPR categories for the year 1998, making it difficult to study the dynamic impact of this Agreement. Aside from the coverage of IPR categories, the time period coverage in the cases of Park (2008) and Park and Lippoldt (2007) are relatively comprehensive. However their data is updated every 5 years, disregarding the possibility that most of the legislative changes may occur within those years, especially within the years 1995 – 2000.

Other attempts at capturing TRIPS are undertaken by Musungu and Oh (2006), and Thorpe (2002). Both papers aim to study the use of TRIPS flexibility by developing country members. Musungu and Oh (2006)'s paper focuses on the public health issue and thus considers patent-related information only. Thorpe (2002)'s research is more exhaustive in that he surveys different countries in different regions and analyzes the patent, copyright and related rights, and undisclosed information. Unfortunately these study papers only examine the current legislations in force, not distinguishing between legislations that are TRIPS-compliant and those that are not, exclude the exact date of TRIPS-compliant legislations implementation, and omit other TRIPS relevant IPR categories in their studies.

A useful TRIPS index should capture the seven IPR categories as the Agreement states and note the different implementation time periods per IPR category over several years, to allow for a dynamic assessment of the Agreement's influence. In Section 2.4.1 I build a TRIPS-specific IPR index that attempts to address these concerns. But prior to building the index I detail how TRIPS differs from previous international IPR agreements to emphasize how TRIPS changes the global IPR landscape in the following section.

Table 2.1: Summary of available IPR indexes

	Legislation		Survey		Both	
Dimensions	Park (2008)[1]	Park & Lippoldt (2007)[2]	Mansfield (1994)[3]	Seyoum (1996)	Ostergard (2000)	Lesser (2003)
Copyright		x		x	x	
Trademark		x		x	x	
GI						
Patents	x		x	x	x	x
Layout designs of IC						
Undisc. info				x		
Int'l agreements	TRIPS, Paris, PCT, Budapest & UPOV	TRIPS, Paris, Berne, Rome, UCC[4] '52 & '71, Brussels, Madrid, Nice, Lisbon, Vienna & Trademark				TRIPS, Paris, PCT & UPOV
Enforcement[5]		WEF[6]	x		USTR report[7]	CPI[8]
Countries	122	120	14[9]	27	76	44[10]
Time	1960—2005	1990—2005	1991	1975—1990	1988—1994	1998
Data type	every 5 years	unsure	one year	averaged	every 3 years	one year
Source	Nat'l legislation	Nat'l legislation	US manufacturing firms survey	IPR experts survey[11]	Nat'l legislations & USTR reports[12]	TRIPS document, CPI & survey

[1] Update of the Ginarte and Park (1997) index.
[2] Paper refers to 3 separate IPR-indexes, one of which includes the patent index of Park [2008] - omitted here because covered in the second column of this Table.
[3] Questionnaire on IPR related to technology transfer, joint venture and licensing decisions.
[4] Universal Copyright Convention.
[5] Refers to enforcement measures outside "in-book" compliance.
[6] World Economic Forum's IPR survey index, but in regressions there are no interactions between the IPR indexes with the WEF's IPR survey.
[7] Previously known as US State Department's *Country Reports on Economic and Trade Practices*, now USTR *National Trade Estimate Report on Foreign Barriers*.
[8] Transparency International's Corruption Perception Index.
[9] Developing countries only.
[10] Ibid.
[11] Questionnaire based on guidelines of the U.S. Chamber of Commerce (1987).
[12] Refer to footnote 7 above.

2.3 Change in global IPR landscape

TRIPS agreement changes the global IPR landscape, harmonizing and setting the minimum level of protection for intangible goods and services. It identifies seven IPR categories: (i) copyrights and related rights, (ii) trademark; (iii) geographical indications; (iv) industrial designs, (v) layout designs of integrated circuits, (vi) patents, and (vii) undisclosed information, above and beyond the pre-TRIPS international IPR conventions. For each of these categories, the WTO principles of most-favored nation (MFN) and national treatment basis are applicable, unlike when reciprocity was a principle for extending IPR protection to foreigners.[13] TRIPS' enforceability at the multilateral level due to the effective dispute settlement mechanism of the WTO presents a credible threat for countries to comply with the obligations (Watal, 2001; Gervais, 2003). Therefore, the harmonized scope of IPR protection and its enforceability would lead toward convergence of IPR regimes across developing countries. Furthermore, this convergence should be relatively independent of the respective countries' economic development because of the implementation deadlines imposed.

2.3.1 Pre-TRIPS

National IPR landscape prior to the TRIPS agreement seemed more flexible, with countries implementing the IPR provisions when it was in their national interest. Prior to the TRIPS, Hong Kong, Singapore, South Korea and Taiwan had enforced "soft" IPR regimes, enabling themselves to adopt, adapt and assimilate technologies from developed nations (Kumar, 2002). Some of the other developing countries were more inclined to copy the IPR systems of their former colonial rulers than build a system suitable for their economic conditions. For example, South Africa, Kenya, Zambia, Namibia, Swaziland and Morocco had a few TRIPS compliant legislations before the WTO agreement was signed in 1995. However, enforcement of these IPR legislations were oftentimes weak because of limited resources and/or lack of political will. As a consequence there was a noticeable and significant relationship between the extent of IPR protection and level of economic development, whereby higher income countries provided more IPR protection than lower income countries (Evenson and Westphal, 1997). The World Bank (2001) report concurs with (Evenson and Westphal, 1997) and adds that IPR regimes also tend to be stronger when the country has high innovation capacities.[14]

[13] MFN and national treatment are principles of the WTO trading system. Simply put, MFN rule obliges each member country to treat every one of its trading partner as its closest partner, while national treatment policy requires that every foreign trader should be treated like a local one.

[14] The term "innovation capacities" refers to the country's ability to produce innovation, usually proxied by the proportion of R&D per domestic production, ratio of science and engineers of the country's labor population, and so on.

Patent protection is an area of IPR where the international agreement governing industrial policy, the *Paris Convention for the Protection of Industrial Property*, (Paris Convention) accords considerable policy room for developing countries to apply the rules according to their country's level of economic development, or to meet specific industrial policy. India used to protect process and not product patenting of pharmaceutical products, thus creating a legal condition for local pharmaceutical companies to produce generic versions of branded drugs. Surveying the IPR regimes in a selected number of countries, a WIPO submitted document to the WTO show that only three of the 42 developing countries studied had patent protection for the duration of 20 years, notably South Africa, Zimbabwe and Nigeria (WIPO, 1988). In addition, exclusion of patent protection in areas such as life forms, pharmaceutical and agriculture chemical products, and computer programs were norm, as they depended on each country's perception of patentability. TRIPS agreement has broadened the scope of protection conferred to patented inventions by: (i) protecting process *and* products; (ii) applying this to all technological fields; and (iii) setting a minimum duration of patent protection. However, strengthening patent protection is not the only change that TRIPS has imposed on developing countries.

2.3.2 Modification in IPR protection

Main multilateral IPR agreements and the practices during the negotiations of the *Uruguay Round* shaped the language and rights of members of the TRIPS agreement. These agreements were the Paris Convention governing industrial property and trademark, *Berne Convention for the Protection of Literary and Artistic Works* (Berne Convention)and *Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations* (Rome Convention) on copyrights and related rights. A then-recent international agreement on integrated circuits, the *Washington Treaty on Intellectual Property in Respect of Integrated Circuit* (Washington Treaty or the IPIC treaty), is also included in the text of the Agreement. TRIPS merges the scope and breath of protection outlined in these agreements as well as the practices related to the implementation of these conventions and formalizes them under one umbrella. Thus obligating members of the WTO to comply with relevant provisions of these agreements, even if they were not formerly signatories to the agreements aforementioned. The new obligations imposed by TRIPS narrows the policy room for many developing countries to tailor their IPR systems according to their development needs.

Patents

Paris Convention extends patent protection to both product and process in all fields of technology. Furthermore, it allows member countries to determine their own standards of protection in regards to duration of protection, patentable subject matters and exceptions to patent rights as long as the principles of national treatment is consistently applied. TRIPS incorporates the substantive elements of Paris Convention on patent protection but curtails the flexibility accorded. All WTO members have to ensure that the duration of patent protection is set at 20 years from date of patent application filing, instances in which suspension of the protection could be invoked are limited, exceptions to subject matters excludable from patenting are clearly defined, and patentees rights are extended to include associated rights of offering for sale or importing.

In general TRIPS' provision on patent protection is applicable to both product and process inventions for all technological fields except for certain subject matters that are considered public goods, biologically occurring products and processes of plants or animals, and any methods for treatment of human or animals. Plant varieties are protected either under patent or by an effective *sui generis* legislation. A transition period of five years from the date of TRIPS enforcement deadline, 1st January 2000, is given to developing countries that have not provided patent protection in any area of technology prior to the general enforcement date of the Agreement, 1st January 1996.[15] Specifically, developing countries that have not provided protection for pharmaceutical and/or agricultural chemical products prior to 1st January 1995 are required to set up a *mailbox* system of patent application and provide exclusive marketing rights (EMR) from the 1st January 1996 (TRIPS Art. 70.8).[16] Failure to comply with this provision implies non-compliance with the agreement even when developing countries are accorded transition periods to phase in the TRIPS-compliant IPR regime (see WTO (1997)'s *India—Mailbox* dispute).

Undisclosed information

Undisclosed information was not formally considered a category of IPR protection until the TRIPS agreement.[17] It was oftentimes protected by general civil law or tort, contract and/or criminal laws. At the international level reference to its protection was mandated by Art. 10*bis* of the Paris Convention particularly vis-à-vis unfair competition, whereby the information is

[15]For LDCs this implementation period is extended to 1st January 2016 because of the Doha Ministerial Declaration.

[16]Under the *mailbox filing system* rule, WTO members that did not allow for patenting of pharmaceutical and/or agricultural chemical products previously had to establish a filing system for these products.

[17]Also referred to as "trade secrets", "confidential information" and the like in many national laws. The term "undisclosed information" was purposely chosen by negotiating parties of the Uruguay Round to avoid referring to specific expressions of any legal system (Gervais, 2003).

safeguarded from misappropriation in an unauthorized manner. During negotiations, developing countries did not recognize undisclosed information as an IPR category and were against its inclusion. They argued that extending protection to this subject matter would push their obligations beyond patent protection because of the limitless term of protection accorded to this category and the absence of disclosure tradeoff for protection, unlike patents (Watal, 2001); but it was included nevertheless. TRIPS underscores the importance of undisclosed protection by setting it as an IPR category and extending it to include data submitted to governments for marketing approval of pharmaceutical and agricultural chemical products.

There are two parts to protecting undisclosed information under the agreement: the general need to protect information that is secret and valuable, also known as trade secrets, and the requirement to protect information disclosed for marketing approval from the government. Trade secrets is defined as information which was generated from a specific investment, considered valuable, known to few people in the industry, and where effort has been undertaken to maintain its secrecy. As for data submitted to governments for marketing approval, the data has to be undisclosed, the product tested to generate the data uses "new chemical entities", and "considerable effort" has to be spent to produce the data. These information are protected for as long as they are not revealed by the owner or an independent third party.

The implementation of TRIPS Art. 39.2 on trade secrets is likely to be straightforward, since many have already provided protection for this category. But the differing interpretations and implementations of Art. 39.3 on data submitted to governments and their respective agencies could lead to varying treatments of protection of data submitted for marketing approval across WTO members. Firstly, it is unclear if protection under this IPR category requires "exclusive rights" protection. If the protection mandates exclusive rights protection, then the common practice in developing countries of allowing for the sufficiency of establishing bioequivalence for generic drugs with the original test data would no longer be acceptable for a given time period. Secondly, the ordinary reading of Art. 39.3 could be interpreted as mandating protection only to "new chemical entity" implying that new uses of existing chemical product would not be covered, which can be controversial for some other member countries such as the United States (Correa, 2002).

Copyrights and related rights

The Berne Convention was the highest protection afforded at the international level for copyrights before TRIPS. It mandates that all literary and artistic works that meet the originality

and intellectual creation criteria should be protected automatically from the date of creation without subject to any formalities for the duration of the author's lifespan plus 50 years. A separate duration of at least 25 years is extended to works of applied arts and industrial design, although members are allowed to determine the extent of application and conditions of this protection. Brazil, for example, protected computer programs as works of applied arts and thus administered the 25 year protection. More importantly the Berne Convention allows for broader scope of exceptions to copyright protection and provides flexible implementation obligations to developing countries. A predominant exception practiced by many countries is the *fair use* doctrine where use of the copyrighted material is sanctioned in instances of private, not for profit and educational purposes, i.e. uses that generate positive spillover (Blair and Cotter, 2005). The appendix to the Berne Convention outlines special provisions applicable to developing countries. For example, translation of copyrighted materials into the national language is allowed if it meets the 3-step criteria for limited uses of exceptions to copyright.[18]

Related rights, also known as neighboring rights, is mainly governed by the Rome Convention. It obliges protection of performers, producers of sound recordings and broadcasting organization for 20 years from the date of performance, broadcast or fixation without subject to any formalities. Protection includes the right to control the reproduction of their work. The Convention, however, did not offer any enforcement provision in case of infringement but most countries offered civil remedies.

TRIPS combines the rights of copyrights and related rights under one heading, merging relevant elements of the Berne and Rome Conventions. However, the marginal addition and legal clarifications of TRIPS provisions on copyrights and related rights, as well as the compliance of many developing countries with the pre-existing international laws on this subject matter made this the least controversial IPR category of TRIPS. Nevertheless, there were some opposition from developing countries in regards to the obligations under rental rights (Art. 11) and related rights (Art. 14). Art. 11 of TRIPS introduces rental rights protection for computer programs and sound recordings, which most developing country negotiators considered as a Berne-plus obligation. Furthermore, Watal (2001) argues that Art. 14 of TRIPS on related rights creates new obligations that are higher than those mandated by Rome Convention but points out that this was not met with much resistance from several of them as they were already providing such protection.

[18]The 3-step test used to establish if the instance to avail to copyright exception is: (i) granted in special cases only; (ii) not conflict with normal exploitation of work; and (iii) not unreasonably prejudice the legitimate interests of the author.

Layout designs of integrated circuits

Protection of layout designs of integrated circuits is a relatively new addition to the global IPR system. The upsurge in United States' semiconductor companies and export to other countries gave rise to this protection. At the time of *Uruguay Round* of negotiations, the Washington Treaty governed the protection of this IPR category at the global level. However lack of adequate number of ratification by members of this treaty ensured that the treaty did not come into force.[19] TRIPS remedies this situation by enforcing it as part of the IPR package. In addition, the Agreement expands the scope of protection to include protected designs and set the term of protection for a minimum of 8 years from filing date or date of first commercial exploitation.

Layout designs of integrated circuits protects the configuration of a circuit board, whereby changes made to the board increases its functionality. These changes oftentimes require high degree of skills and large amount R&D, thus qualifying it for patent protection in some jurisdictions.

Industrial designs

Industrial designs protection has been protected under the Paris Convention and is included as an IPR category. Prior to TRIPS, countries were able to protect industrial designs with copyright laws, unfair competition or by establishing *sui generis* legislation on the matter. Protection in this area is in regards to the aesthetic, and sometimes functional, aspects of any product that is industrially produced. It can also be protected under copyright laws, thus obtaining concurrent and simultaneous protection. However unlike copyright, protection under industrial designs safeguards from independent development of similar design.

TRIPS did not create additional obligations under industrial design protection. It merely reinforces the common practices and rules of Paris Convention, whereby the term of protection is for least 10 years.

Trademark and GI

Trademark and geographical indication (GI) protect consumers from being misinformed about the products that they are purchasing due to false advertisements or similar appearances. Trademark has been protected under Paris Convention but is only extended to goods and not services. TRIPS marginally increases the protection level of trademark in both developed and developing

[19]Developing countries were actively participating in the negotiations of this treaty, and thus reflected many of its views. However, the United States and Japan did not sign onto the treaty as it was perceived as providing inadequate protection level (Gervais, 2003; Watal, 2001).

countries. It clearly defines trademark, outlines the treatment of well-known foreign marks, and provides limited protection for services trademark (Watal, 2001).

GI was protected under Madrid System for the International Registration of Marks[20] and Lisbon Agreement for the Protection of Appellations of Origin and their International Registration[21] in regards to appellations of origin. Prior to TRIPS, GI was provided by a few countries and there was diversity in the protection methods and standards. TRIPS included GI as one of the IPR categories but left implementation of this particular area to members, with a caveat that members will continue their negotiations in this matter to define its scope and depth of protection.

The last table in the appendix of this chapter summarizes the seven IPR categories mentioned above. It shows the definition, term of protection, criteria for protection, rights conferred and the exceptions for each of the IPR types. In the following section I build the TRIPS index base on the definition and the term of protection of the IPR categories.

2.4 TRIPS index: method

TRIPS agreement is broken into eight parts. Part I upholds the basic tenets of the WTO, while Part II highlights the minimum substantive protection in the different IPR categories. Parts III and IV outline the various process procedures to be implemented or modified. Part V mandates publications of new or modified legislations and that disputes would be conducted under the WTO's Dispute Settlement Understanding (DSU) agreement. Part VI sets the transitional arrangements for developing countries. And finally Part $VIII$ describes institutional arrangements and other final details of the agreement. All of these TRIPS provisions are equally binding but the relevant provisions that pertain to IPR scope and depth of protection are contained in parts II and III.[22]

I select my sample of developing countries by considering all 76 countries that joined the WTO on the 1st January 1995 but dropping those that the World Bank classifies as high income countries[23]. I omit two of the 44 developing countries remaining due to the difficulty of obtaining their IPR legislations online. For personal interest and to add diversity to the sample purposes, I

[20] Hereinafter referred to as the Madrid Treaty.
[21] Hereinafter referred to as the Lisbon Treaty.
[22] Every part of this Agreement is technically equally binding. Thus, there is no hierarchy between enforcing either *Trademark* and *Undisclosed Information* rights. This is referred to as the principle of effective interpretation. (See Appellate Body Report, WTO (1999).
[23] These countries include those that are members of the OECD and those that are considered non-OECD.

include 11 developing countries that join the WTO in the year 1995 other than the 1st January,[24] and three high income countries from the Southeast Asia region.

2.4.1 Data collection

I focus on the substantive elements of the Agreement to capture institutional changes that would affect innovative activities and simplify data collection effort. Procedural and administrative aspects of TRIPS is likely to affect the behaviors of IPR users in regards to time for filing or challenges to patent, trademark or copyright grants. But they are less likely to affect the undertaking of innovative activities and thus are not included in the construction of the TRIPS index. I note that a country is in compliance with the Agreement when the term of protection for each of the IPR category reflects those mandated by TRIPS. Sub-section 2.4.2 describes in detail how the index was constructed.

Data collection of each of the 53 developing member countries are based on careful examination of primary and secondary sources and in consultation with IPR experts, wherever possible. Following Lesser (2002), I scour the WTO official documents, which reviews members' efforts in implementing TRIPS provisions[25] and cross-reference them to the WTO Secretariat documents on these members' overall trade policies. These documents, referred to as the *TRIPS Council Legislation Review* and *Trade Policy Review* reports, are reliable sources for members' legislative changes as they are based on the governments' own submissions and the Secretariat's objective research.[26] I note compliance of each IPR category base on whether the legislation in the reports meet the TRIPS mandated minimum term of protection; a method similar to Rapp and Rozek (1990). When the minimum term of protection is in concordance with the Agreement, I save the name of the legislation and consult WIPO's *Collection of Laws for Electronic Access* (CLEA) database for the year that the legislation is implemented.[27]

I collect both the *implementation* and the *in force* dates of the TRIPS specific IPR categories national legislations. For my thesis purposes, the *implementation* date of the national legislations is more important than the *in force* as this is when I assume people should be aware of the new or modified legislation.[28] In most cases, *implementation* and *in force* dates are within the same

[24]These countries acceded to the WTO over the course of 1995, and thus are able to use the transition period for implementation according to their income levels.

[25]This includes the question and answer portion of the TRIPS Review Mechanism.

[26]These documents can be retrieved from the WTO site by searching for documents "IP/Q*" and "WTO/TPR" respectively.

[27]There are two dates that corresponds to legislation - the *implementation* and *in force* date. The *implementation* date is usually the date wherein which the legislation is signed and approved, while the *in force* date refers to when the legislation comes into force.

[28]I assume that all agents would make their decisions on all information available to them during that period.

year except for low income and a few other countries.

In creating the index I make three assumptions. First, I assume that a year prior to the WTO inception, 1994, members in the sample were not TRIPS-compliant. Second, I assume that members would use the transition period afforded by the TRIPS agreement in implementing their IPR obligations.[29] And lastly, I assume that members are not able to implement all seven IPR categories simultaneously because of various constraints, e.g. budget. Given these assumptions, I build an index that takes into consideration all seven IPR categories and the different implementation times for each of those categories for the years 1994 onward.

2.4.2 Creating the index

Copyright, trademark, geographical indication, industrial designs, patents, layout designs of integrated circuits and undisclosed information are the seven categories of IPR identified by TRIPS. I create dummy variables to reflect members' compliance with the respective terms of duration per category. I assign 1 to the category, and 0 otherwise, if the IPR legislation mandates the protection term that is in-line with the Agreement. I create three subsections for under the headings of patent and copyright and related rights, and two subsections for the undisclosed information because of the additional demands imposed by the Agreement on these IPR categories.

The three subsections under the patent heading accommodates the obligation to provide 20 years term of patent protection, including extension of the patent protection to pharmaceutical and agricultural chemical products, and the *sui generis* plant varieties legislation. Data collection of dates for implementation of these three patent subsections show time implementation discrepancies. In comparison to the 36 member countries who currently offer the 20-year patent protection term, 12 members have different date of implementation for pharmaceutical and agricultural chemical products, while for plant varieties there are 26 members.

Copyright and related rights category in TRIPS refers to the copyright law as protected under Berne Convention and related rights, which falls under Rome Convention. Given that most countries were complying with the main Berne Convention provisions, I note TRIPS compliance when the country meets the additional obligations imposed by the Agreement. These additional

And thus, even if a legislation may not be in force, the important fact is that the agent expects the legislation to be in force within a specific time period and thus will base her future actions on the information she has today.

[29] An additional time period of four years is accorded to countries considered as *developing*, and ten years for least-developed countries from the 1st January 1996. The WTO follows the United Nation's categorization of least-developed countries (LDCs). However, the status of *developing* country is based on self-selection. The Doha Ministerial Conference allowed LDCs a further extension until 1st July 2013 to ensure that complete TRIPS-compliance.

obligations that are not specifically covered in the Berne Convention are the treatment of computer programs as literary works, inclusion of rental rights and related rights. These add-ons raise the level of protection on copyrights and related rights and are important from economic perspectives. Firstly, protecting computer program as literary work entails longer term of protection. Secondly, rental rights obligations on computer programs and cinematographic work are important in countries where rampant pirating of these works render the copyright protection useless (Watal, 2001). And lastly, protection of performers, producers of phonogram and broadcasting organizations rights ensure adequate legal protection for these entities. Therefore, I count these add-ons as my three subsections towards compliance under the copyright and related rights category. Six and seven countries of those that implemented the treatment of computer programs as literary works have different implementation dates of rental rights and related rights respectively, confirming that these add-ons should be considered separately.

I also treat undisclosed information differently from the rest of the IPR categories. Undisclosed information is broken down into two subsections because of the protection afforded by TRIPS under this heading. It is defined by TRIPS as information kept secret plus data submitted to governments and their respective agencies for marketing approval. Comparison of undisclosed information protection across countries shows differing approaches to the protection of data submitted to governments for marketing approval. There has not been any expressed protection of data submitted for marketing approval for most of the developing countries here. Those countries that did provide for this particular protection allow the use of this data to establish bioequivalence of a similar product.[30] The results show that some 14 odd-countries out of 37 member countries that do provide TRIPS-compliant trade secret compliance have not implement data submitted for marketing approval protection until later.

Noting compliance of the remaining IPR categories, trademark, layout designs of integrated circuits, industrial design and geographical indication are more straightforward than for copyrights and related rights, patents and undisclosed information. I consider the remaining categories as TRIPS-compliant when the term of protection for the category as listed by the Agreement is implemented in the national legislations. As such, compliance occurs only when (i) the IPR category is as defined by TRIPS is protected for the (ii) minimum term of protection.

Table 2.2 summarizes how a country's IPR legislations sum towards its TRIPS-compliance index number. Each of the seven IPR categories enter the index unweighted, reflecting the

[30]Interestingly, protection of data submitted for marketing approval of pharmaceutical or agricultural chemicals was an attempt by the United States negotiators to curb the use of data collected by its pharmaceutical and chemical industries by generic producers and other competitors.

IPR Category		Total
Copyright and related rights		1
Computer program	$\frac{1}{3}$	
Rental rights	$\frac{1}{3}$	
Related rights	$\frac{1}{3}$	
Trademark		1
Geographical indications		1
Industrial designs		1
Patents		1
Patents	$\frac{1}{3}$	
Pharmaceutical patents	$\frac{1}{3}$	
Plant varieties	$\frac{1}{3}$	
Layout designs of integrated circuits		1
Undisclosed information		1
Trade secrets	$\frac{1}{2}$	
Data submission	$\frac{1}{2}$	
Total		7

Table 2.2: TRIPS index method

equal importance of each provisions considered under international law and practice.[31] This index ranges from 0 to 7, from non-compliance to full TRIPS compliance. Full compliance, or an index total of 7, implies that the country has legally met all of the substantial TRIPS obligations, while 0 connotes that the particular country has not yet undertaken any efforts to comply with the Agreement. The index thus allows for examination of the TRIPS implementations across many developing countries over the time studied (1994 — 2007), and to observe any impact of this obligation on the countries' economic activities.

2.4.3 Some issues

This TRIPS index has several drawbacks that should be taken into consideration when using for economic analysis. These shortcomings are attributable to the assumptions I make and method I use in building this legislative-type index.

Firstly, as in the legislation-type approach of building indexes, I construct the index using binary numbers to represent whether a developing country has satisfied a particular IPR category, depending on the TRIPS' minimum term of protection for the category defined. This method is likely to underestimate the extent of a country's compliance with a specific category if one of the two criteria is not satisfied. For example, I would consider a country's trademark legislation as not TRIPS-compliant if the country allows for trademark of goods but not services, even if

[31] See footnote 22.

the country could be mostly compliant with its trademark legislation. It has been proposed that further granularity per IPR category should be introduced, as I have done for copyright and related rights, patents and undisclosed information. However, I introduce granularities for these IPR categories and not the remaining ones because the Agreement imposes additional demands on these categories.

Secondly, every one of the seven IPR categories enter the TRIPS index unweighted, meaning that each category has equal importance for this index. Legal interpretation requires that each IPR category listed in the Agreement are treated equally, that there is no hierarchy in the implementation of the TRIPS provisions. However, economic rationale argues that protection of trademark may not be as important or significant as protection of patented innovation, or vice-versa. However attaching weights to any one of the category could be subjective, like the index created by Sherwood (1997). A possible option to get around this subjectivity is to interact each component of the TRIPS index with variables that correspond to economic activities in the countries. For example, we could weight the services-related IPR categories of a country by the proportion of the country's economy attributable to services sector and so on.

In addition, each incremental increase of the index mirrors the country's implementation effort with any one of the seven IPR categories, in no particular order. Therefore, the index may not reflect the strength of the country's IPR regime, making it difficult to argue that a country with TRIPS index of 3 is significantly different from another with an index of 4. We could address this flaw by subdividing the index into three categories of high-, middle- and low-compliance levels. Countries with a TRIPS index of above 5 can be deemed high-, between 2.1 and 4.9 as middle-, and below 2 as low-levels of compliance.

Another problem associated with the unweighting of the TRIPS index is that we do not know which IPR category is being implemented at different time periods. For example, a country may achieve a TRIPS index of 5, implying high TRIPS compliance, but may neglect to fully comply with its obligations for patent protection. In this case, access to the disaggregated TRIPS index would be rectify the problem.

Thirdly, this index considers memberships to other IPR international agreement as irrelevant. It can be contended that membership to those agreements, such as Paris Convention, reflects the country's willingness to abide by certain agreed rules and regulations and thus should be taken into consideration. I argue that if membership to those agreements were sufficient, then the need to have another international agreement on IPR, such as TRIPS, would be redundant. Recall from Section 2.2 that the TRIPS agreement can be better enforced than older international IPR

agreements, thus making this Agreement "stronger" than its predecessors. In addition, TRIPS adopts the main elements of some of the more important IPR agreements, such as Paris and Berne, and thus including membership to the said agreements would be double-counting.

Lastly, as legislation-type indexes discussed earlier, this index considers TRIPS-compliant rules and regulations without looking at the enforcement aspect. Enforcement of the IPR legislation at the national level is dependent on (i) government's willingness to enforce the legislation and (ii) the ability of IPR holders, as well as challengers to the IPR granted, to have recourse to the judicial system, which may include but are not limited to, opposition of patent grant procedures, legal fees, and the transparency of IPR system, assuming the competence of the local judicial system in dealing with IPR issues. Furthermore, unlike the indexes built by Park (Park (2008) and Park and Lippoldt (2007)), I do not include the specificities of local legal administrative enforcement, such as existence of *burden-of-proof reversal* in the case of patent system. However, the Agreement sets the administrative enforcement standards for member countries and failure to comply with these standards can lead to dispute settlement proceeding. This allows for the assumption that when a developing country member complies with any of the IPR categories, it also complies with the administrative aspect of that category. Furthermore, we can overcome the lack of these enforcement-specific factors by interacting the TRIPS index with data collected by the USTR, WEF or IMD, or any other data that captures the actual local enforcement of the IPR system, following Lesser (2002).

Nevertheless this index still retains the important factors that sets it apart from other indexes: it is TRIPS-specific, takes into consideration the transition periods accorded to developing countries, and covers several countries over ten years of annual observation. Furthermore, the index in its current form is adequate for the purpose of this paper.

I discuss and analyze the results of this compilation of IPR legislations of the 53 countries in the following section.

2.5 Analysis of data collected

I examine and cross-check the IPR legislations, *Trade Policy Reports* and *TRIPS Council Legislation Review* documents of 53 countries to build the index necessary for this paper.[32] The sample consists of countries from the European (7%), Asian (21%), African (32%) and Latin American and Caribbean (40%) continents with varying income levels. Most of the countries in

[32]Refer to subsection 2.4 for explanation of country selection.

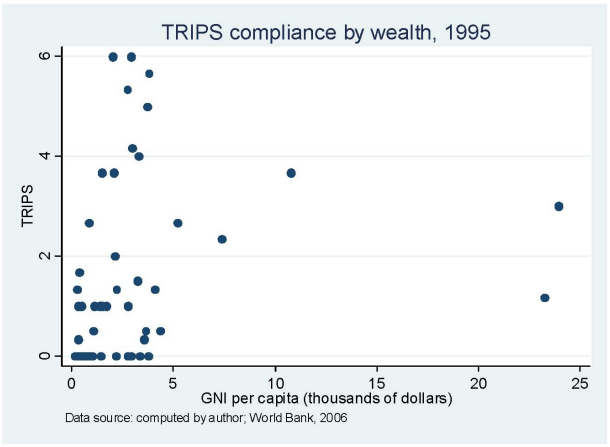
the sample are upper-middle (36%), lower-middle (34%) and low income countries, while high income countries only account for 3%. There are seven LDCs among the countries studied, all from the African continent except for Bangladesh, in Asia. I subdivide the countries by region and income levels to get a comprehensive picture of the efforts undertaken. The result of the data collection effort below refer to the legislations in those countries that are *in force*. Approximately 12 countries have TRIPS-compliant legislations that were not *in force*, and so I omit them from the analysis below.

2.5.1 Graphical analysis

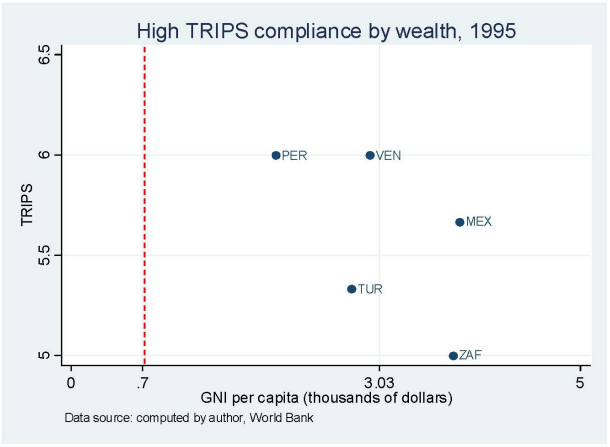
Three trends appear from the developing countries' implementation of their TRIPS obligations. Firstly, almost all countries avail themselves to the transition periods afforded by the Agreement, and in most cases have exceed the time limit imposed by the transition period, excluding the LDCs. Mexico, Romania, and South Africa of the developing countries and Côte d'Ivoire of the LDCs are the few that have implemented the TRIPS obligations before their deadline, year 2013. The figures displayed in this subsection and on page A–40 in the appendix show to this effect.

Secondly, implementation efforts of developing countries vary, and not necessarily because of their income levels. Given the stylized fact that most high income countries have higher IPR protection than lower income countries, it can be argued that countries with high income levels should implement TRIPS relatively quickly in comparison to low income countries. However, snapshots of TRIPS compliance efforts of developing countries for the years 1995 and 2000, Fig. 2.1 and 2.2 respectively, show evidences contrary to this. In 1995, five developing countries had most of their IPR legislations in compliance with the TRIPS agreement, categorized by index $\geq$ 5, (Fig. 2.1(b)). In the year 2000, the number of countries with four of the 27 developing countries highly compliant with the Agreement are low income countries (Fig. 2.2(b)). Countries to the left of the red dotted line in Fig. 2.1(b) and 2.2(b) are low income countries. More comprehensively, Fig. 2.3 the income levels of developing countries studied against the years when they became highly TRIPS-compliant (TRIPS index $\geq$ 5). The figure shows that most of the developing countries achieve high TRIPS compliance in the year 2000 regardless of their income levels. Examination of the countries' TRIPS compliance and their innovative capacities also show that the developing countries' studied seem obliged to implement the TRIPS agreement regardless of their countries' innovative capacities. Fig. 2.4 plots countries that have achieved high TRIPS compliance by their innovative capacities proxied by the ArCo index, computed by Archibugi and Coco (2004). The ArCo index classifies the developing countries into four cate-

gories: leader, potential, latecomers and marginalized, indicating the levels of these countries' innovation capacities.

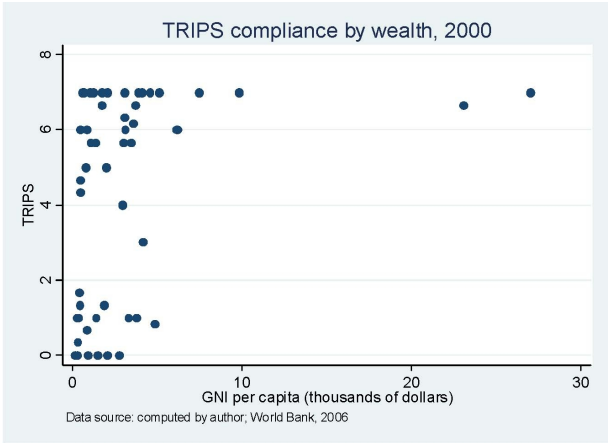


(a) All 53 countries

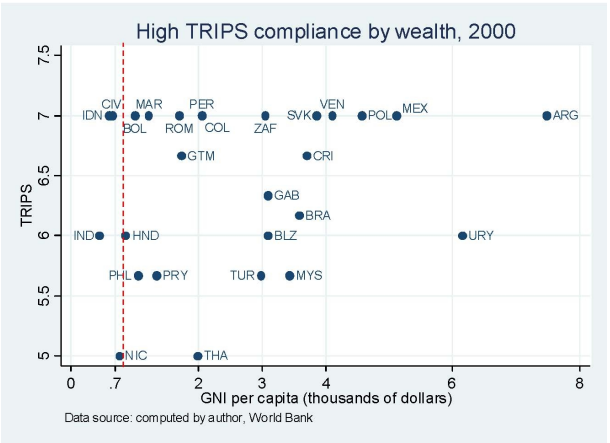


(b) Upper-left hand corner

Figure 2.1: TRIPS compliance by wealth, 1995



(a) All 53 countries



(b) Upper-left hand corner

Figure 2.2: TRIPS compliance by wealth, 2000

Analysis of the implementation efforts over the years give further support to the fact that implementation of TRIPS agreement is not entirely related to income levels. Fig. 2.5 shows the evolution of TRIPS-compliant legislation implemented in these African countries from the years 1994 until 2007. The two dotted vertical lines in the figure mark the original deadlines for developing countries and LDCs, 2000 and 2006 respectively.[33] South Africa, Morocco and Côte d'Ivoire are the only African countries that have managed to fully become TRIPS-compliant by

[33]The new deadline for LDCs is 2013, and 2016 for pharmaceutical and agriculture chemical products.

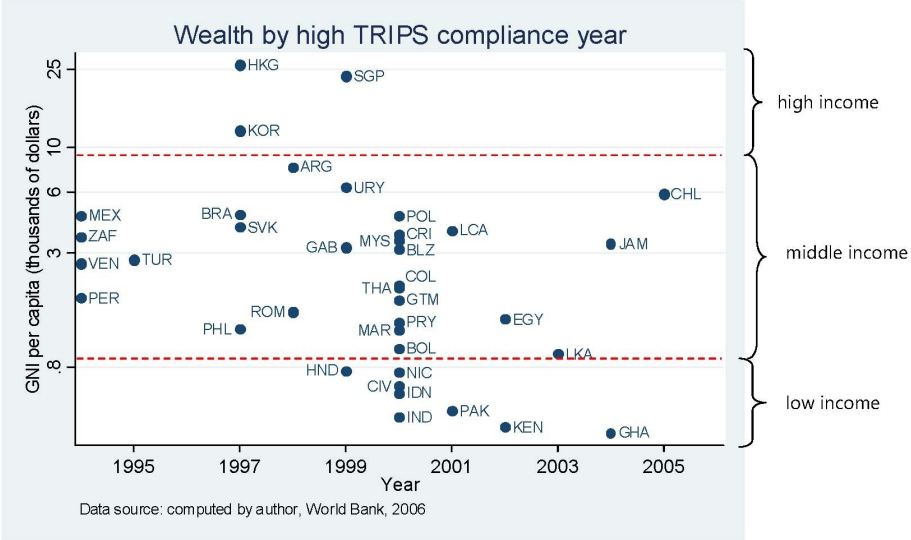


Figure 2.3: Countries' wealth by high TRIPS compliance year

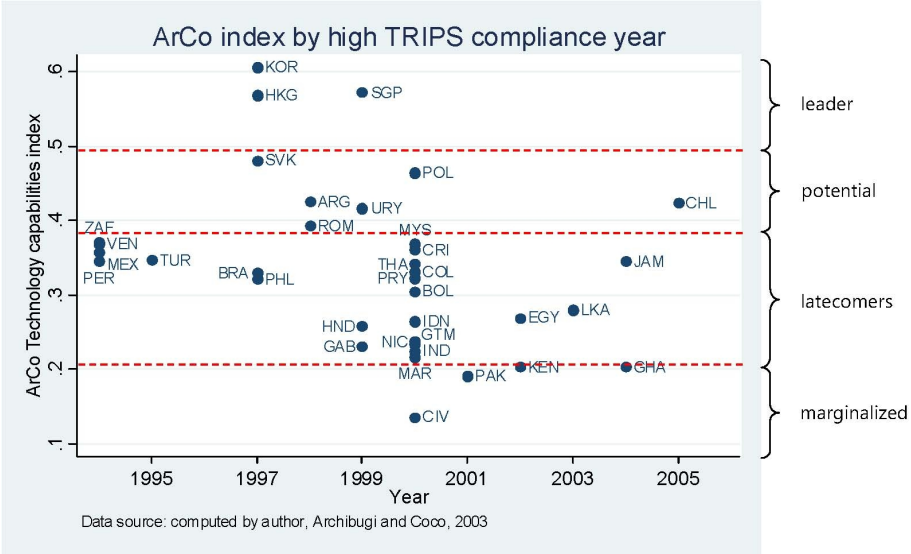


Figure 2.4: Countries' innovation capacities by high TRIPS compliance year

the year 2000 deadline, and they are from upper-, lower-middle and low incomes respectively. When examining the implementation efforts of low income countries in Fig. 2.6, compliance does not appear to be completely affected by income level. Furthermore, comparing the efforts of low income countries and upper-middle income countries of Fig. 2.6 and 2.7 show that the implementation efforts are similar, albeit with a particular caveats. An advantage that most upper-middle income countries have over low-income countries is that they are likely to have more TRIPS-compliant legislations already in place before the WTO agreement was signed and comes into force. Nevertheless these figures here show that low income countries exert as much effort as their richer counterparts in implementing their TRIPS obligations. A possible conjecture explaining this similar implementation effort by these income levels could be attributable to

the difficulty of the richer income countries in restructuring their IPR legislations to maintain protection their local industries.

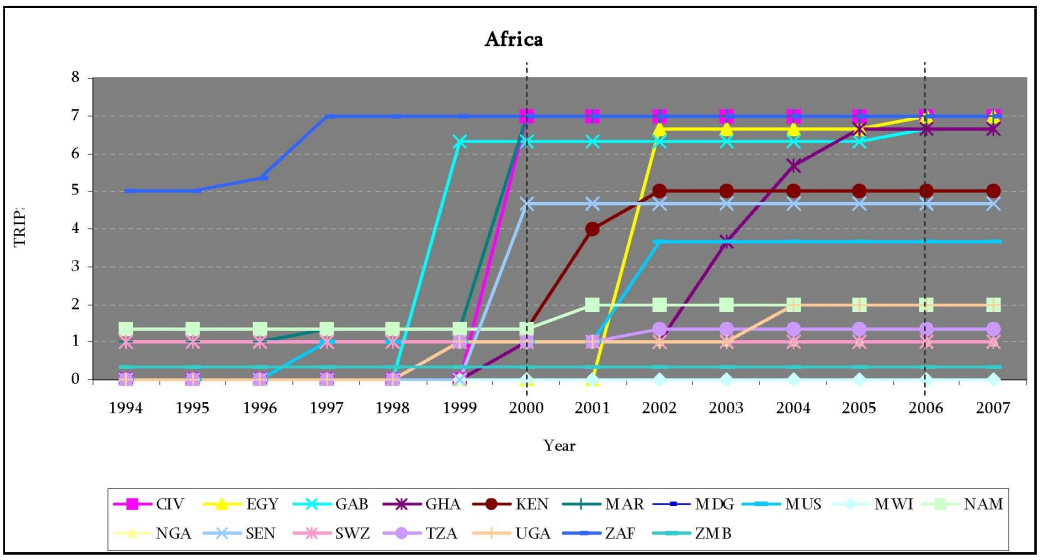


Figure 2.5: TRIPS compliance for African countries, 1994 — 2007

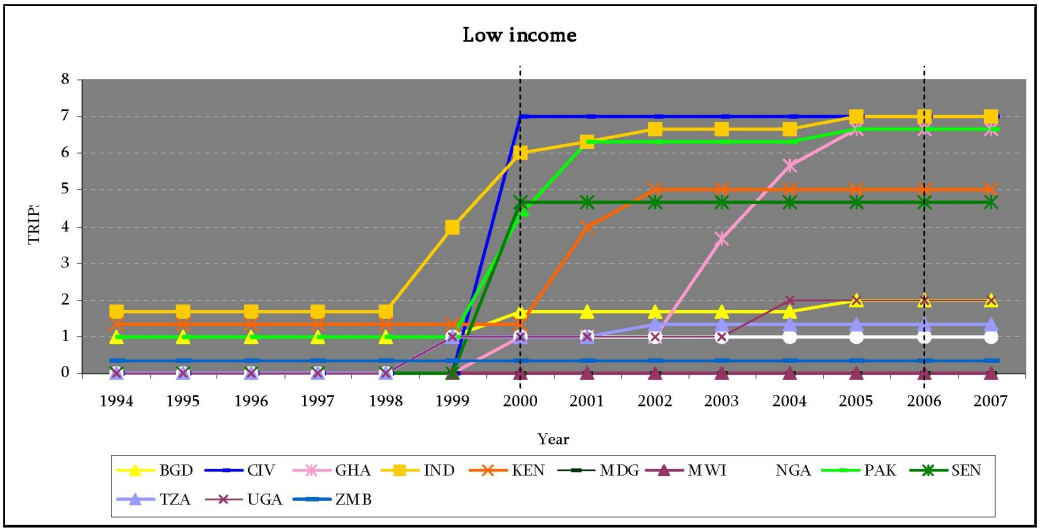


Figure 2.6: TRIPS compliance for low income countries, 1994 — 2007

And lastly, countries in regional trade agreements (RTAs) include IPR obligations tend to have their compliant legislations in place sooner than those who are not, as evidenced in Fig. 2.8. The RTAs in question here are the Andean Community, European Communities, OAPI, ARIPO and NAFTA. This trend lends support to the argument that engagements in RTAs are beneficial and could complement progress at the broader multilateral level.

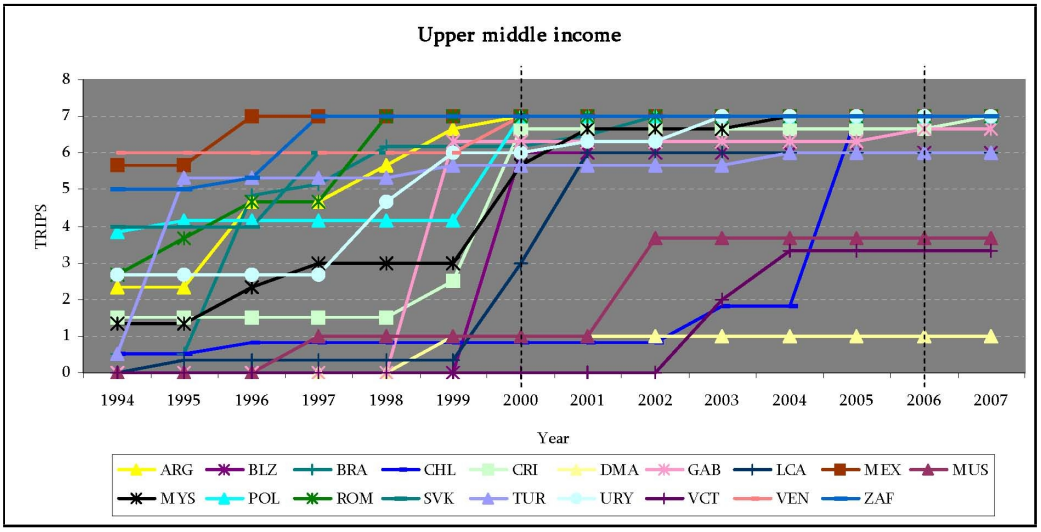


Figure 2.7: TRIPS compliance for upper-middle income countries, 1994 — 2007

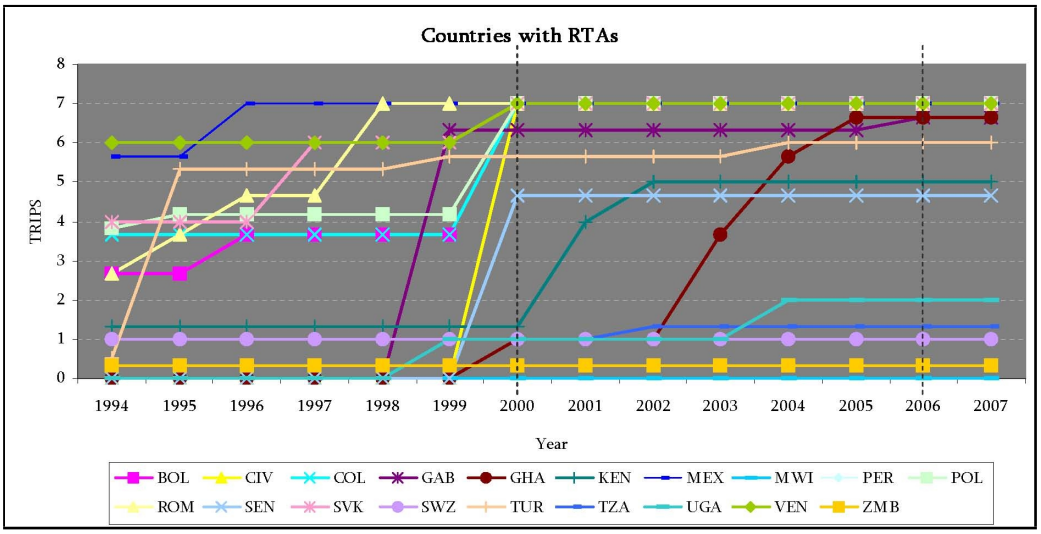


Figure 2.8: TRIPS compliance for countries in RTAs, 1994 — 2007

2.5.2 Future econometrics analysis

Several notable studies have investigated the impact of IPR regimes on economic activities using the then-available IPR indexes. The TRIPS index that I produce here can be used to analyze the impact of the TRIPS agreement on those activities as well. Below I run a simple Pearson pairwise correlation of the TRIPS index for all 53 developing countries with proxies of innovative activities. For most of the variables, the Pearson pairwise correlation numbers are positive and significant, indicating that there may be links between the implementation of the TRIPS agreement and these activities. Pearson pairwise correlation allows us to see the relationship, if any, between two variables. The advantages of using this correlation to determine the association between two variables is that it does not require that the variables under study to have the same units of measurement and avoids casewise deletion.[34]

Table 2.3 shows values of Pearson pairwise correlation of the TRIPS index with the various indicators of economic activities. The columns show the different correlation models for varying income levels.[35] The columns labeled "All", "Not high", "Middle", "Low" and "LDC" refer to the various income levels of the 53 developing countries, where "Not high" refer to all developing countries in the sample that are not classified as high income by the World Bank .

Correlation	**TRIPS index**				
ρ	All	Not high	Middle	Low	LDCs
Net FDI	0.2996*	0.3112*	0.2919*	0.2835*	0.1933
High Technology %	0.2650*	0.2279*	0.1785*	0.0866	0.1965
Royalties payments	0.2889*	0.3861*	0.3458*	0.4424*	0.0243
Royalties receipts	0.2360*	0.2820*	0.2358*	0.4344*	-0.0517
Trademark nonresident	0.4857*	0.4102*	0.2855*	0.7517*	0.6053*
Trademark resident	0.3358*	0.3284*	0.2735*	0.3788*	0.7921*
Patent filing at EPO	0.1778*	0.2031*	0.3429*	0.3583*	0.1722
Patent filing at JPO	0.1298*	0.1466*	0.2856*	0.3329*	0.1333
Patent filing at national patent office	0.1492*	0.1783*	0.1573*	0.2004	-0.2449
Triadic patent filing	0.1444*	0.1396*	0.2889*	0.3295*	0.131
Patent filing at USPTO	0.1556*	0.2074*	0.3656*	0.3980*	0.1814
GDP per capita	0.2932*	0.3662*	0.2332*	0.5788*	0.5541*
Chemical (% value added)	0.0264	0.0333	0.1967*	0.0623	-0.1497

Table 2.3: TRIPS index correlation table

[34]For a detailed comparison of casewise versus pairwise deletion see http://www.statsoft.com/textbook/stbasic.html#ccasewise

[35]Note that in the WTO developing country term is politically motivated, however for this paper I refer developing countries as those not considered high income countries, whether in the OECD group or not.

Examination of correlation table shows that although there is a significant and positive relationship between the TRIPS index and national income per capita, although the relationship is not very strong for each of the income categories, with correlation varying from 29% to 58%. This simple association test concur with our graphical analysis that the implementation of the TRIPS-compliant regime is not necessarily dependent on the countries' economic development levels.

Across all income levels there are significant and positive relationships between the index and FDI, both royalty payments and receipts, trademark, and patent filings at the EPO, JPO and USPTO. Interestingly patent filing at the national patent office is positive and significant for models all income levels except for low income countries.

These simple correlations merit further examination of the relationship between these values and the TRIPS index to determine if there is a causality affect, which will be undertaken in future research papers.

2.6 Conclusion

This paper attempts to build a TRIPS-specific IPR index to study the impact of the TRIPS agreement for developing WTO member countries. I make three assumptions: (i) a year prior to the WTO inception, in the year 1994, members in the sample were not TRIPS-compliant; (ii) members use the transition period afforded by the TRIPS agreement in implementing their IPR obligations; and (iii) members are not be able to implement all seven IPR categories simultaneously because of various constraints. These assumptions help me construct the TRIPS index by considering all seven IPR categories separately, narrowing the legislation search to the periods after the conclusion of the Uruguay Round of negotiations, and refrain from using the transition deadlines as the actual date of full TRIPS compliance. In addition, the assumption would later allow me to conduct a natural experiment in investigating the impact of the Agreement on various economic activities of the countries studied.

Analysis of the data shows three implementation trends. Firstly, almost all developing countries take advantage of the transition periods clause of the Agreement (Art. 65), and in some cases have exceeded the TRIPS implementation deadline for developing countries, in the year 2000. Secondly, implementation efforts of developing countries vary, and not necessarily because of their income levels. Lastly, countries in regional trade agreements (RTAs) that include IPR obligations tend to comply with TRIPS earlier than the rest. The results confirm

that the TRIPS agreement leads to a convergence of global IPR protection across countries. It also makes the case that the Agreement's implementation is an external factor, neither strongly influenced by the country's level of economic development nor by its level of innovation capacity. This index can be used as a natural experiment to understand how strengthened IPR protection influences economic activities and behaviors.

The lack of endogenous attribution of IPR level to economic development and convergence of global IPR across countries lead to the possibility of using this index as a natural experiment to understand how IPR influences economic activities and behaviors. This TRIPS index will be used in future research studies to examine the impact of the Agreement on local economic activities. An interesting case to study would be to examine how the implementation of this Agreement affect countries with low- and middle-range technological capacities vis-à-vis access to new technology and potential for local innovation to name a few.

APPENDIX

Countries in the sample

*denotes an LDC

Code	Latin America & Caribbean	Code	Africa & Middle East
ARG	Argentina	CIV	Côte d'Ivoire
BLZ	Belize	EGY	Egypt
BOL	Bolivia	GAB	Gabon
BRA	Brazil	GHA	Ghana
CHL	Chile	KEN	Kenya
COL	Colombia	MAR	Morocco
CRI	Costa Rica	MDG	Madagascar*
DMA	Dominica	MUS	Mauritius
GTM	Guatemala	MWI	Malawi*
GUY	Guyana	NAM	Namibia
HND	Honduras	NGA	Nigeria
JAM	Jamaica	SEN	Senegal*
LCA	Saint Lucia	SWZ	Swaziland
MEX	Mexico	TZA	Tanzania*
NIC	Nicaragua	UGA	Uganda*
PER	Peru	ZAF	South Africa
PRY	Paraguay	ZMB	Zambia*
SUR	Surinam		
URY	Uruguay		
VCT	Saint Vincent & the Grenadines		
VEN	Venezuela		

Code	Asia	Code	Europe
BGD	Bangladesh*	POL	Poland
HKG	Hong Kong	ROM	Romania
IDN	Indonesia	SVK	Slovak Republic
IND	India	TUR	Turkey
KOR	South Korea		
LKA	Sri Lanka		
MYS	Malaysia		
PAK	Pakistan		
PHL	Philippines		
SGP	Singapore		
THA	Thailand		

Regional trade agreements

Andean Community

Bolivia	Columbia	Ecuador
Peru	Venezuela	

OAPI

Cameroon	Côte d'Ivoire	Gabon
Guinea	Guinea Equatorial	Mali
Mauritania	Senegal	Chad

ARIPO[1]

Botswana	Gambia	Ghana
Kenya	Lesotho	Malawi
Mozambique	Sierra Leone	Sudan
Swaziland	Tanzania	Uganda
Zambia	Zimbabwe	

EC

Poland	Romania	Slovak Republic
Turkey[2]		

NAFTA

Mexico

[1] An intergovernmental organization that cooperates in industrial property matters.
[2] Bilateral with EC, with the intention of eventually joining when possible.

Summary of the variables

Variables	Obs	Mean	Std. Dev.	Min.	Max	Source
TRIPS index	742	3.636343	2.873804	0	7	Computed
Net FDI as % of GDP	613	1.60E+09	3.80E+09	-1.17E+10	3.05E+10	WDI
High Technology %	564	10.80869	15.79071	0.0003458	74.9573	WDI
Royalties payments	559	2.94E+08	8.51E+08	-100000	8.65E+09	WDI
Royalties receipts	532	3.99E+07	1.51E+08	0	1.86E+09	WDI
Trademark nonresident	221	5938.566	5786.889	124	21147	WDI
Trademark resident	223	12921.84	19958.39	8	92368	WDI
Patent filing at EPO[1]	568	77.26408	331.8688	0	4326	PATSTAT
Patent filing at JPO[2]	568	100.6743	571.3816	0	5650	PATSTAT
Patent filing at NPO[3]	393	4288.687	15471.58	1	145955	PATSTAT
Triadic patent filing	568	39.66549	189.0346	0	2204	PATSTAT
Patent filing at USPTO[4]	568	219.2377	1172.785	0	15561	PATSTAT
GDP per capita	636	3218.984	4666.643	118.8362	27372.1	WDI
Chemical (% value added)	325	9.145821	5.902041	0.0069126	49.71656	WDI

[1]European Patent Office
[2]Japanese Patent Office
[3]National Patent Office
[4]United States of America Patent Office

Graphical compliance of countries by region and income level

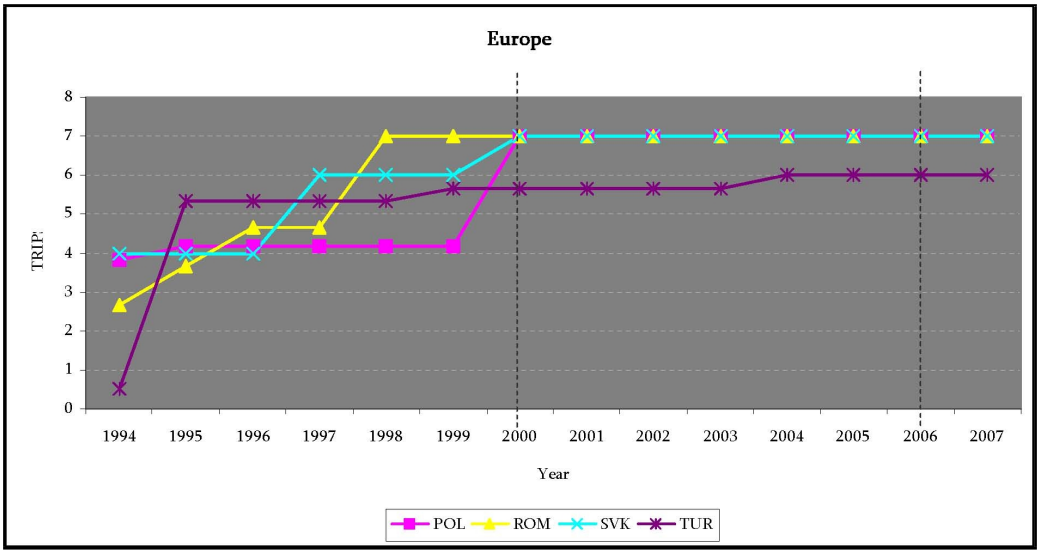


Figure 2.9: TRIPS compliance for European countries, 1994 — 2007

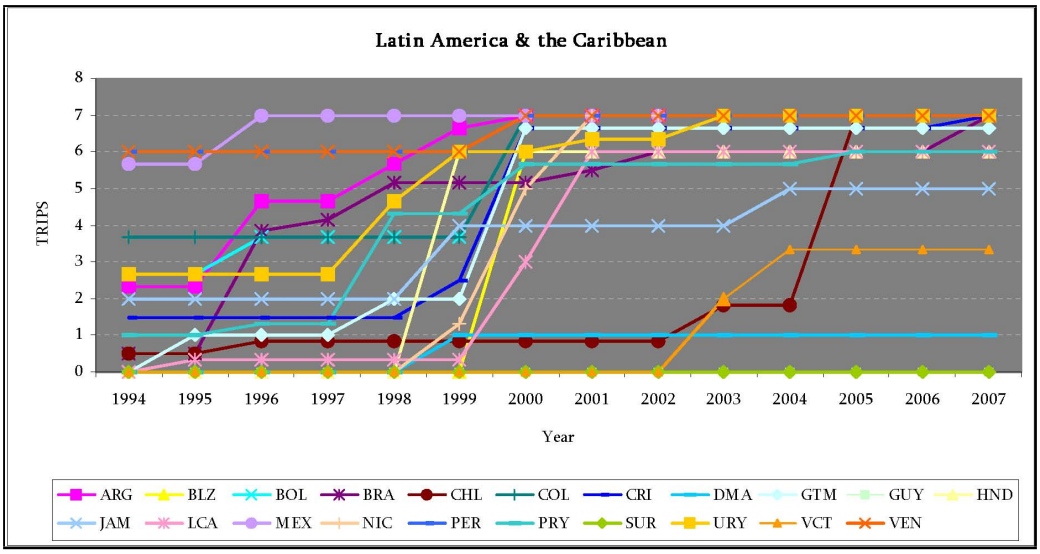


Figure 2.10: TRIPS compliance for Latin American and Caribbean countries, 1994 — 2007

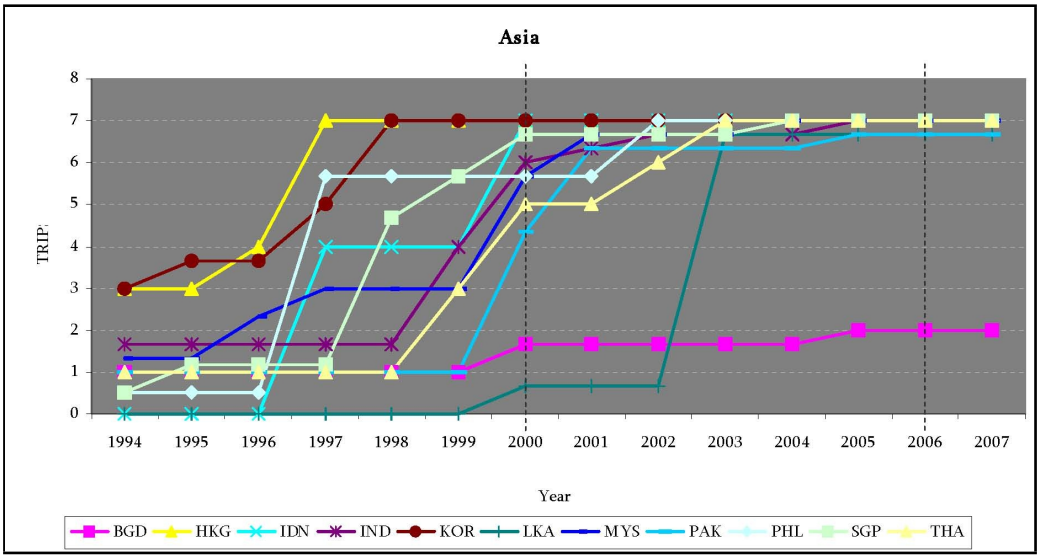


Figure 2.11: TRIPS compliance for Asian countries, 1994 — 2007

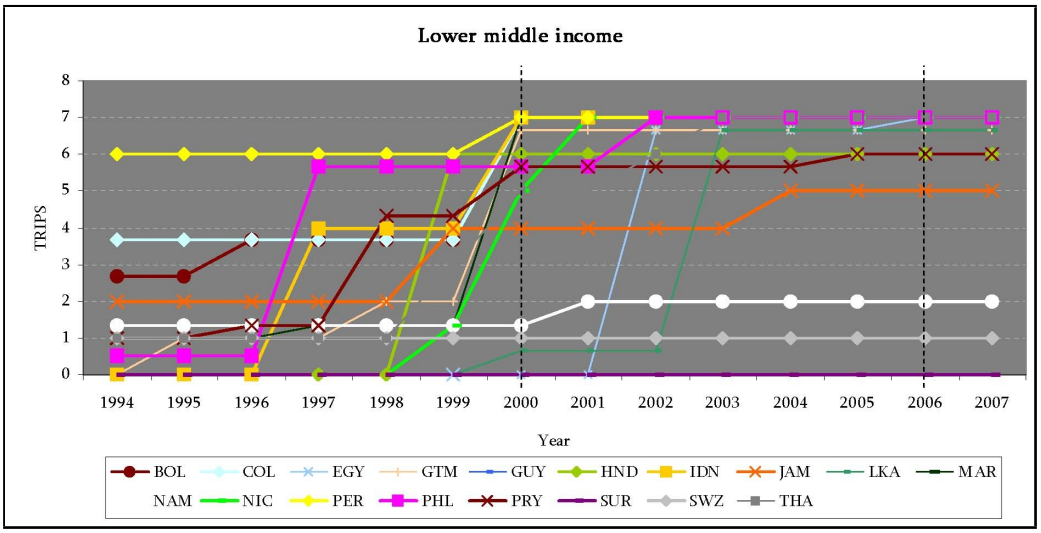


Figure 2.12: TRIPS compliance for lower-middle income countries, 1994 — 2007

TRIPS Provision Overview

IPR	General definition	Term of protection	Criteria for protection	Rights conferred	Exceptions
Copyright and related rights	Copyright and related rights are rights provided to expressions and includes "every production in the literary, scientific and artistic domain" regardless of the form or mode of expression or whether they were published or not (Berne Art. 2.1). It also extends to computer programs well as compilations of data or other materials (Art. 10.1 & Art. 10.2). But excludes from protection ideas, procedures, methods of operation and mathematical concepts (Art. 9.2).	For expressions: (i) author's life plus 50 years (Berne Art. 7.1); or (ii) 50 years from year of authorized publication; or (iii) 50 years from year of making (if no authorized publication) (Art. 12). For performers and producers of phonograms: at least 50 years from when performance was made (Art. 14.4). For broadcasting organizations at least 20 years from year of broadcast (Art. 14.4).	To qualify for copyright protection, the work must "by reasons of the selection and arrangement of their contents" altogether form an intellectual creation (Berne Art. 2(5)). In practice, the level of originality requirement varies from country to country.	Right to exclude unauthorized reproduction or distributions of copyrighted work and its derivatives (Berne Art. 6.1, 8, 11 and 12 and TRIPS Art. 14.2).	Use for public interest allows some unauthorized copying for limited purposes (e.g. education, research). This is also known as the fair use doctrine in common law countries. Art. 9(2) of Berne sets out 3-step analysis to evaluate consistency of exception: (i) granted in special case only; (ii) not conflict with normal exploitation of work; and (iii) not unreasonably prejudice the legitimate interest of the author. This provision is in conformity with TRIPS Art. 13.
Trademark	Trademark is "any sign, or combinations of signs" that would distinguish the specific goods or services from another goods or services (TRIPS Art. 15.1).	More than 7 years of protection from initial registration and each renewal of registration. Indefinite renewal of trademark registration required (TRIPS Art. 18).	Distinctiveness of sign, otherwise distinctiveness may be acquired through use (TRIPS Art. 15.1). Possible to require that the signs be "visually perceptible" (TRIPS Art. 15.1); or that (ii) registrability dependent on use but (actual) use cannot be a condition for filing an application for registration (TRIPS Art. 15.3).	Right to prevent use by all third parties of signs that are similar or identical to the trademarked sign for goods or services so as to avoid confusion (TRIPS Art. 16.1). This right also extends to prevention of using the trademarked sign for goods or services that are not those which the sign is usually associated with, other than the rightful holder of the sign (TRIPS Art. 16.3).	Public interest use allowed (e.g. fair use and prior user's rights) as long as it meets the 3-step criteria set out in copyrights protection. Compulsory licensing not permitted (TRIPS Art. 21).
Geographical indications	Geographical indications are indications which "identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographical origin" Art. 22.1). Additional protection is extended for wines and spirits (Art. 23).		GI protection is conferred to goods that have distinctive traits identifying the good to a specified geographical area.	Prevention of: (a) "the use of any means in the designation or presentation of a good that indicates or suggests that the good in question originates in a geographical area other than the true place of origin in a manner which misleads the public as to the geographical origin of the good;" and (b) "any use which constitutes an act of unfair competition within the meaning of Article 10bis of the Paris Convention (1967)" (Art. 22.2).	Generic names are exlucdable from protection. GI of services are not included.

IPR	General definition	Term of protection	Criteria for protection	Rights conferred	Exceptions
Industrial design	Not defined in TRIPS per se, but protection for textile designs are specifically underscored in Art. 25.2. Protection is usually granted for the ornamental, aesthetic and functional (optional) aspects of an industrial product.	Depends: (i) if protected under industrial design sui generis regime, then at least 10 years of protection awarded (Art. 26.3); or (ii) if under copyright regime, then protection at least 50 years post mortem auctoris; or 1.5[ex] (iii) if under sui generis design law and copyright, then duration of protection is at least 25 years.	New or original and independently created. Possible to exclude design from protection if the said design is not significantly different from "known designs or combinations of known design features" (Art. 25.1). Possible to refuse protection for "designs dictated essentially by technical or functional considerations" (Art. 25.1).	Prevention of "making, selling or importing articles bearing or embodying a design which is a copy, or substantially a copy of the protected design" by third parties, especially for commercial purposes (Art. 26.1). Depends on the protection regime chosen. Copyright and unregistered sui generis regimes deliberate copying is prevented but independent development of design is permitted. Under registered sui generis regime, both deliberate copying and independent development of design is prohibited.	Allowed as long as the exceptions: (i) "do not unreasonably conflict with the normal exploitation of protected industrial designs," (ii) "do not unreasonably prejudice the legitimate interests of the owner of the protected design" and (iii) interests of third parties are taken into consideration (Art. 26.2).
Patents	Patent is a protection granted to new process or product inventions, regardless of the technology field. In exchange for the patent protection, the patent applicant has to disclose the invention "in a manner that is sufficiently clear and complete" for a skilled person to carry out (Art. 29.1	20 years from the filing date; if no original grant system then date is computed from the filing date in the system of original grant (Art. 33).	(i) New (ii) Involve inventive step (iii) Capable of industrial application	An exclusive right conferred to patent holder to prevent third parties from using, making, selling or distributing the patented products or products made from the patented process (Art. 28.1). Rights holder can assign or transfer the patented product or process to another holder, and even to conclude licensing contract (Art. 28.2).	Members may exclude from patentability inventions that (i) would have a negative impact on society, i.e. for ordre public or morality reasons; (ii) certain subject matters such as methods for the treatments of humans or animals, plants and animals that have not had any human interventions (Art. 27.3). Several conditions have to be met if using patented invention without the approval of the rights holder either for research purposes or compulsory licensing (see TRIPS Art. 30 and 31 respectively). Transition periods available for: (i) developing, LDCs and transitional economies; (ii) countries with no product patenting for pharmaceutical and agrochemical products.
Layout designs of integrated circuits	Protection offered to IC ("chips" in IT industry) as well as the layout-design of the IC, whereby the IC is in and/or on a piece of material "intended to perform and electronic function and the layout-design of the IC is of three dimensional form that is intended for manufacture" (Washignton, Art 2(i) and 2(ii)).	At least 10 years from date of filing an application for registration or from first commercial exploitation (regardless of where first exploitation took place) (Art. 38.1 and Art. 38.2). Protection may be limited to not exceed 15 years after the creation of the layout design (Art. 38.3). Possible to protect using sui generis, copyrights or patents. Terms of protection thus depends on either one of the categories listed.	Original in the sense that the layout designs are "the result of their creators' own intellectual effort and are not commonplace among creators of layout designs and manufacturers of IC at the time of their creation" (Washington Treaty Art. 3.2(a)).	Protection prevents third parties from "importing, selling or otherwise distributing for commercial purposes a protected layout-design, an IC in which a protected layout-design is incorporated, or an article incorporating such IC only in so far as it continues to contain an unlawfully reproduced layout-design" (Art. 36). Does not protect the layout-design's functionality.	Exceptions for use without authorization of rights holder are the same as applied for patents (Art. 37.2). Also, exceptions provided for those creations that were independently created (Washington Art. 6.2(c)). Compulsory licensing only allowed for (i) anti-competitive grounds; and (ii) for use by government for non-commercial purposes.

IPR	General definition	Term of protection	Criteria for protection	Rights conferred	Exceptions
Undisclosed information	Defined as information that: (a) not generally known or readily accessible to the circle of people who normally deal with the matter in its precise configuration and assembly of its component; (b) has commercial value because it is secret; and (c) reasonable effort has been undertaken to keep the information secret (Art. 39.2). Protection for data submitted for marketing approval of pharmaceutical or agricultural chemical products is highlighted and kept separate from the general treatment of "undisclosed information."	Protection lasts as long as information is kept secret, unless an independent discover publishes the secret. Silent on duration of term of protection on data submitted for marketing approval of pharmaceutical and agricultural chemical products.	Any information that has commercial value because it is secret and actions have been taken to ensure its confidentiality, beyond the key personnel who usually deal with the matter. When data is required to approve marketing of pharmaceutical or agricltural chemical products, which "utilize new chemical entities" that involved "considerable effort" to obtain and is not publicly known, then data submitted should be protected against unfair commercial use (Art. 39.3).	Protection against unlawful disclosure, acquisition and use by third parties in manner contrary to honest commercial practice.	None listed under TRIPS provisions. But differing interpretations of TRIPS Art. 39.3 in developed countries have led to differing practice of allowing use of original data submitted for marketing approval of pharmaceutical and agircultural chemical products to approve generic products (e.g. to prove bioequivalence without having to duplicate test data for generic drugs).

Chapter 3

Does TRIPS Implementation Affect Access to Foreign Technologies?

3.1 Introduction

Access to foreign technologies is important for developing countries.[1] As most developing countries produce few, if none, innovation within their national borders, acquiring and adapting foreign technologies to local conditions could be a partial solution to catching-up with the rest of the world. Firstly, acquiring foreign technology useful for the developing countries would avoid duplicative costs of research and development (R&D). A prime example are foreign technologies that are considered *general purpose technologies* (GPTs) (see Helpman, 1998; Bresnahan and Trajtenberg, 1992). Secondly, accessing, adapting and exploiting foreign technologies may enable developing countries to possibly build their own technological capabilities.

Developing countries can access foreign technologies through trade, foreign direct investment (FDI), licensing and patent applications.[2] Locals in the countries can learn about new technologies from using the imported innovations, working in multinational companies, franchising or licensing technology from overseas, and interacting with foreign colleagues with expertise in particular fields of technology. The importance of these modes of technology transfer, especially trade, FDI and patenting on local economies have been examined by previous researchers and well reviewed in the papers by Keller (2004), Barba Navaretti and Tarr (2000), and Falvey and Foster (2006), respectively. Literature on analyzing the importance of licensing on tech-

[1] I use the terms "access" and "exposure" interchangeably.

[2] Temporary labor migration is another channel for access to foreign technology. The paper by Mansfield (1985) alludes to movement of people as source for technology diffusion and this is also applicable to developing countries' access to foreign technology. However, there is lack of evidence on this channel, probably due to the difficulty of measuring movement of skilled labor and its impact on foreign technology exposure. A recent theoretical paper by Kelly (2009) makes an attempt at showing how learning by imitation can impact technological progress.

nology exposure are usually covered under studies on FDI (see Maskus, 1998; Mansfield, 1993; Horstmann and Markusen, 1987).

Each of these modes of accessing foreign technology can generate positive spillovers to the developing countries (see Archibugi and Pietrobelli, 2003b), which may lead to positive economic growth in the countries through increase in levels of innovative activities in the country (see Thompson and Rushing, 1999; Gould and Gruben, 1996; Thompson and Rushing, 1996). For example, imports of intermediate goods and capital-intensive goods have been shown to increase total factor productivity in the importing countries (Coe et al., 1997). Furthermore, exposure to foreign technologies has enabled some countries to build their innovative capacities through learning by doing and by using as evidenced in countries like Japan, South Korea and Taiwan (Kumar, 2002).

However, accessing foreign technologies is different from diffusion of these technologies. The difference lies in how these foreign technologies are employed in countries acquiring them. *Exposure* implies that countries can access the new technologies while *diffusion* suggests that these countries can absorb the new technologies acquired, usually because they have some sustainable levels of absorptive capacities. This paper focuses on the exposure to foreign technologies and does not deal with diffusion of technologies.

In this paper I question whether the implementation of the *Trade-related Aspects of Intellectual Property Rights* (TRIPS) agreement improves developing countries' exposure to foreign technologies. This global policy on intellectual property rights (IPR) protection has strengthened many developing countries' protection of intellectual property (IP) systems with the general objective of ensuring that relatively free movement of technology intensive goods and services around the world.[3] Given that the TRIPS agreement protects intellectual creations as embedded in goods or services, this strengthened IPR policy should affect and influence the flow of trade, FDI, licensing and patenting activities into the countries implementing the Agreement.

I investigate whether developing countries' compliance with the TRIPS agreement facilitates their exposure to foreign technologies via trade, FDI and licensing.[4] My objective in this paper is to apply the newly built TRIPS-specific index to the three observable channels of technology exposure. I consider the legislative implementation of the Agreement as well as its enforceability

[3]The TRIPS agreement is specific to movements of goods, as specified in its preamble. However, given the intangible aspect of intellectual creation, either via process or product, TRIPS inherently covers services as well.

[4]I refrain from analyzing the impact of TRIPS protection on patenting activities since patenting activity is highly dependent on specificities of local patent protection, such as patentable subject matters. In addition, comparable and reliable patenting data for developing countries is lacking.

in answering my research question. I further make the distinction between the developing countries in my sample by distinguishing those with varying degrees of innovative capacities.

Results show that developing countries' compliance with TRIPS agreement does influence their exposure to foreign technologies, and that this impact varies according to the countries' absorptive capacities to a certain extent. The effect becomes more pronounced when I include a proxy to capture local government's commitment to enforcing the legislation.

In the following section I review relevant literature investigating the influence of IPR protection on trade, FDI and licensing and introduce the theoretical framework for my empirical research. In the third section I outline the methodology for my investigation. I present the results and analyze them in the penultimate section. And the last section concludes with discussion on the limitation of this paper.

3.2 IPR and accessing foreign technologies

Falvey and Foster (2006) and World Bank (2008) conduct extensive and exhaustive reviews on the issue of IPR protection and technology diffusion. Reviewing all the previous research on this subject matter here would be redundant. In this section I select and survey a few of the empirical literature on the matter, focusing on their approaches to answering their research questions. Table 3.1 on page 54 summarizes the studies mentioned here.

3.2.1 Channels of foreign technology exposure

Research studies analyzing the impact of IPR levels of protection and exposure to foreign technologies differ as to whether strengthened IPR protection unambiguously increases trade, FDI and/or licensing activities. Most of the differences in the research results stem from difficulty in measuring the channels of foreign technology exposures and IPR strengths.

The seminal work by Teece (1986) on assessing how the *appropriability* regime, the *complementary assets* and *dominant design paradigm* affect firms' business strategies to service the market is as an appropriate framework to analyze how IPR can affect the channels of foreign technology exposure. He argues that firms can plan a strategy to introduce its invention based on these three dimensions.

In our particular case, the *appropriability* regime and *complementary assets* are useful factors to consider when discussing how IPR protection can affect developing countries' access to foreign technologies. The *appropriability* regime refers to the existence of weak or strong IPR system

while *complementary assets* refer to potential rival firms that have capacity to imitate the firm's technological innovation in developing countries.

An innovative firm can choose to service the foreign market either through trade, FDI or licensing.

When IPR regime is weak but there are no potential or existing rival firms, trade may be the least risky method to service the foreign market. However, when the IPR regime is weak but there are some potential or existing rival firms, then establishing a subsidiary in the market may be the best strategy. On the other hand, when the IPR regime is strong, then the technological innovator could service the developing country market through trade, if there are no rival firms and by licensing, if there are some rival firms.[5]

Therefore, there may be a trade-off between trade, FDI and licensing activities. This trade-off gives rise to the mix impact of each one of these channels of foreign technology exposure when assessing the influence of strengthened IPR protection. In addition, firms can choose to service foreign markets via various combinations of the three channels.

Most empirical studies tend to be optimistic about the relationship of strengthened IPR protection and trade, FDI and licensing activities. This impact can be further amplified when the countries accessing these technologies have some level of imitative abilities.[6] Countries with higher imitative abilities tend to witness increase in their exposure to foreign technologies, while those with weak imitative abilities see none, or negative impact of strengthened IPR protection (Smith, 1999; Yang and Maskus, 2001).

Trade

Maskus and Penubarti (1995) and Rapp and Rozek (1990) find that strengthened IPR protection does significantly and positively increase imports in general, but Fink and Braga (1999) could not find the same significant relationship for trade of high technology imports. Nevertheless, recent empirical studies employed with more detailed observations find significant and positive impact of strengthened IPR protection on trade, given the sectors considered and the level of imitative abilities of the importing countries (Park and Lippoldt, 2007; Smith, 1999).

Park and Lippoldt (2007) examine the aggregates of imports to and FDI flows of 120 countries comprising of developed, developing and least developed countries (LDCs). They use three

[5] In this case, the rival firms are not exactly rivals but rather potential collaborators or partners.
[6] I use the terms "imitative" ability to refer to the ease with which locals can reproduce new technologies.

different proxies to capture IPR protection effects, patent protection of Ginarte and Park (1997), copyright and trademark protections. Their findings show different impacts of trade from each one of these IPR types, with patent protection strongly affecting trade, trademark exerting a slight impact on trade and no significant impact from copyright protection. Interestingly, they find that the IPR effect on imports is quantitatively highest in developed countries. Given that patent rights strength tend to be highly correlated with levels of economic development (Maskus and Penubarti, 1995; Ginarte and Park, 1997; Rapp and Rozek, 1990), it could be possible that this IPR measure could be capturing the market size, or effectiveness of legal institutions and infrastructure in the countries rather than the IPR impact.

Smith (1999) employs United States of America (U.S.) state-level aggregate manufacturing export data at 2-digit industry codes to 96 countries in the year 1992. Similar to Park and Lippoldt (2007), she finds that strengthened patent protection does increase flow of U.S. exports and that this impact varies across industrial sectors. In addition, she divides her sample of countries by their income levels and divides her countries into four categories depending on their imitative abilities and strength of patent protection. Therefore Smith considers three dimensions of the importing countries: their level of economic development, imitative abilities and patent strength. She finds that most of the differences in patent index on trade can be explained by the importing countries' imitative abilities. In particular, she finds that strengthened IPR protection increases U.S. exports flow to countries with high imitative abilities but decreases exports for those with weak imitative abilities.[7] Smith argues that the contraction of exports from the United States to countries with weak imitative abilities is probably an exercise of market power.

She explains that the contraction in the flow of U.S. exports to countries with weak imitative abilities as the U.S. firms' exercise of monopoly power over the countries.

FDI

Governments of developing countries have underscored the importance of attracting FDI into their countries, given that the benefits and the spillover impact of foreign multinationals establishing subsidiaries in the countries can be quite significant. However, evidence of FDI generating positive spillovers on developing countries has been mixed (see Görg and Greenaway, 2004; Aitken and Harrison, 1999). Nevertheless, empirical studies investigating the impact of IPR on attracting FDI assume that FDI is generally beneficial for the host country.

Most of the empirical findings show that strengthened IPR protection positively and signif-

[7]Smith (1999) distinguishes countries by their threat of imitation using R&D per gross national product and patent index developed by Ginarte and Park (1997).

icantly influences FDI inflow to countries (see Park and Lippoldt, 2007; Javorcik, 2004; Lesser, 2002; Lee and Mansfield, 1996; Seyoum, 1996), except for Kondo (1995).

Seyoum (1996), using an IPR index that covers copyright, trademark, patent and trade secret protections built through surveys sent to practitioners in 27 different countries, finds that differences in countries' FDI level can be explained mainly by their IPR protection levels, 43% for newly industrializing countries and 35% for developed countries respectively. These IPR impacts are quantitatively more important than the countries' respective economic policy variables, implying that differences in FDI levels are mainly explained by the IPR levels rather than other economic policy variables such as market size and public investments.

The study by Park and Lippoldt (2007), reviewed earlier in regards to trade, also considers how FDI is affected by IPR protection. Unlike in the case of trade, they find that all three types of IPR protection significantly and positively affect FDI inflows to the countries studied. And similar to their earlier finding of relationship between trade and IPR protection, their result shows positive and quantitatively higher impact of IPR on FDI for developed countries.

More important than levels of FDI inflow into developing countries is the type of FDI activity undertaken in the host country. Javorcik (2004) shows that while IPR increases the likelihood of FDI, the type of FDI activities undertaken in the Eastern European countries studied change from distribution to manufacturing. This change in composition of the FDI activities is a positive finding given that manufacturing FDI activities can be assumed to generate more positive spillovers than distribution types. She uses two proxies for IPR protection, one by Ginarte and Park (1997) and another which she constructs using the International Intellectual Property Alliance's (IIPA) list of *Special S301* countries for the United States Trade Representative's (USTR) consideration.[8] Javorcik's finding echoes the findings of Branstetter et al. (2007) and Mansfield (1994).

Mansfield (1994) is the one of the first few papers to establish how IPR protection influences access to foreign technologies. Results from his survey conducted in 1991 on how IPR protection affects 100 U.S. multinational companies operating in developing countries show that IPR protection influences the type of FDI activities in the host countries. This impact is especially important for multinationals engaging in R&D in the host countries, as well for multinationals operating in IPR-sensitive industrise such as the chemical industry.

[8]Every year, the IIPA, which lobbies for enforcement of copyright protection worldwide, publishes a list of countries that it considers as serious offenders of copyright protection to the USTR. A subset of these countries usually appears in the USTR's list of *Special S301*. Countries who continue to be on the list may be have special trading rights revoked by the United States, such as the *special and differential treatment* rights.

However a recent paper by Zhao (2006) convincingly shows that multinationals can employ different internal organization structures, benefit from the low cost but relatively highly educated human capital and minimize its risk of IPR expropriation by local competitors. Therefore, IPR protection may not be an important element for developing countries to have so as to be exposed to foreign technology through FDI, especially when there are other factors such as low cost of production and internal organization that could prevent IPR violations.

Licensing

Royalty and license payments are indicative of licensing activities, and it seems to be the only channel of foreign technology exposure where there is actual transfer of technology to the country licensing it. However, it cannot be ascertained if the technologies licensed are new. In general, studies show that strengthened IPR protection facilitates licensing activities.

The paper by Yang and Maskus (2001) was one of the first few to directly consider the impact of patent protection on technology transfer, as proxied by royalty and license fees. They conduct an econometric study of how patent protection affects the flow of U.S. licensing to affiliated and nonaffiliated firms in 23 countries, using the Ginarte and Park (1997) index on patent protection. They find that increase in patent protection affects licensing in a non-linear manner. Specifically, strengthened patent protection negatively affects licensing activities of countries that initially have weak patent protection. After a specific patent protection level, further increases in the patent right positively impacts the licensing activities from the United States.

Yang and Maskus explain that the significant and different effect of patent protection on licensing activities could be attributable to the fact that patent rights strength correlates highly with the countries' imitative abilities, measured by ratio of skilled labor endowment. They argue that in countries where there is limited imitative abilities, strengthened patent protection would reduce the cost of licensing the new technology to the licensor which enables the licensor to appropriate more rent from the technology licensed. This increased rent received from the licensing country gives less incentive to the technology producer to innovate more and thus decreases the total number of licensing activities to the country.

However, countries that have reached and exceeded the specific critical patent protection level tend to have higher imitative abilities. As such, marginal increase in the patent protection level for these countries would facilitate more licensing activities.

Co (2007) runs a similar study to Yang and Maskus (2001), but differs by considering how the local imitative abilities influence licensing activities. In addition to employing the Ginarte and Park (1997) patent protection index, Co follows Smith (1999) in distinguishing between countries with high imitative abilities and low imitative abilities. Dummies for high imitative ability equals one when the country's R&D expenditure as a percentage of gross national product is higher than the median R&D expenditure across countries sampled for a particular year, and zero otherwise. She finds there is a positive and significant relationship between patent protection and technology transfer in countries with high imitative abilities, but negatively for those with weak abilities. Her results concur with the Yang and Maskus (2001), although unlike their paper she assumes linear relationship of licensing and patent protection.

Modes of foreign technology exposure: substitutes or complements

Recent empirical studies have concurrently studied the effects of IPR protection on the different channels of technology transfers. The rationale behind this is that there may be an impact of IPR protection on one channel of technology transfer which may then be offset in another channel. As Ferrantino (1993) clarifies, IPR protection concurrently affects trade, FDI and licensing activities simultaneously.

Ferrantino (1993) considers how host countries' IPR protection level influences U.S. firms choice between exporting or establishing subsidiaries in those countries. Using export and sales of foreign affiliates data of U.S. firms for the period 1982 and using membership to the Paris Convention as existence of strong IPR protection, he finds no significant impact of IPR protection on trade or FDI. However, Ferrantino shows that subsidiaries in countries with strong IPR protection tend to receive more component sources from and have higher royalty payments made to their firms located in the United States. His finding echoes those of Javorcik (2004), suggesting that strong IPR protection affects the composition of FDI activities in host countries.

Smith (2001) examines how IPR protection simultaneously influences the flow of U.S. exports, affiliate sales and licenses for 50 countries from different income levels for the period 1989, taking into consideration the countries' respective levels of imitative abilities. She finds that strengthened IPR protection, as measured by Rapp and Rozek (1990) patent index, facilitates technology transfer for all of the three modes and that this effect is stronger for countries with strong imitative abilities.

And lastly, McCalman (2004) considers how firms in the music industry choose between licensing or establishing affiliates based on the host countries' patent protection. Using the

patent protection index as measured by Ginarte and Park (1997) index, he finds that higher patent protection positively affects licensing activities.

Table 3.1 on page 54 provides a summary of the empirical work investigating the impact of strengthened IPR protection on developing countries' exposure to foreign technologies mentioned here. In general, most studies find that strengthened IPR protection induces FDI inflow but that its impact of trade and licensing activities could be dependent on the host countries' imitative abilities.

Table 3.1: Summary of literature review on IPR protection and access to technology in alphabetical order

Paper	**Dependent variable**	***in-book* IPR**	**actual IPR**	**Imitative abilities**	**Sample**	**Results**
Co (2007)	Bilateral flow of U.S. royalties and license fees and services for the period 1989 – 2002	Ginarte and Park (1997) patent index		Dummy variable = 1 if $\frac{R\&D\ expenditure}{GNP}\% >$ median, 0 otherwise	29 countries; of which 15 are developed countries	Positive influence of patent protection on licensing activities
Fink and Braga (1999)	Bilateral trade flow for total non-fuel and high technology trade in 1989	Ginarte and Park (1997) patent index			88 countries from varying income levels	Positive impact of IPR protection on total non-fuel imports (and exports); but negative and insignificant impact on high technology trade flows
Kondo (1995)	U.S. outward FDI for the period 1976 – 1987		survey built from own questionnaire		35 countries	No evidence that patent protection affects FDI
Lee and Mansfield (1996)	100 U.S. firms' FDI volume and composition to 14 developing countries in 1991		Mansfield (1994) index built from survey of 100 U.S. firms		14 developing countries	Positive influence of IPR protection on the volume and composition of FDI
Lesser (2002)	Merchandize imports; FDI inflow; high-technology exports and royalty payments in 1998	built own IPR index	Transparency International's *Corruption Perception Index*		99 countries, of which 44 are developing countries	Positive impact of IPR protection on total imports and FDI inflow, positive but not significant for high technology exports and royalty payments
Maskus and Penubarti (1995)	Bilateral imports for 28 manufacturing sectors in 1984	Rapp and Rozek (1990)		countries split according to income levels	OECD countries and 25 developing countries	Correcting for possible endogeneity of patent rights index with levels of economic development and openness of countries; find that patent strength does positively determine trade flow into small and developing countries; this impact varies according to sectors — *market power* effect is more prominent in patent-sensitive sectors

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Table 3.1: (continued)

Paper	Dependent variable	*in-book* IPR	actual IPR	Imitative abilities	Sample	Results
McCalman (2004)	Firm-level data on FDI and licensing activities of Hollywood studios in 1997	Ginarte and Park (1997) patent index			40 countries, of which 18 are developing countries	Assuming non-linear impact of patent strength on firms' decision to either license or establish affiliate in foreign technology, finds that firms are likelier to establish an affiliate rather than license in countries with either low or high patent protection system. For countries with moderate patent protection, firms are likelier to enter into licensing agreements
Park and Lippoldt (2007)	Total imports or exports as a share of GDP; and by sectors	Park (2008) patent; Park and Wagh (2002) on copyright and trademark protection			120 countries, of which 25 are developed, 70 are developing countries and 25 LDCs	Patent protection positively and significantly affect trade at the aggregate levels, impact varies according to sector; trademark has slight impact on trade; copyright has no impact on trade
Seyoum (1996)	Aggregate FDI inflows for 1975 – 1990				27 countries, of which 9 are developed	Positive impact of IPR protection on FDI inflow
Javorcik (2004)	Firm-level dataset on FDI activities in 1995	Ginarte and Park (1997) patent index	IIPA[1] recommendation for S301 Watch List		24 developing countries of eastern Europe and former Soviet Union	IPR protection increases likelihood of FDI activities undertaken in IPR sensitive sectors. It also encourages local production activities rather than just distribution activities.
Smith (1999)	Bilateral trade equations of state-to-country manufacturing exports by industrial sectors in 1992	Rapp and Rozek (1990); Ginarte and Park (1997) patent indexes		$\frac{R\&D\ expenditures}{GNP}\%$	96 countries consisting of developed, developing and LDCs	Dividing countries according to their income levels and imitative abilities, she find that countries with weak imitative abilities but strong patent rights experience *market power* impact when IPR strengthened; while those with high imitative abilities but weak initial IPR protection observe *market expansion* effect when patent rights are strengthened

Continued on Next Page...

Table 3.1: (continued)

Paper	Dependent variable	*in-book* IPR	actual IPR	Imitative abilities	Sample	Results
Smith (2001)	Bilateral exports, FDI and royalty and license fees from the U.S. in 1989	Rapp and Rozek (1990); Ginarte and Park (1997) patent indexes		Strong (weak) imitative abilities dummy variable = 1 if $\frac{R\&D\ technicians}{1{,}000{,}000} >$ (<) 1000; 0 otherwise	49 countries; 22 are developed countries	Find strong positive relationship between patent protection and exports, FDI and licensing activities. This relationship is enhanced when the countries have strong imitative abilities.
Wakasugi (2007)	Firm-level data of Japanese MNCs' foreign subsidiaries in 1995 and 2001	Park and Wagh (2002)			33 countries	Stronger patent protection has positive effect on the promotion of intra-firm technology transfer
Yang and Maskus (2001)	Unaffiliated licensing fees and royalties; unaffiliated fees for using industrial processes; affiliated licensing fees and royalties and unaffiliated licensing fees and royalties relative to trade volumes in 1985, 1990 and 1995	Ginarte and Park (1997) patent index		Ratio of skilled labor to total labor	23 countries; of which 13 are developed countries	Find non-linear relationship between patent protection and variables proxing licensing activities to affiliates and non-affiliates in foreign countries. Patent protection negatively impacts licensing activities but its squared value positively influences licensing activities. However, the ratio of unaffiliated licensing fees and royalties to trade volume is strictly positive.

[1]International Intellectual Property Alliance

3.2.2 Simple framework

This paper investigates how developing countries' implementation of the TRIPS agreement affects their exposure to foreign technologies. In order to do so, I employ a recently built TRIPS-specific index to examine the subject matter.

TRIPS agreement differs from previous international IPR standards. It sets the minimum level of international IPR protection, standardizing protection across World Trade Organization (WTO) member countries. The Agreement is in essence a combination of the main international rules governing IPR protection, such as the Paris Convention (1883), Berne Convention (1886), and Rome Convention (1961), but with less implementation flexibilities and an effective international enforcement mechanism of the WTO's dispute settlement mechanism. It also includes provisions of the Washington Treaty (1989) on integrated circuits, acknowledges the protection of undisclosed information as a formal IPR type, and ensures that computer softwares are protected as copyrights with minimum term of protection set at the author's life plus 50 years.

The literature reviewed in previous subsections are predominantly based on patent protection indexes. These indexes, while still relevant today, are not completely TRIPS-specific. Patent protection explains one-seventh of the types of IPR protection declared by the TRIPS agreement. In order to capture countries' compliance with the TRIPS agreement, we should use an index which captures particular aspects of the Agreement. An extensive description of how the TRIPS agreement differs from all other international IPR agreements and review of all available IPR indexes are documented Hamdan-Livramento (2009) and will not be reviewed here.

The impact of strengthened IPR protection should be more pronounced for countries with some level of imitative abilities. As Mansfield (1985) finds in his survey of 100 American manufacturing multinationals, countries with some level of imitative abilities present higher risk for technology exporting firms. Therefore, developing countries' access to foreign technology is highly dependent on their imitative abilities.

Proposition 1 *Strengthened IPR protection through TRIPS compliance could significantly influence developing countries' exposure to foreign technologies, and the significance of this influence varies according to the countries' level of imitative abilities.*

Legislative compliance with TRIPS agreement may not be sufficient in facilitating access to foreign technologies, enforcement of the Agreement is also necessary. Recent finding of WTO

dispute settlement panel report on China's enforcement measure attests to this importance (WTO, 2009). The United States argued that China, while having implemented its TRIPS obligations in its legislation, had not been enforcing the rights of its obligations in practice. The panel report found in favor with the United States's claim.

I highlight the difference between statutory compliance and actual enforcement because countries may fulfill their TRIPS obligations according to their legislations, but may not administer or enforce these rules as they should, as the WTO case mentioned above proves. I refer to *actual* enforcement as the type where the government does not properly enforce its legislations, either because of budgetary or lack of proper infrastructure to do so. This enforcement aspect should not be confused with the statutory enforcement outlined in the Agreement detailing specific legal avenues and course of action in case of an infringement.

Proposition 2 *In-book TRIPS compliance is not enough to significantly impact channels of technology transfer. Developing countries that implement the TRIPS legislation in practice are more likely to see the influence of TRIPS on access to technologies rather than those that only comply with the Agreement but do not enforce those agreements actively.*

3.3 Data collection

I examine how compliance with TRIPS agreement affects developing countries' imports, FDI and royalty and licensing payments for 53 developing countries for the time period 1994–2005. I attempt to reproduce prior findings on the three channels of developing countries' exposure to foreign technologies through econometric estimations. The list of 53 countries in this sample can be found in the appendix on page B–72.

Four main factors separate my research from other empirical studies on this subject matter. Firstly, I employ an index that specifically captures countries' compliance with the TRIPS agreement. Most empirical papers use patent-specific Ginarte and Park (1997) index, which measures changes in patent protection every 5 years.

I further make a distinction between legislative compliance with TRIPS agreement and the enforcement of the agreement by interacting the index with how the governments in the countries studied enforce laws in general. This enforcement measure is different from the "enforcement" provisions highlighted by the Agreement, which can loosely be considered as rules outlining actions to be undertaken at the border with regards to counterfeited goods, and legal avenues

available for injured parties to obtain remedies for any infringements (Part III of the TRIPS agreement). The type of enforcement that I try to capture in this paper is the governments commitment to apply the TRIPS rules and regulations.

Thirdly, I only consider developing countries that enter the WTO membership in the same year, 1995. This allows me to omit countries that may have had long traditions of IPR protection, as most developed countries have, and focus on countries that are "new" to strengthened levels of IPR protection. Using cohorts of WTO member countries who joined in 1995 also controls for any signalling impact that the membership may have on exposure to foreign technologies.

And lastly, I use the Archibugi and Coco (2004) technological index ($ArCo$) to distinguish between developing countries' levels of imitative abilities. This index assesses countries' technological capacities by looking at their technology creation, technological infrastructure and human skills development. This approach allows me to consider countries that have some imitative abilities even if they do not produce the usual indicators of innovative activities, such as patenting, R&D expenditures and number of scientific articles published. Most of the countries in my sample are developing countries, and so the $ArCo$ index captures their abilities to reproduce new technologies.

3.3.1 Dependent variables

My three dependent variables are aggregate imports, net inflow of FDI and, licensing payments, to be estimated separately, in constant U.S. dollars over the period 1994 to 2005. Data for aggregate imports is collected from the World Bank's World Development Indicator 2007, FDI from UNCTAD's World Investment Report 2008, and finally royalty and license payments, licensing, from the IMF's Balance of Payment database.[2]

3.3.2 Explanatory variables

TRIPS index

TRIPS identifies seven categories of IPR: copyrights and related rights, trademark, geographical indications, industrial designs, patents, layout designs of integrated circuits and undisclosed information. The available indexes mainly focus on patent protection. A few of available IPR indexes, such as Seyoum (1996), and Park and Lippoldt (2007) do cover other IPR types than

[2]I attempted to collect bilateral trade, FDI and royalty payments data to follow the seemingly unrelated regression method that Smith (2001) employs. While bilateral data on trade could be easily collected from the UN COMTRADE database, those of bilateral FDI data are not as easily accessible without having to pay a significant amount of contribution. In addition, data on bilateral royalty and licensing payments seem non-existent.

just patent protection, unlike Rapp and Rozek (1990), however they are limited in terms of years surveyed and numbers of countries covered. The list of countries flagged by the IIPA for weak copyright enforcements, as used by Javorcik (2004), looks at copyright only and is probably biased by the market size of the countries flagged.

The index I employ in this paper examines developing countries' compliance with their TRIPS obligations annually from 1994–2006. The Park and Lippoldt (2007), and Ginarte and Park (1997), indexes used in papers reviewed earlier only capture legislative changes every 5 years, possibly averaging out impacts of legislative changes that may occur annually.

And lastly, the TRIPS index I employ in this study is not highly correlated with countries' level of economic development, unlike the Ginarte and Park (1997) index. Prior to TRIPS countries were able to apply the level of IPR protection that suited its industrial policies best. Thus countries who have not built their capacities to innovate tended to have weaker IPR protections while those countries that have attained a specific level of economic development tended to have higher IPR protection, likely reflecting their high innovative capacities. But given the TRIPS agreement, these countries have to apply this minimum level of IPR protection regardless of their development levels.

The following Table 3.2 summarizes how the Hamdan-Livramento (2009) index is constructed. The index is an unweighted sum of the seven IPR types listed in the Agreement, ranging from 0 to 7, where a TRIPS index of 7 implies that the country is fully compliant with its TRIPS obligations. The index gives equal weighting to each IPR category but since I am only interested in analyzing how levels of TRIPS compliance affects the modes of technology transfer, this does not pose a major problem.

In similar vein to Smith (1999), I take into consideration the countries' imitative abilities in analyzing how strengthened IPR protection could affect their exposure to foreign technologies. Smith divides the sample of her countries into four categories: those with high imitative abilities but weak IPR protection, high imitative abilities with high IPR protection, low imitative abilities but weak IPR protection and those with low imitative abilities and high IPR protection. In building her dummy variables to divide her countries into four categories, Smith considers their R&D expenditure as percentage of the gross national product and the Ginarte and Park (1997) patent strength index. Unlike Smith who considers cross-section sample, I have a panel of 53 countries for 11 time periods.

In addition, I use the *ArCo* index to account for the countries' varying levels of imitative

IPR Category		Total
Copyright and related rights		1
Computer program	$\frac{1}{3}$	
Rental rights	$\frac{1}{3}$	
Related rights	$\frac{1}{3}$	
Trademark		1
Geographical indications		1
Industrial designs		1
Patents		1
Patents	$\frac{1}{3}$	
Pharmaceutical patents	$\frac{1}{3}$	
Plant varieties	$\frac{1}{3}$	
Layout designs of integrated circuits		1
Undisclosed information		1
Trade secrets	$\frac{1}{2}$	
Data submission	$\frac{1}{2}$	
Total		7

Table 3.2: TRIPS index method

abilities. Countries with imitative abilities are able to copy new technologies and under weak IPR protection, the risk of IPR expropriation is significant. As such, higher IPR protection level in those countries should affect the countries' exposure to the foreign technologies. The variable $dArCo\_1$ takes the value of 1 when the countries are classified as "leaders", "potential leaders", and "latecomers", and 0 otherwise. I further distinguish between these subset of countries with some imitative abilities by creating the dummy variables *dArCo_lead* and *dArCo_late*, corresponding to countries with high- and low imitative abilities respectively. Dummy variable *dArCo_lead* takes the value of 1 when the countries are designated as "leaders" and "potential leaders", and 0 otherwise, while *dArCo_late* takes on the value of 1 when the countries are "latecomers", and 0 otherwise.[3] Table 3.3 summarizes the dummies assigned to differentiate between countries' imitative abilities.

ArCo	**Imitative abilities dummies**		
categories	*dArCo_1*	*dArCo_lead*	*dArCo_late*
Leaders	x	x	
Potential leaders	x	x	
Latecomers	x	x	x
Marginalized			

Table 3.3: Dummies for imitative abilities

And lastly, I interact the TRIPS index with data collected by the World Bank on *rule of law* to take into consideration the actual enforcement of the TRIPS agreement. This variable measures the locals' confidence in its government to enforce the law. The World Bank describes

[3]See the appendix for more information on how the *ArCo* index differentiates between the four levels of technological capabilities.

it as "the extent to which agents have confidence in and abide by the rules of society, in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence." I refrain from using other measures of IPR enforcement, such as countries flagged by the IIPA, like Javorcik (2004), or those compiled by the IMD and the World Economic Forum institutions because of their inadequate coverage of years and countries. The variable *rule of law* index ranges from -2.5 to 2.5, with 2.5 being the maximum value achievable.[4]

Control variables

Purchasing power - I measure countries' purchasing power by using GDP per capita in constant U.S. dollars. Developing countries with higher GDP per capita will purchase more goods on average. I expect this variable to be significant and positive as higher purchasing power indicates higher demand and so should positively impact the modes of technology transfer. Data is collected from the World Bank's World Development Indicator 2007.

Market size - I measure market size using countries' total population size. Larger population indicates more demand. I expect the coefficient associated with this market size measure to be significant and positive. Data is collected from the World Bank's World Development Indicator 2007.

Open - Countries that trade more are likely to have open regimes. Openness is measured as the total imports plus exports per country's GDP. The more open countries are, the easier it would be to have access to foreign technologies. I thus expect the measure to be significant and positive. Data is collected from the World Development Indicator 2007.

The descriptive statistics and correlation table for these variables can be found in the appendix on pages B–73 and B–74 of this paper. There is no problem with correlation between the explanatory variables except for the various permutations of the TRIPS index with the dummies measuring countries' imitative abilities.

3.3.3 Regression methods

I estimate the following log-linear model specification to answer *Proposition 1*:

$$ln(X_{i,t}) = \alpha + \beta_1 * ln(GDPcap_{i,t}) + \beta_2 * ln(Pop_{i,t}) + \beta_3 * (Open_{i,t})$$

[4]The *rule of law* measure starts from 1996, but I assumed that the measure did not change very much and used data from 1996 for the years 1994–1995.

$$+\gamma_1 * (TRIPS_{i,t-1}) + \gamma_2 * (TRIPS * dArCo\_1_{i,t-1})$$
$$+\gamma_3 * (TRIPS * dArCo\_lead_{i,t-1}) + \gamma_4 * (TRIPS * dArCo\_late_{i,t-1})$$
$$+\epsilon_{i,t} \quad (3.1)$$

where $X_{i,t}$ refers to the three channels of technology transfer, trade, FDI and licensing at time t, $TRIPS_{i,t-1}$, $TRIPS*dArCo\_1_{i,t-1}$, $TRIPS*dArCo\_lead_{i,t-1}$, and $TRIPS*dArCo\_late_{i,t-1}$ refer to the TRIPS index and its permutations according to levels of imitative abilities from the year before. I assume that the countries' past year TRIPS compliance and its permutations influence the current access to foreign technologies.

In order to test *Proposition 2*, I modify Eq. 3.1 above to include the index of TRIPS interacted with a variable that captures government enforcement dimension:

$$\begin{aligned} ln(X_{it}) &= \alpha + \beta_1 * ln(GDPcap_{i,t}) + \beta_2 * ln(Pop_{i,t}) + \beta_3 * (Open_{i,t}) \\ &+\gamma_1 * (TRIPS_{i,t-1}) + \gamma_2 * (TRIPS * dArCo\_1_{i,t-1}) \\ &+\gamma_3 * (TRIPS * dArCo\_lead_{i,t-1}) + \gamma_4 * (TRIPS * dArCo\_late_{i,t-1}) \\ &+\gamma_5 * (TRIPSr_{i,t-1}) + \gamma_6 * (TRIPSr * dArCo\_1_{i,t-1}) \\ &+\gamma_7 * (TRIPSr * dArCo\_lead_{i,t-1}) + \gamma_8 * (TRIPSr * dArCo\_late_{i,t-1}) \\ &+\epsilon_{it} \quad (3.2) \end{aligned}$$

where $X_{i,t}$, $TRIPS_{i,t-1}$, $TRIPS * dArCo\_1_{i,t-1}$, $TRIPS * dArCo\_lead_{i,t-1}$, and $TRIPS * dArCo\_late_{i,t-1}$ are the same as in the previous equation. The difference between Eq. 3.1 and Eq. 3.2 is the inclusion of the variable, $TRIPSr_{i,t-1}$, the interaction of two continuous variables, the TRIPS index and the *rule of law* index.

3.4 Results and analysis

There are three possible outcomes of how TRIPS compliance can influence any one of the developing countries' channels to access foreign technologies. In the first case compliance with the TRIPS agreement has no significant impact on the channels of technology access. This

outcome would imply that TRIPS protection is not a main issue for how technology transfer takes place, either for trade, FDI or licensing.

A second possible outcome is *market expansion* effect, whereby there is a positive and significant relationship between TRIPS implementation and the means of technology exposure. Innovative firms increase their supply of goods or services to the developing country markets because they no longer face risk of imitation from local firms. *Market expansion* thus refers to the foreign firm *expanding* the penetration of its goods and/or services into the developing countries' markets.

Lastly, strengthened IPR protection through compliance with TRIPS in developing countries' markets could influence firms to exert their *market power*. Strengthened IPR protection via TRIPS implementation implies that foreign innovative firms face lower risk from imitation of their goods or services in the local markets. But instead of an increase in the supply of goods and/or services from these firms, the developing countries observe contraction in their exposure to foreign technologies. The only plausible explanation for this outcome is that the innovative firms decide to exercise their monopoly control, arguably in an anti-competitive manner, over the goods and/or services and extract further rent from the markets in the developing countries.

In this section I report my findings and proceed to analyze the results. In general TRIPS compliance influences FDI and licensing modes of technology diffusion, especially when we taken into consideration the countries' imitative abilities. This influence is prominent when the compliance also includes the enforcement, as in the case for imports.

3.4.1 Estimation methods

I run separate regressions for the three variables that measure access to foreign technologies: imports, FDI and licensing activities. I first pool the observations together and run ordinary least square (OLS) estimations, clustering the standard errors by countries to account for possible correlation between the errors from one year to the next per country. I then test whether pooling and running OLS regression is appropriate and find that panel regressions of fixed effect (FE) and random effects (RE) estimations are superior to the pooled OLS ones. For all the models estimated, I correct for heteroscedasticity using robust White standard errors and include year intercepts to account for year-specificities.[5]

[5]I run a Wald joint-significance test on the coefficients of the year-intercepts and reject the null hypothesis at 5% significance level.

Using the Hausman test, I find that for regressions using FDI and licensing as dependent variables respectively can be estimated using the RE estimation while import should be estimated using the FE.

One of my dependent variables, licensing, has some zero values for certain countries, implying that some countries do not license any technologies. The appropriate model would be to use the Tobit model. I run pooled Tobit and panel Tobit RE estimation censored at lower-limit of zero to account for these zero values. The results from the Tobit estimation do not deviate significantly from panel estimations.

For every regression model I run, using the three dependent variables separately, I find that the control variables capturing purchasing power, market size and openness are significant and positive as per expectation. The outputs for models estimated for each dependent variable capturing access to foreign technology can be seen in the appendix. I report the regression output of pooled OLS, FE- and RE- estimations side-by-side according to the equations that I estimated.

Recall that in Eq. 3.1, I attempt to investigate how TRIPS compliance affects imports, FDI and licensing respectively. I then estimate a permutation of Eq. 3.1 with the interaction variable of TRIPS index and the enforcement variable, *rule of law*, which I refer to as Eq. 3.1'. And lastly I estimate Eq. 3.2 which considers how both in-book and actual enforcement of TRIPS compliance affects the channels of exposure to foreign technologies.

In order to facilitate analysis of the regressions estimated, I report the estimates of the TRIPS in-book and enforcement variables, as well as the interaction with the dummies capturing levels of imitative abilities, in Tables 3.5, 3.6 and 3.7 respectively. A summary of the regression estimated for equations (3.1), (3.1') and (3.2) can be found in Table 3.4. Each column in Table 3.4, and thus also in Tables 3.5, 3.6 and 3.7, correspond to specific model estimation. I report the full regressions for each dependent variables of imports, FDI and licensing in the appendix. Estimations for Eq. 3.1 are on pages B–75 onwards, Eq. 3.1' are on pages B–79 onwards and Eq. 3.2 are on pages B–83 onwards.

Each column reported in the tables below correspond to the models that I estimated. Column I is the baseline model where I run the dependent variable against the control variables of countries' purchasing power, market size and openness. It also includes year-specific effects. Columns II until III are estimations of the baseline model and includes TRIPS index and its permutations of variables *TRIPS*dArCo_1*, *TRIPS*dArCo_lead* and *TRIPS*dArCo_late*. In

column IV I estimate all the TRIPS variables together. These regression models provide results to answer my first hypothesis in *Proposition 1*.

Columns II', III' and IV' are similar to the regressions I run for *Proposition 1*, but the difference is that I now use the *TRIPSr* measure, capturing both the countries' TRIPS compliance and the government enforcement of the legislation. The same interpretation given above applies for columns I' until IV' for Eq. 3.1'.

In columns V to VII, corresponding to models V to VII, I run the regressions for Eq. 3.2, which estimates both the in-book and enforcement of TRIPS compliance as well as the control variables. In column VII, corresponding to model VII, I estimate all the TRIPS variables together.

		Eq. 3.1			Eq. 3.1'			Eq. 3.2		
	I	II	III	IV	II'	III'	IV'	V	VI	VII
TRIPS		Yes	Yes	Yes				Yes	Yes	Yes
TRIPS_1			Yes						Yes	
TRIPS_lead				Yes						Yes
TRIPS_late				Yes						Yes
TRIPSr					Yes	Yes	Yes	Yes	Yes	Yes
TRIPSr_1						Yes			Yes	
TRIPSr_lead							Yes			Yes
TRIPSr_late							Yes			Yes

"Yes" corresponds to estimations which include the TRIPS variable.
Columns labeled I through IV correspond to models I to IV in the analysis

Table 3.4: Summary sheet for model analysis

Following Yang and Maskus (2001) and McCalman (2004), I also considered that there may be a non-linear relationship between countries' TRIPS implementation and their exposure to foreign technologies. However, two issues argue against looking at this non-linear relationship. Firstly, I use an index of TRIPS compliance, which theoretically does not capture the strength of the IPR regime. An increase in the index implies that the developing country is one step closer to fully complying with its obligations. Once the country reaches a TRIPS score of 7, it cannot go up any further. From a legislative perspective, the "strength" of IPR protection depends not only on the scope of the protection but also the depth of protection. Any "increase" from TRIPS perspective would be to further define each component of the seven IPR categories. Capturing this depth of IPR protection is a different and complicated manner, outside the scope of this paper. Nevertheless, I run Eq. 3.1 with the squared values of the TRIPS permutations but find no significant difference between the regressions with the squared values and without of TRIPS index.

3.4.2 Analysis of results

I summarize the results for imports, FDI and licensing in the following Tables 3.5, 3.6 and 3.7 respectively. Recall as I mentioned earlier, I find that regression using imports as dependent variable is best with FE estimation, FDI with RE estimation, and licensing with panel Tobit random-effects estimation. These tables report the estimates using the above-mentioned regression methods.

	Eq. 3.1			Eq. 3.1'			Eq. 3.2		
	II	III	IV	II'	III'	IV'	V	VI	VII
TRIPS	0.005	0.004	0.002				0.004	0.011*	0.010*
TRIPS_1		0.000						-0.008	
TRIPS_lead			-0.001						-0.003
TRIPS_late			0.000						0.010
TRIPSr				-0.005	0.001	0.003	-0.003	0.009	0.010
TRIPSr_1					-0.009			-0.016*	
TRIPSr_lead						-0.001			-0.005
TRIPSr_late						-0.046***			-0.057***

note: $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$

Table 3.5: Estimates of FE regression on Imports

	Eq. 3.1			Eq. 3.1'			Eq. 3.2		
	II	III	IV	II'	III'	IV'	V	VI	VII
TRIPS	-0.002	-0.017	-0.017				0.011	0.012	0.013
TRIPS_1		0.017						0.005	
TRIPS_lead			0.067***						0.018
TRIPS_late			0.008						-0.007
TRIPSr				0.045***	0.042***	0.040***	0.048***	0.046*	0.046*
TRIPSr_1					0.004			0.006	
TRIPSr_lead						0.053*			0.033
TRIPSr_late						-0.009			-0.016

note: $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$

Table 3.6: Estimates of RE regression on FDI

	Eq. 3.1			Eq. 3.1'			Eq. 3.2		
	II	III	IV	II'	III'	IV'	V	VI	VII
TRIPS	0.089	-0.014	-0.020				0.075	-0.064	-0.073
TRIPS_1		0.161*						0.202	
TRIPS_lead			0.032						0.246*
TRIPS_late			0.190**						0.101
TRIPSr				-0.043	0.020	0.023	-0.025	-0.076	-0.078
TRIPSr_1					-0.102			0.029	
TRIPSr_lead						-0.086			0.089
TRIPSr_late						-0.152			-0.024

note: $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$

Table 3.7: Estimates of panel Tobit RE regression on Licensing

3.4.3 Proposition 1

I estimate Eq. (3.1) to test the first hypothesis of whether TRIPS compliance affects the three channels of access to foreign technologies, given the countries' imitative abilities levels. I refrain from prejudging the expected coefficients on the TRIPS variable and its permutations. The coefficients could either be of *market expansion*, *market power* effects, or are not statistically significant at all.

TRIPS variable positively affects FDI inflow and licensing activities, and this impact varies according to the countries' imitative abilities. An increase of TRIPS compliance by one unit leads to a 6.7% increase in FDI inflow in the RE estimation. Regression of licensing as dependent variable shows that TRIPS compliance has a *market expansion* impact on licensing for countries with some imitative abilities. In particular this impact is captured by countries with low imitative abilities, where an increase in one unit of the TRIPS index affects the licensing activities of countries with low imitative abilities by 1.9%.

3.4.4 Proposition 2

I run permutations of Eq. 3.2 regression to investigate my second proposition, which includes the enforcement term. The coefficients for the control variables are significant and positive across all models and for all of the three channels of technology exposure. In general, results show that in-book TRIPS compliance coupled with government's enforcement of the rules is important in facilitating developing countries' access to foreign technologies.

Consider columns V—VII of the FE estimation of imports in Table 3.5. We find that TRIPS compliance displays a significant and positive impact on imports, which is a *market expansion* effect. However, countries with some imitative abilities experience a *market power* impact whereby an increase in the TRIPS compliance index holding enforcement constant, prompts a reduction in imports of goods and services by 0.5% ($= 1.1\% - 1.6\%$). In particular, countries with low levels of imitative abilities experience contraction of the imports of goods and services when they comply with their TRIPS obligations.

An interesting result can be observed if we substitute the government enforcement of TRIPS agreement measure into the result obtained for countries with low imitative abilities. The variable *rule of law* ranges from -2.5 to 2.5, with 2.5 being highest achievable value. Taking the mean of this measure for the subset of our developing countries with weak imitative abilities, we find that compliance with TRIPS increases their imports of goods and services by approximately

1.9% on average.[6] This result suggests that countries with low levels of government enforcement would experience *market expansion* effect.

As for FDI, TRIPS compliance when considered with the enforcement aspect significantly and positively affects FDI inflow. Unlike the result from our estimation of Eq. 3.1 earlier, this impact does not vary according to the countries' imitative abilities.

For licensing, we observe that various permutations of the coefficient of TRIPS index interacted its enforcement measure do not significantly impact licensing activities at all. TRIPS compliance is still important, although now the importance of developing countries' compliance with the Agreement is significant for countries with strong imitative abilities.

3.5 Conclusion

This paper investigates whether developing countries' implementation of the TRIPS agreement increase their exposure to foreign technologies through imports, FDI and licensing. I find that there is significant and positive impact of complying with TRIPS on developing countries, especially when we consider the *actual* enforcement of the TRIPS compliance. In addition, taking into consideration the countries' levels of imitative abilities, I find that TRIPS implementation positively influences licensing activities for countries with strong imitative abilities, negatively impacts imports of countries with weak imitative abilities, as Smith (1999) finds. However, there is no difference in the impact TRIPS implementation on FDI inflows when we consider countries' imitative abilities.

The results I obtain do not deviate too much from theory. Diffusing new technologies to countries with strong imitative abilities but weak IPR protection is risky for firms. Fear of technology imitation prompts these firms to carefully choose how they would service these markets. Therefore protection of IPR as per the international standards should minimize these risk factors.

Licensing may be the riskiest channel of the three modes access to foreign technologies. And I find that increasing IPR protection to the international standard increases the licensing activities of those countries with strong imitative abilities.

The increase in FDI inflow to developing countries as they comply with their TRIPS obligations also resonates with theory. Although the difference in FDI inflow does not vary according

[6] This is calculated using mean of *rule of law* for countries with low imitative abilities, multiplied by the estimate for $TRIPSr\_late$ plus the estimate for in-book TRIPS compliance, $TRIPS$. Thus $[(-0.153) * (-0.057) + 0.01] * 100 = 1.8721$.

to countries' levels of imitative abilities, this could be explained by the various management strategies that the firms undertake to protect their innovations within the firm structure as Zhao (2006) explains.

However, one concern is in regards to imports. Countries that do have strong imitative abilities should see a marked increase in their channels of accessing foreign technologies versus those with low or no imitative abilities. And while TRIPS compliance does lead to an increase in imports of goods and services, the impact is negative for developing countries with weak imitative abilities. This suggests that firms exert their market power in countries with weak imitative abilities, which is detrimental to these countries. This empirical finding suggests there could be a role for the establishment of anti-competitive authorities in these economies.

In summary, developing countries' compliance with the TRIPS agreement does influence their access to foreign technologies, and these impacts vary according to the countries' imitative abilities. When we consider governments' commitment to enforcing this Agreement factor, we find that this impact becomes more pronounced, except in the case for FDI.

3.5.1 Limitation

This paper is not without limitations, most of them are due to difficulties in finding appropriate measures to capture technology diffusion, local imitative abilities and changes in IPR legislations.

I attempt to capture developing countries' exposure to foreign technologies using trade, FDI and licensing as proxies, suggesting that increase in any one of these channels directly leads to beneficial spillovers for these countries. While trade, FDI and licensing are channels for accessing foreign technologies, using the aggregate level data partially explains the big picture. Access to these data on bilateral terms per industry sectors would be more informative. For example, studies that are able to use firm-level data to investigate this issue such as Branstetter (2006); Javorcik (2004); Smith (2001, 1999) have richer data and their analysis more reliable. However the data that they employ are specific to the firm-level bilateral flows from the United States and they also include developed countries in their estimation, except for Javorcik (2004). In addition they use patent index which is likely to be strongly correlated with levels of economic development and is measured once every 5 years. The correlation of the TRIPS index with levels of economic development is less than 50%.

The magnitude of spillover effects from accessing new technologies are highly dependent on how the transfers take place, which is also dependent on the local imitative abilities. While

I try to control for imitative abilities using the *ArCo* index, the problem lies with how we usually measure this concept, via patent applications, R&D expenditures, years of schooling, and scientific articles to name a few. Although in using data from the World Bank and various UN agencies accounts for cross-country comparability and reliability of data, there are still some limits to these data.

Firstly, R&D expenditures data are not as widely collected for developing countries as for developed countries, and may not be as reliable. Secondly, number of patent applications is highly dependent on the existence of a reliable and effective patent system. Countries with no or weak effective patent systems may not have as many patent application numbers as they could. This could be rectified by a local innovator patenting overseas, such as at the USPTO or the EPO. However, a local innovator's ability to patent overseas would be dependent on the cost of the patent application. In addition, the types of innovation in developing countries could be of different nature from those in developed countries. As such applying for patent for adaptive or imitative innovations will not be captured by the patent system. This would also hold true for developing countries' scientific publications output where most of publications may not be published in the leading scientific journals.

The TRIPS index may be an inadequate attempt at quantify legislation changes. But it is the only available index that tries to capture developing countries' efforts in implementing this international standard of IPR protection, even if it is the minimum standard. While the construction of the index is based on obligations highlighted in the Agreement, there are some flexibilities for each WTO member country to implement their obligations. Countries can define the parameters of their obligations according to their interpretation of the rules and regulations even if the scope of these flexibilities that were once available under the Paris, Berne and Rome Conventions are now limited. For example, there are two interpretations on protection of undisclosed information on data submitted to government agencies. The loose interpretation argues that countries can allow the marketing of generic drugs if those drugs can prove *bioequivalance* with the original patented drug, while the strict interpretation argues against this. In addition, there may be nuances in each legislation related to the TRIPS agreement that are not captured by the TRIPS index.

APPENDIX

Countries in the sample

L. America & Caribbean	ArCo	Africa & Middle East	ArCo
Argentina	potential leader	Côte d'Ivoire	marginalized
Belize		Egypt	latecomer
Bolivia	latecomer	Gabon	latecomer
Brazil	latecomer	Ghana	marginalized
Chile	potential leader	Kenya	marginalized
Colombia	latecomer	Morocco	marginalized
Costa Rica	latecomer	Madagascar*	marginalized
Dominica		Mauritius	latecomer
Guatemala	latecomer	Malawi*	marginalized
Guyana	latecomer	Namibia	marginalized
Honduras	latecomer	Nigeria	marginalized
Jamaica	latecomer	Senegal*	marginalized
Saint Lucia		Swaziland	marginalized
Mexico	latecomer	Tanzania*	marginalized
Nicaragua	latecomer	Uganda*	marginalized
Peru	latecomer	South Africa	latecomer
Paraguay	latecomer	Zambia*	latecomer
Surinam	latecomer		
Uruguay	potential latecomer		
Saint Vincent & the Grenadines			
Venezuela	latecomer		

Asia	ArCo	Europe	ArCo
Bangladesh*	marginalized	Poland	potential leader
Hong Kong	leader	Romania	potential latecomer
Indonesia	latecomer	Slovak Republic	potential leader
India	latecomer	Turkey	latecomer
South Korea	leader		
Sri Lanka	latecomer		
Malaysia	latecomer		
Pakistan	marginalized		
Philippines	latecomer		
Singapore	leader		
Thailand	latecomer		

**denotes an LDCs*

The ArCo technological capabilities indicator classify countries according to the country's creation of technology capabilities, the technological infrastructures and the development of human skills. The countries are then subdivided into four main groups: *leader*, *potential leader*, *latecomers* and *marginalized*. *Leaders* are the group of countries with ability to create and sustain technological innovation. *Potential leaders* have invested in the necessary infrastructure, such as human capital and technological infrastructure, to build the countries' innovative capacity but have yet to achieve significant levels of innovation. *Latecomers* refer to countries that are in the process of building their human capital and technological infrastructure concurrently. And lastly, the *marginalized* are group of countries that do not even have significant access to "old" technologies. They mostly consist of least-developed countries.

Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Dependent variables					
ln: Imports	628	21.7793	1.83211	17.7175	25.7058
ln: FDI	630	19.9462	1.25012	13.3812	23.653
ln: Licensing	508	16.0526	3.30142	0	21.8292
Explanatory variables					
ln: GDP per cap	636	6.51583	1.17463	3.80328	9.70698
ln: Pop	636	16.2516	1.9987	11.1716	20.8136
Open	628	84.6783	58.8815	16.2996	456.088
rule of law	624	-0.1528	0.65477	-1.65	1.81
TRIPS-specific variables					
TRIPS	583	3.18554	2.79902	0	7
TRIPS_1	539	2.87229	2.9397	0	7
TRIPS_lead	539	0.91558	2.15832	0	7
TRIPS_late	539	1.95671	2.75194	0	7
TRIPSr	574	-0.3704	2.8831	-10.43	12.67
TRIPSr_1	539	-0.1853	2.75656	-8.61	12.67
TRIPSr_lead	539	0.4916	1.76613	-6.23	12.67
TRIPSr_late	539	-0.6769	1.95259	-8.61	4.46667

Table 3.8: Descriptive statistics

Correlation table

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Dependent variables																
1	ln: Imports	1														
2	ln: FDI	0.8182*	1													
3	ln: Licensing	0.7449*	0.6971*	1												
Explanatory variables																
4	ln: GDP per cap	0.4090*	0.5234*	0.3967*	1											
5	ln: Pop	0.7398*	0.4916*	0.5084*	-0.2707*	1										
6	Openness	0.0447	0.0892*	0.0364	0.3869*	-0.4318*	1									
7	rule of law	0.2543*	0.3475*	0.2371*	0.6334*	-0.2453*	0.4327*	1								
TRIPS-specific variables																
8	TRIPS	0.5527*	0.4673*	0.4648*	0.4194*	0.2803*	0.0406	0.0771	1							
9	TRIPS_1	0.5680*	0.5066*	0.4554*	0.5520*	0.1795*	0.0988*	0.1824*	0.8971*	1						
10	TRIPS_lead	0.3865*	0.4128*	0.2766*	0.5345*	-0.0545	0.3005*	0.4680*	0.4075*	0.4513*	1					
11	TRIPS_late	0.3051*	0.2164*	0.2465*	0.1705*	0.2345*	-0.1291*	-0.1722*	0.6387*	0.7143*	-0.3022*	1				
12	TRIPSr	0.1699*	0.2447*	0.1558*	0.3888*	-0.1912*	0.5061*	0.7610*	-0.1329*	-0.023	0.5079*	-0.4228*	1			
13	TRIPSr_1	0.2270*	0.2455*	0.1937*	0.3241*	-0.1335*	0.5086*	0.6959*	-0.1081*	-0.1129*	0.5055*	-0.5170*	0.9283*	1		
14	TRIPSr_lead	0.3838*	0.4098*	0.2941*	0.5138*	-0.1177*	0.5904*	0.5722*	0.2441*	0.2740*	0.6260*	-0.1983*	0.6858*	0.7092*	1	
15	TRIPSr_late	-0.0196	-0.0285	-0.0067	-0.0072	-0.0821	0.1906*	0.4649*	-0.3734*	-0.4072*	0.1473*	-0.5505*	0.6901*	0.7703*	0.0967*	1

note: * denotes significance at 5% significance level.

Table 3.9: Pearson pairwise correlation

Eq. 3.1 regressions

Trade

	Pooled				FE				RE			
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	0.913***	0.906***	0.903***	0.910***	0.936***	0.940***	0.940***	0.940***	0.928***	0.927***	0.927***	0.927***
	(0.010)	(0.012)	(0.013)	(0.013)	(0.049)	(0.049)	(0.050)	(0.050)	(0.021)	(0.021)	(0.021)	(0.021)
ln:pop	0.909***	0.906***	0.906***	0.907***	0.676**	0.676**	0.679**	0.657*	0.899***	0.897***	0.897***	0.897***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.286)	(0.291)	(0.303)	(0.358)	(0.024)	(0.024)	(0.024)	(0.024)
% of GDP	0.008***	0.008***	0.008***	0.008***	0.007***	0.007***	0.007***	0.007***	0.007***	0.007***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
lTRIPS		0.005	-0.002	-0.002		0.005	0.004	0.005		0.004	0.003	0.003
		(0.005)	(0.007)	(0.007)		(0.005)	(0.006)	(0.006)		(0.003)	(0.004)	(0.004)
lTRIPS_1			0.008				0.000				0.002	
			(0.007)				(0.007)				(0.004)	
lTRIPS_lead				-0.001				-0.001				0.001
				(0.009)				(0.011)				(0.008)
lTRIPS_late				0.009				0.000				0.002
				(0.007)				(0.007)				(0.004)
cons	0.476***	0.517***	0.547***	0.490***	4.284	4.122	4.076	4.436	0.588	0.621	0.622	0.620
	(0.164)	(0.177)	(0.180)	(0.178)	(4.873)	(4.890)	(5.108)	(6.020)	(0.475)	(0.484)	(0.486)	(0.491)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.983	0.983	0.983	0.983	0.928	0.928	0.928	0.928	0.982	0.982	0.982	0.982
N	533	533	533	533	533	533	533	533	533	533	533	533

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.10: Pooled OLS, FE- and RE-estimations for Imports, Eq. 3.1

FDI

	Pooled				FE				RE			
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	0.695***	0.735***	0.710***	0.689***	0.954**	0.965***	0.968***	1.013***	0.757***	0.760***	0.751***	0.715***
	(0.030)	(0.045)	(0.049)	(0.049)	(0.376)	(0.365)	(0.364)	(0.376)	(0.089)	(0.104)	(0.106)	(0.104)
ln:pop	0.536***	0.551***	0.549***	0.547***	-1.607*	-1.608*	-1.563	-0.306	0.519***	0.520***	0.520***	0.513***
	(0.027)	(0.024)	(0.024)	(0.024)	(0.950)	(0.946)	(1.021)	(1.218)	(0.071)	(0.065)	(0.063)	(0.065)
% of GDP	0.004***	0.004***	0.004***	0.004***	-0.001	-0.000	-0.000	-0.001	0.003	0.003	0.003	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
lTRIPS		-0.029	-0.075***	-0.077***		0.014	0.010	0.007		-0.003	-0.017	-0.015
		(0.018)	(0.019)	(0.020)		(0.025)	(0.031)	(0.032)		(0.020)	(0.020)	(0.020)
lTRIPS_1			0.053***				0.005				0.017	
			(0.019)				(0.029)				(0.021)	
lTRIPS_lead				0.080***				0.108				0.067**
				(0.021)				(0.077)				(0.027)
lTRIPS_late				0.050***				0.002				0.008
				(0.019)				(0.030)				(0.022)
cons	6.478***	6.129***	6.328***	6.508***	41.040**	40.907**	40.125**	18.773	6.174***	6.104***	6.169***	6.531***
	(0.448)	(0.442)	(0.441)	(0.465)	(16.659)	(16.552)	(17.767)	(21.543)	(0.962)	(0.811)	(0.790)	(0.832)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*				
R^2	0.717	0.718	0.721	0.722	0.177	0.177	0.175	0.183	0.721	0.722	0.723	0.722
N	527	527	527	527	527	527	527	527	527	527	527	527

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.11: Pooled OLS, FE- and RE-estimations for FDI, Eq. 3.1

Licensing

	Pooled				FE				RE			
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	1.340***	1.325***	1.313***	1.384***	1.273***	1.354***	1.519***	1.391***	1.401***	1.335***	1.285***	1.367***
	(0.080)	(0.118)	(0.132)	(0.157)	(0.354)	(0.407)	(0.456)	(0.450)	(0.205)	(0.224)	(0.236)	(0.245)
ln:pop	1.092***	1.086***	1.085***	1.084***	0.563	0.410	2.112	-1.882	1.273***	1.226***	1.205***	1.205***
	(0.079)	(0.079)	(0.080)	(0.079)	(2.814)	(2.845)	(3.363)	(3.695)	(0.293)	(0.299)	(0.304)	(0.309)
% of GDP	0.010***	0.010***	0.010***	0.011***	-0.001	-0.001	0.000	-0.000	0.008**	0.008**	0.007*	0.009***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.010)	(0.010)	(0.011)	(0.010)	(0.004)	(0.004)	(0.004)	(0.003)
lTRIPS		0.011	-0.007	-0.002		0.097	-0.030	-0.021		0.093	-0.013	-0.018
		(0.060)	(0.054)	(0.053)		(0.103)	(0.076)	(0.084)		(0.075)	(0.057)	(0.056)
lTRIPS_1			0.021				0.200				0.154**	
			(0.046)				(0.122)				(0.074)	
lTRIPS_lead				-0.055				-0.057				0.032
				(0.081)				(0.198)				(0.136)
lTRIPS_late				0.032				0.216				0.183**
				(0.044)				(0.132)				(0.079)
cons	-12.939***	-12.776***	-12.680***	-13.119***	-2.160	-0.294	-29.879	37.726	-15.036***	-15.090***	-13.708**	-14.255***
	(1.616)	(1.528)	(1.559)	(1.616)	(47.222)	(47.860)	(57.523)	(61.927)	(5.202)	(5.214)	(5.472)	(5.462)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.532	0.531	0.530	0.531	0.116	0.120	0.128	0.132	0.535	0.533	0.528	0.530
N	421	421	421	421	421	421	421	421	421	421	421	421

note: $^{***}p < 0.01$,$^{**}p < 0.05$,$^{*}p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.12: Pooled OLS, FE- and RE-estimations for Licensing, Eq. 3.1

Licensing: Tobit

	Pooled				Tobit, RE			
	I	**II**	**III**	**IV**	**I**	**II**	**III**	**IV**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	1.339***	1.323***	1.311***	1.382***	1.411***	1.354***	1.313***	1.392***
	(0.095)	(0.122)	(0.129)	(0.136)	(0.275)	(0.278)	(0.282)	(0.288)
ln:pop	1.093***	1.087***	1.086***	1.085***	1.288***	1.239***	1.220***	1.217***
	(0.075)	(0.080)	(0.080)	(0.080)	(0.253)	(0.256)	(0.260)	(0.261)
% of GDP	0.010***	0.010***	0.010***	0.011***	0.008	0.007	0.007	0.008
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)
lTRIPS		0.012	-0.007	-0.001		0.096	-0.014	-0.020
		(0.056)	(0.086)	(0.086)		(0.061)	(0.086)	(0.086)
lTRIPS_1			0.022				0.161*	
			(0.077)				(0.089)	
lTRIPS_lead				-0.055				0.032
				(0.090)				(0.129)
lTRIPS_late				0.032				0.190**
				(0.077)				(0.092)
cons	-12.986***	-12.807***	-12.709***	-13.149***	-16.476***	-15.419***	-14.839***	-15.343***
	(1.456)	(1.672)	(1.707)	(1.722)	(4.828)	(4.886)	(4.968)	(5.001)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
σ	2.037***	2.037***	2.037***	2.030***				
	(0.071)	(0.071)	(0.071)	(0.071)				
σ_u					2.487***	2.494***	2.539***	2.556***
					(0.364)	(0.364)	(0.367)	(0.368)
σ_e					1.512***	1.507***	1.497***	1.492***
					(0.058)	(0.058)	(0.057)	(0.057)
R^2	0.154	0.154	0.154	0.155				
Log-Likelihood					-845.68	-844.46	-842.84	-841.87
N	421	421	421	421	421	421	421	421

note: $^{***}p < 0.01$,$^{**}p < 0.05$,$^{*}p < 0.1$

Lower limit censoring at zero

Table 3.13: Pooled Tobit and Tobit random-effect estimations for Licensing, Eq. 3.1

Eq. 3.1' regressions

Trade

	Pooled			FE			RE		
	II'	**III'**	**IV'**	**II'**	**III'**	**IV'**	**II'**	**III'**	**IV'**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	0.914***	0.910***	0.929***	0.942***	0.949***	0.966***	0.932***	0.934***	0.955***
	(0.010)	(0.010)	(0.012)	(0.049)	(0.049)	(0.051)	(0.021)	(0.021)	(0.020)
ln:pop	0.909***	0.912***	0.918***	0.623**	0.659**	0.668**	0.899***	0.901***	0.909***
	(0.007)	(0.007)	(0.007)	(0.307)	(0.305)	(0.308)	(0.024)	(0.024)	(0.023)
% of GDP	0.008***	0.008***	0.008***	0.007***	0.007***	0.007***	0.007***	0.007***	0.008***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
lTRIPSr	-0.001	0.024***	0.025***	-0.005	0.001	0.003	-0.004	0.004	0.006
	(0.004)	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)	(0.003)	(0.004)	(0.004)
lTRIPSr_1		-0.029***			-0.009			-0.010**	
		(0.008)			(0.008)			(0.005)	
lTRIPSr_lead			-0.063***			-0.046***			-0.048***
			(0.015)			(0.013)			(0.014)
lTRIPSr_late			-0.016**			-0.001			-0.002
			(0.008)			(0.009)			(0.005)
cons	0.443***	0.428***	0.198	5.126	4.466	4.203	0.508	0.493	0.210
	(0.152)	(0.150)	(0.150)	(5.212)	(5.178)	(5.287)	(0.468)	(0.468)	(0.442)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.983	0.983	0.984	0.928	0.928	0.932	0.982	0.983	0.983
N	533	533	533	533	533	533	533	533	533

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.14: Pooled OLS, FE- and RE-estimations for Trade, Eq. 3.1'

	Pooled			FE			RE		
	II'	**III'**	**IV'**	**II'**	**III'**	**IV'**	**II'**	**III'**	**IV'**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	0.685***	0.675***	0.659***	0.895**	0.872**	0.836**	0.729***	0.726***	0.701***
	(0.029)	(0.029)	(0.032)	(0.350)	(0.348)	(0.348)	(0.083)	(0.081)	(0.084)
ln:pop	0.532***	0.539***	0.534***	-1.084	-1.214	-1.236	0.509***	0.509***	0.498***
	(0.028)	(0.030)	(0.029)	(0.974)	(1.008)	(1.020)	(0.074)	(0.074)	(0.075)
% of GDP	0.003***	0.004***	0.003***	-0.002	-0.002	-0.003	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
lTRIPSr	0.019	0.078***	0.076***	0.047**	0.024	0.020	0.046***	0.042***	0.040***
	(0.013)	(0.016)	(0.016)	(0.023)	(0.019)	(0.020)	(0.016)	(0.011)	(0.011)
lTRIPSr_1		-0.069***			0.032			0.004	
		(0.023)			(0.029)			(0.023)	
lTRIPSr_lead			-0.038			0.107**			0.053*
			(0.026)			(0.043)			(0.031)
lTRIPSr_late			-0.081***			0.016			-0.009
			(0.026)			(0.030)			(0.025)
cons	6.434***	6.381***	6.770***	32.838*	35.188**	35.783**	6.792***	6.614***	6.996***
	(0.530)	(0.539)	(0.515)	(17.060)	(17.605)	(17.651)	(1.042)	(0.959)	(0.971)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*			
R^2	0.718	0.721	0.721	0.188	0.188	0.192	0.720	0.720	0.719
N	527	527	527	527	527	527	527	527	527

note: $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.15: Pooled OLS, FE- and RE-estimations for FDI, Eq. 3.1'

Licensing

	Pooled			FE			RE		
	II'	**III'**	**IV'**	**II'**	**III'**	**IV'**	**II'**	**III'**	**IV'**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	1.378***	1.376***	1.457***	1.357***	1.491***	1.511***	1.442***	1.465***	1.497***
	(0.085)	(0.086)	(0.092)	(0.377)	(0.416)	(0.433)	(0.218)	(0.221)	(0.225)
ln:pop	1.104***	1.105***	1.134***	0.000	0.499	0.560	1.279***	1.293***	1.305***
	(0.078)	(0.078)	(0.076)	(2.832)	(2.937)	(2.965)	(0.296)	(0.299)	(0.298)
% of GDP	0.011***	0.011***	0.013***	0.001	0.003	0.003	0.009**	0.010***	0.011***
	(0.002)	(0.002)	(0.002)	(0.010)	(0.010)	(0.010)	(0.004)	(0.004)	(0.004)
lTRIPSr	-0.054**	-0.044	-0.041	-0.051	0.023	0.025	-0.041	0.019	0.021
	(0.024)	(0.045)	(0.045)	(0.044)	(0.034)	(0.036)	(0.030)	(0.036)	(0.036)
lTRIPSr_1		-0.012			-0.128**			-0.096**	
		(0.046)			(0.058)			(0.045)	
lTRIPSr_lead			-0.139**			-0.178			-0.149**
			(0.058)			(0.113)			(0.064)
lTRIPSr_late			0.047			-0.112*			-0.080
			(0.050)			(0.057)			(0.049)
cons	-13.475***	-13.489***	-14.544***	6.590	-2.712	-3.874	-16.625***	-16.135***	-16.577***
	(1.625)	(1.623)	(1.544)	(47.397)	(49.472)	(50.161)	(5.208)	(5.313)	(5.273)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.533	0.531	0.535	0.116	0.116	0.115	0.537	0.537	0.539
N	421	421	421	421	421	421	421	421	421

note: $^{***}p < 0.01,^{**}\ p < 0.05,^{*}\ p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.16: Pooled OLS, FE- and RE-estimations for Licensing, Eq. 3.1'

Licensing: Tobit

	Pooled			Tobit, RE		
	II'	**III'**	**IV'**	**II'**	**III'**	**IV'**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	1.378***	1.376***	1.456***	1.456***	1.485***	1.513***
	(0.099)	(0.100)	(0.107)	(0.282)	(0.285)	(0.292)
ln:pop	1.105***	1.107***	1.135***	1.293***	1.308***	1.320***
	(0.076)	(0.077)	(0.077)	(0.253)	(0.256)	(0.256)
% of GDP	0.011***	0.012***	0.013***	0.009*	0.010*	0.010*
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)
lTRIPSr	-0.054	-0.044	-0.042	-0.042	0.020	0.023
	(0.041)	(0.087)	(0.087)	(0.058)	(0.088)	(0.088)
lTRIPSr_1		-0.012			-0.102	
		(0.092)			(0.108)	
lTRIPSr_lead			-0.139			-0.152
			(0.110)			(0.157)
lTRIPSr_late			0.047			-0.086
			(0.096)			(0.114)
cons	-13.523***	-13.536***	-14.586***	-16.931***	-17.420***	-17.811***
	(1.507)	(1.511)	(1.589)	(4.873)	(4.931)	(5.004)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
σ	2.033***	2.033***	2.022***			
	(0.071)	(0.071)	(0.071)			
σ_u				2.490***	2.508***	2.504***
				(0.365)	(0.367)	(0.367)
σ_e				1.511***	1.508***	1.508***
				(0.058)	(0.058)	(0.058)
R^2	0.154	0.154	0.156			
Log-Likelihood				-845.41	-844.97	-844.88
N	421	421	421	421	421	421

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Lower limit censoring at zero

Table 3.17: Pooled Tobit and Tobit random-effect estimations for Licensing, Eq. 3.1'

Eq. 3.2 regressions

Trade

	Pooled			FE			RE		
	V	**VI**	**VI**	**V**	**VI**	**VI**	**V**	**VI**	**VI**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	0.906***	0.906***	0.913***	0.944***	0.949***	0.980***	0.930***	0.933***	0.953***
	(0.013)	(0.014)	(0.014)	(0.049)	(0.049)	(0.048)	(0.021)	(0.021)	(0.020)
ln:pop	0.906***	0.910***	0.913***	0.636**	0.649**	0.844**	0.898***	0.900***	0.906***
	(0.008)	(0.008)	(0.008)	(0.312)	(0.313)	(0.352)	(0.024)	(0.024)	(0.024)
% of GDP	0.008***	0.008***	0.008***	0.007***	0.007***	0.008***	0.007***	0.007***	0.008***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
lTRIPS	0.005	0.021***	0.021***	0.003	0.011*	0.010*	0.003	0.010**	0.010**
	(0.005)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.003)	(0.004)	(0.004)
lTRIPS_1		-0.017***			-0.008			-0.008*	
		(0.006)			(0.007)			(0.004)	
lTRIPS_lead			-0.009			0.010			0.006
			(0.011)			(0.016)			(0.010)
lTRIPS_late			-0.009*			-0.003			-0.004
			(0.005)			(0.007)			(0.004)
lTRIPSr	0.000	0.038***	0.037***	-0.004	0.009	0.010	-0.002	0.011**	0.011**
	(0.005)	(0.008)	(0.008)	(0.005)	(0.007)	(0.007)	(0.003)	(0.005)	(0.005)
lTRIPSr_1		-0.043***			-0.016*			-0.017***	
		(0.010)			(0.009)			(0.006)	
lTRIPSr_lead			-0.074***			-0.057***			-0.058***
			(0.019)			(0.018)			(0.017)
lTRIPSr_late			-0.024***			-0.005			-0.006
			(0.009)			(0.010)			(0.006)
cons	0.518***	0.456**	0.338*	4.754	4.497	1.041	0.548	0.515	0.254
	(0.176)	(0.178)	(0.177)	(5.251)	(5.261)	(5.891)	(0.476)	(0.481)	(0.461)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.983	0.983	0.984	0.928	0.928	0.933	0.982	0.983	0.983
N	533	533	533	533	533	533	533	533	533

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.18: Pooled OLS, FE- and RE-estimations for Trade, Eq. 3.2

FDI

	Pooled			FE			RE		
	V	**VI**	**VI**	**V**	**VI**	**VI**	**V**	**VI**	**VI**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	0.720***	0.702***	0.689***	0.906***	0.888***	0.894**	0.706***	0.703***	0.680***
	(0.043)	(0.046)	(0.047)	(0.344)	(0.340)	(0.365)	(0.097)	(0.096)	(0.097)
ln:pop	0.545***	0.549***	0.552***	-0.942	-1.038	-0.450	0.499***	0.499***	0.495***
	(0.027)	(0.028)	(0.028)	(0.999)	(1.067)	(1.269)	(0.069)	(0.069)	(0.069)
% of GDP	0.003***	0.004***	0.003***	-0.002	-0.002	-0.003	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)
lTRIPS	-0.023	-0.045	-0.046*	0.036	0.031	0.032	0.017	0.012	0.013
	(0.017)	(0.027)	(0.027)	(0.025)	(0.038)	(0.040)	(0.019)	(0.033)	(0.033)
lTRIPS_1		0.026			0.004			0.005	
		(0.024)			(0.040)			(0.032)	
lTRIPS_lead			0.042			0.050			0.018
			(0.027)			(0.068)			(0.037)
lTRIPS_late			0.010			-0.010			-0.007
			(0.025)			(0.042)			(0.033)
lTRIPSr	0.013	0.051**	0.053**	0.060**	0.039	0.041	0.052***	0.046*	0.046*
	(0.013)	(0.025)	(0.025)	(0.024)	(0.027)	(0.028)	(0.015)	(0.027)	(0.027)
lTRIPSr_1		-0.046			0.029			0.006	
		(0.030)			(0.040)			(0.034)	
lTRIPSr_lead			-0.039			0.066*			0.033
			(0.034)			(0.036)			(0.040)
lTRIPSr_late			-0.077**			0.001			-0.016
			(0.034)			(0.043)			(0.036)
cons	6.331***	6.383***	6.428***	30.254*	31.999*	22.127	6.902***	6.911***	7.160***
	(0.537)	(0.547)	(0.550)	(17.321)	(18.435)	(22.373)	(0.970)	(0.904)	(0.914)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*			
R^2	0.718	0.721	0.723	0.192	0.190	0.194	0.718	0.718	0.718
N	527	527	527	527	527	527	527	527	527

note: $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.19: Pooled OLS, FE- and RE-estimations for FDI, Eq. 3.2

Licensing

	Pooled			FE			RE		
	V	**VI**	**VI**	**V**	**VI**	**VI**	**V**	**VI**	**VI**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	1.407***	1.390***	1.443***	1.390***	1.659***	1.540***	1.354***	1.339***	1.432***
	(0.143)	(0.154)	(0.163)	(0.407)	(0.513)	(0.505)	(0.253)	(0.261)	(0.260)
ln:pop	1.114***	1.109***	1.111***	0.141	1.590	-1.864	1.231***	1.215***	1.221***
	(0.081)	(0.081)	(0.078)	(2.874)	(3.330)	(3.573)	(0.302)	(0.311)	(0.318)
% of GDP	0.012***	0.011***	0.013***	0.000	0.002	0.002	0.008**	0.008**	0.010***
	(0.001)	(0.001)	(0.002)	(0.010)	(0.010)	(0.010)	(0.003)	(0.003)	(0.003)
lTRIPS	-0.018	-0.066	-0.062	0.090	-0.080	-0.086	0.088	-0.063	-0.072
	(0.068)	(0.069)	(0.069)	(0.111)	(0.105)	(0.114)	(0.083)	(0.078)	(0.077)
lTRIPS_1		0.052			0.242*			0.196**	
		(0.070)			(0.143)			(0.098)	
lTRIPS_lead			0.041			0.030			0.102
			(0.096)			(0.207)			(0.151)
lTRIPS_late			0.089			0.283*			0.240**
			(0.064)			(0.167)			(0.106)
lTRIPSr	-0.059*	-0.089	-0.099	-0.025	-0.084	-0.097	-0.015	-0.075	-0.077
	(0.031)	(0.069)	(0.070)	(0.056)	(0.079)	(0.088)	(0.040)	(0.060)	(0.060)
lTRIPSr_1		0.032			0.007			0.032	
		(0.076)			(0.109)			(0.076)	
lTRIPSr_lead			-0.049			-0.041			-0.020
			(0.082)			(0.130)			(0.074)
lTRIPSr_late			0.128*			0.084			0.092
			(0.075)			(0.129)			(0.084)
cons	-13.797***	-13.606***	-14.050***	3.932	-22.201	36.340	-15.316***	-14.303**	-15.018***
	(1.632)	(1.684)	(1.595)	(48.428)	(57.215)	(60.179)	(5.347)	(5.698)	(5.686)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.532	0.529	0.533	0.118	0.127	0.129	0.533	0.529	0.533
N	421	421	421	421	421	421	421	421	421

note: $^{***}p < 0.01,^{**}\ p < 0.05,^{*}\ p < 0.1$

Robust standard errors in brackets

R^2 refer to the adjusted R^2 for pooled OLS, R^2 within for FE and R^2 overall for RE estimations

Table 3.20: Pooled OLS, FE- and RE-estimations for Licensing, Eq. 3.2

Licensing: Tobit

	Pooled			Tobit, RE		
	V	**VI**	**VII**	**V**	**VI**	**VII**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
ln:GDPcap	1.405***	1.388***	1.441***	1.373***	1.370***	1.456***
	(0.136)	(0.141)	(0.142)	(0.289)	(0.295)	(0.302)
ln:pop	1.115***	1.110***	1.112***	1.244***	1.230***	1.233***
	(0.082)	(0.083)	(0.085)	(0.256)	(0.262)	(0.264)
% of GDP	0.012***	0.011***	0.013***	0.008	0.008	0.009*
	(0.002)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)
lTRIPS	-0.017	-0.065	-0.062	0.090	-0.064	-0.073
	(0.060)	(0.114)	(0.114)	(0.064)	(0.124)	(0.124)
lTRIPS_1		0.053			0.202	
		(0.107)			(0.128)	
lTRIPS_lead			0.041			0.101
			(0.115)			(0.157)
lTRIPS_late			0.090			0.246*
			(0.108)			(0.131)
lTRIPSr	-0.059	-0.089	-0.099	-0.015	-0.076	-0.078
	(0.043)	(0.120)	(0.119)	(0.061)	(0.130)	(0.129)
lTRIPSr_1		0.032			0.029	
		(0.126)			(0.148)	
lTRIPSr_lead			-0.048			-0.024
			(0.144)			(0.185)
lTRIPSr_late			0.128			0.089
			(0.133)			(0.156)
cons	-13.824***	-13.632***	-14.072***	-15.640***	-15.428***	-15.392***
	(1.830)	(1.873)	(1.900)	(4.967)	(5.097)	(5.234)
Year effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
σ	2.032***	2.032***	2.020***			
	(0.071)	(0.071)	(0.070)			
σ_u				2.495***	2.556***	2.565***
				(0.364)	(0.370)	(0.371)
σ_e				1.507***	1.495***	1.490***
				(0.058)	(0.057)	(0.057)
R^2	0.155	0.155	0.157			
Log-Likelihood				-844.43	-842.47	-841.38
N	421	421	421	421	421	421

note: $^{***}p < 0.01$,$^{**}p < 0.05$,$^{*}p < 0.1$

Lower limit censoring at zero

Table 3.21: Pooled Tobit and Tobit random-effect estimations for Licensing, Eq. 3.2'

Chapter 4

TRIPS implementation and Exploitation of Foreign Technologies

4.1 Introduction

Developing countries' implementation of the *Trade-related Aspects of Intellectual Property Rights* (TRIPS)[1] agreement creates a dual issue vis-à-vis exploitation of foreign technologies by firms in developing countries. On the one hand, the compliance with the Agreement should encourage access to the technologies as strengthened intellectual property rights (IPR) protects foreign inventors from unlawful expropriation of their intellectual creation. On the other hand, stronger IPR could raise the barrier to acquiring the foreign technology and thus discourage its exploitation.[2] Therefore total impact of strengthening IPR protection on use of the foreign technology would depend on whether the increased exposure to new technology outweighs the higher transaction cost of acquiring it.

This paper examines how TRIPS implementation, which strengthens developing countries' IPR protection level, affects entrepreneurs' use of foreign technologies. Concentrating on entrepreneurs enables me to investigate how budget-constrained economic agents are effected by the change in the rules governing the exploitation of technologies from abroad, especially when these agents' economic activities are dependent on the use of the foreign technologies.

I find that TRIPS implementation adversely influences local entrepreneurs' use of new technology. This evidence implies any possible access to new technology may be outweighed by the increase in cost to acquire and later exploit that technology. In addition, I find that this

[1] I use "TRIPS" and "Agreement" interchangeably.

[2] I use the terms "IPR" to refer to the general intellectual property rights protection while "TRIPS" refers to a specific IPR standard.

influence varies across industry sectors and categories. Considering that the bulk of developing countries in this sample has potential to imitate foreign technology, the results presented here is contrary to argument that strengthened IPR protection would encourage more exploitation of new foreign technologies. Instead, they lend support to the argument that strengthened IPR system creates higher barrier to using technologies from abroad for developing countries.

In the following section I provide literature review on the relationship between IPR and entrepreneurship, briefly discuss the TRIPS agreement, and outline the framework for my investigation. Section 3 describes in detail the data I use in this paper as well as the econometric methodology. The penultimate section presents and analyzes the results of this research, and section 5 concludes with discussion on the limitation of this paper, and future research questions.

4.2 IPR protection & Entrepreneurs

IPR protection provides a mechanism for the entrepreneurs to appropriate their returns to innovation (Casson, 1995).[3] By granting monopoly rights to the inventor of an invention, IPR protection ensures that the inventor's cost in the research and development (R&D) of her invention can be recouped upon commercialization. The inventor can start her own business based on her invention or she can license her invention off to another firm.[4] Her decision between two commercialization options would depend on the appropriability regime and her rivals', or collaborators', complementary assets (Teece, 1986).[5]

If our inventor decides to start her own business, the IPR protection on her invention would ensure that other competitors would face legal barriers in trying to blatantly imitate her technology, thus ensuring that she would be able to profit from her invention when she starts her own company. Shane (2001), using patent data assigned to Massachusetts Institute of Technology between 1980 and 1996, shows that effective patent protection increases the likelihood of new technology exploitation through firm formation. Furthermore Burke and Fraser (2005) find that self-employment rates in 34 countries, most of them members of the *Organization of Economic Co-operation and Development* (OECD), are positively influenced by IPR protection, although they do not suggest possible explanations for this result.

[3]Throughout this paper I refer to "innovation" as the commercialization of an "invention". In addition, I use the terms "innovation" and "technology" interchangeably.

[4]In both cases, our inventor is also an entrepreneur, the difference between the two cases is the market that she competes. By starting her own company, our inventor/entrepreneur engages in the traditional goods market. By licensing her invention out to another firm, our inventor/entrepreneur competes in the market for technology.

[5]Teece introduces a third factor of commercialization, the *dominant design paradigm*, which refers to standardization issues. This standardization matter, while relevant, is outside the scope of this paper.

Our inventor can also choose to license her invention out to another firm to commercialize rather than producing it herself. This is also made possible by the IPR regime. IPR protection creates transferrable rights, allowing for the trade of invention between "suppliers", in this case is our inventor, and the "demanders", other firms. Shane (2004), in studying the effect of the Bayh-Dole Act implementation, shows that this change in the United States' IPR law by allowing universities to patent their research output provides incentive for universities to increase patenting in fields where "licensing provides an effective mechanism for acquiring new technical knowledge."

The inventor's ability to decide between starting her own business based on her invention or licensing it off to other firms suggests that IPR protection grants her control on downstream activities of her invention. But what about the entrepreneur who would like to exploit others' innovations rather than invent her own? How would this entrepreneur's activity be affected by the IPR protection regime?

The other impact of IPR protection on entrepreneurial activities is in regards to accessing and exploiting the innovations, the downstream activities of innovation.[6] Strengthened IPR protection can affect entrepreneurs's access and exploitation of new technologies in two ways: (i) through increased exposure to a wider selection of technologies, or (ii) creating barriers to using the technologies.

As mentioned earlier, IPR protection creates transferrable rights and allows for innovations to be traded in the market for technology. This market provides a wider selection of technologies for the entrepreneurs to choose in one setting. The more technologies our entrepreneur can choose and the lower search and transaction cost she will face, the higher will her marginal benefit be. As Arora et al. (2001) argue, the existence of market for technologies enables entrepreneurs in start-ups to focus on meeting their customers' needs and demands without the complication of searching for new technologies to serve this need. Therefore strengthened IPR protection facilitates access to and exploitation of technologies (see Arora and Merges, Arora and Merges; Arora et al., 2003; Hall and Ziedonis, 2001).

However, strengthened IPR protection grants the rights holders of the technologies higher returns to their innovations through providing monopoly rights, thus curtailing competition for those particular technologies. Studies on strategic patenting behavior in large firms show that

[6] I distinguish between "access" to and "exploitation" of new technologies by arguing that "exploitation" requires the actual use of the technology while "access", like "exposure", do not involve actual usage of the technology. For example, an entrepreneur can have access to a particular technology but if she does not exploit it then she cannot benefit from that technology.

firms patent to prevent competition and also as a bargaining chip for access to one another's technology (Reitzig, 2004; Hall and Ziedonis, 2001). In addition, inventors can exercise their monopoly power by charging monopoly prices for their technologies or preventing others from exploiting their technologies through legal avenues. For example, our inventor could impose reach-through clause in her licensing arrangements that could reduce the potential profit of entrepreneurs exploiting her technology. This could have the effect of reducing the number of entrepreneurs acquiring this technology to be used in their businesses.

The monopoly price of exploiting a specific new technology and the anti-competitive behavior from using IPR protection creates social welfare loss as well. High cost of accessing and exploiting existing and new technologies creates obstruction to the possible diffusion (Cornish, 1999) and/or incremental improvements of the innovations (Scotchmer, 1991).

Therefore there are two possible outcomes of how IPR protection affects entrepreneurial activities. IPR protection may be useful to entrepreneurs to protect their innovation from their competitors, allowing for commercialization of the innovation. The reduced risk from commercialization of technologies facilitates broader dissemination, giving other entrepreneurs more opportunities to exploit technologies appropriate for their businesses. But IPR protection could also pose a significant barrier for these entrepreneurs to exploit new innovations in their firms either because of the higher cost imposed or through complex licensing contracts which minimizes the entrepreneurs' returns to investment. The sum of stronger IPR protection impact on the entrepreneurial activities is thus ambiguous.

As for developing countries, strengthened IPR protection is likely to affect their access and exploitation of technologies acquired from abroad, given that most developing countries are net importers of technology.

4.2.1 Entrepreneurs in developing countries

For entrepreneurs in developing countries the influence of IPR protection on access and exploiting to new technology is slightly different than for developed countries. A large portion of new-to-the-world technologies are invented in countries that have strong innovative capacities, such as the developed countries. It is thus reasonable to assume that developing countries would depend on developed countries to produce new technologies rather than competitively generating their own.

Prior to TRIPS agreement, most developing countries had weak IPR protection. The absence of strong appropriability mechanism, such as IPR protection, allowed for blatant copying of in-

ventions which were then commercialized and in most cases helped develop a viable technological industry. Hong Kong, Singapore, South Korea and Taiwan are a few examples of countries that have profited from the lax enforcement of IPR protection, building their current comparative advantage as technology exporters on the weak IPR protection regime (Kumar, 2002). In addition, the Romanian president openly acknowledged that pirated copies of Microsoft's *Windows* software helped developed his country's software industry (Zoeller, 2007). But the benefit of *free-riding* on foreigners' R&D investment for the countries with weak IPR regimes does not stop there. The commercialization of these imitations of foreign technologies offered a cheaper alternative to customers, therefore allowing customers that demand them but cannot initially afford them, the possibility to acquire and use them at lower cost.

In light of this *free-riding* problem of acquiring technologies, reverse-engineering them and commercializing the cheaper versions of the original technologies by entrepreneurs in countries with weak IPR regimes, firms in developed countries find significant reduction in their returns to investment. In response, they can either reduce the export of technologies overseas and minimize the imitation of their technologies, establish their own subsidiaries in those countries, or ignore the blatant copying of their technologies with the hopes of later recapturing these customers through offering complementary products.[7] If developments at the international trade negotiations is to be believed, weak IPR protection poses a significant barrier to trade for these firms (see Gervais, 2003; Watal, 2001; Correa, 2000).

Feeble, or no, IPR protection in developing countries arguably limits dissemination of new technologies to these countries. The preamble of the TRIPS agreement highlights this issue by stating that its objective is to "reduce distortions and impediments to international trade." In addition, studies analyzing the flow of technologies to countries via trade, foreign direct investment (FDI) and research and development (R&D) argue that strengthening IPR protection would increase countries' exposure to foreign technologies (see Branstetter et al., 2007; Branstetter, 2006; Javorcik, 2004; Mansfield, 1994; Smith, 1999; Maskus and Penubarti, 1995). However, these studies stop short of answering how this IPR reform would affect entrepreneurs' exploitation of foreign technologies, except for Yang and Maskus (2001). The paper by Yang and Maskus (2001) finds that strengthened IPR protection increases U.S. licensing flow to unaffiliated firms in foreign countries when those countries have achieved a certain level imitative abilities, but not for those who do not have any or little imitative abilities.

[7] *The Economist magazine* reported on how Microsoft tolerates the widespread use of pirated versions of its software in China because this use, even if illegally, has given it huge market share. Microsoft hopes that once these customers can purchase the legitimate copies of its software, that they would prefer to stick to using its software (see The Economist, 2008).

More access to technologies from abroad is beneficial, but if these technologies cannot be used by local entrepreneurs because of the higher cost of acquiring them, then the overall benefit of TRIPS implementation for developing countries may not be as positive as some empirical studies have argued.

Therefore, there is a tradeoff in regards to strengthening IPR regimes, through TRIPS implementation, for entrepreneurs in developing countries. TRIPS protection increases the entrepreneurs' exposure to foreign technologies but it may make the technologies less accessible because of the higher cost of acquiring them.

4.2.2 TRIPS

The TRIPS agreement requires developing countries to modify their IPR system to reflect those of developed countries. It imposes a general strengthening of IPR system for many developing countries, regardless of the country's level of economic development, although there are some flexibilities in regards to implementation time and various legal interpretation of its texts.[8]

Before the TRIPS agreement, countries were able to implement differing levels of IPR protection according to what they deemed were appropriate for their levels of economic development. This is no longer the case under the TRIPS agreement. The *one-size-fits-all* approach to TRIPS implementation would create different welfare impact across countries. Technologically advanced countries, usually comprised of developed countries, are likely to benefit from the implementation of the Agreement at the expense of less-technologically advanced countries, usually comprised of developing countries (Grossman and Lai, 2002).

While most empirical studies to date suggest that strong IPR regimes would increase countries' exposure to foreign technologies (see Branstetter et al., 2007; Park and Lippoldt, 2007), it is not obvious if this increased exposure would lead to increased exploitation of the technologies. Studies by Falvey et al. (2006) and Helpman (1993) show that developing countries with high imitative abilities are likely to be adversely effected by strengthened IPR protection. In addition, reports by the *Commission on Intellectual Property Rights* and the World Bank's *Global Economic Prospects* convincingly argue that TRIPS implementation would create welfare loss in terms of higher cost of using foreign technologies in these countries (Commission, 2002; World Bank, 2001). The negative impact of TRIPS on these countries may be further aggravated by the potential increase in cost of acquiring the foreign technologies by local firms (Commission,

[8]For a brief introduction to the TRIPS agreement see Hamdan-Livramento (2009); Gervais (2003); Watal (2001); Correa (2000).

2002), although Branstetter et al. (2007) argues that this may be mitigated by increased multinational activities in the developing country. Again, the overall impact of strengthened IPR protection varies, and this time according to channels of foreign technology exposure of the developing countries (Glass and Wu, 2007; Lai, 1998).

This paper attempts to shed more light on the matter by examining the effect of TRIPS implementation on entrepreneurs' exploitation of foreign technologies in developing countries.

4.2.3 Framework

Harmonized and strong IPR protection worldwide begets a global market for technologies by creating transferrable rights for intellectual creations. Market for technologies facilitates transaction of knowledge via licensing arrangements, thus increasing access to new technology and potential exploitation of these technologies. Therefore strong IPR protection should function in a similar manner to market for technologies by increasing access to and exploitation of foreign technologies by entrepreneurs in developing countries.

However, most entrepreneurs in developing countries have smaller budgets than their counterparts in developed countries to purchase their technologies from abroad. Therefore, their use of these technologies is constrained by their abilities to pay. Entrepreneurs in developing countries may no longer have access to cheaper versions of foreign technologies because TRIPS protects these technologies from expropriation. And if the price of acquiring the legitimate version of the technologies are too high, then the number of entrepreneurs using technologies from abroad would likely decrease.

The sum of the total impact of TRIPS implementation on exploitation of foreign technologies in developing countries would depend on whether the access to the technologies outweighs the cost of exploiting the technologies.

There are two distinct issues in regards to developing countries' implementation of the TRIPS agreement that need to be emphasized. The first is the countries' in-book legislative compliance. The other is the countries' actual enforcement of its obligations under the Agreement, not to be confused with the statutory enforcement specified in the TRIPS agreement.

It is possible that a country could have all of its TRIPS obligations enacted and implemented in its legislations but not enforce its obligations. On the other hand, it is possible that a country could not have managed to implement all of its TRIPS obligations but enforce whatever rules and regulations of the TRIPS provision it has implemented strongly.

Proposition 1 *Developing countries' TRIPS implementation could either facilitate or hinder local entrepreneurs' use of new foreign technologies. However the total influence of this strengthened IPR protection depends on whether the countries implement TRIPS in its legislations and enforce the rules and regulations of the TRIPS provisions in practice concurrently.*

Some industries are likely to be strongly affected by IPR protection than other industries (see Cohen et al., 2000; Mansfield, 1994, 1986; Levin et al., 1987). Foray (2004), for example, argues that IPR protection is important for industries that face high R&D costs, where imitation and reverse engineering is widespread and when the final cost of production manufacturing is low. I thus expect that the influence of strengthened IPR protection on access and exploitation of new technologies would vary across industrial sectors and categories.

Proposition 2 *The overall impact of TRIPS, both the compliance and enforcement aspects, should vary across industrial sectors. Entrepreneurs operating in IPR-sensitive sectors should be significantly more affected than the rest.*

4.3 Data collection

Lack of empirical research on examining the relationship between entrepreneurs, their activities and how they relate to IPR protection can be attributed to the difficulty of measuring entrepreneurship. Different definitions of entrepreneurship and the methods of data collection are some of the factors which make cross-country comparison on this subject matter complicated.

Recent international initiatives by the World Bank and the GEM research programs attempt to overcome this difficulty by setting out standardized questions and definitions to capture this elusive measure of economic activity by an important economic agent. I employ the information gathered on entrepreneurship to study the impact of strengthened IPR protection by TRIPS implementation on entrepreneurs in developing countries.

4.3.1 GEM data

The GEM research program has collected entrepreneurship data at the country level since 1998. A standardized adult population questionnaire is sent to the teams of participating countries to implement the survey. The frequency of countries' participation in the survey varies from year to year, and thus we do not have consistent observations number over per year over the period of study.[9]

[9]For more information on GEM data collection design and implementation see Reynolds et al. (2005).

GEM defines entrepreneurs as "adults in the process of setting up a business they will (partly) own and/or currently owning and managing an operating young business." Three main questions are posed to capture these "entrepreneurs": (i) whether the individual is trying to start a new business; (ii) whether the individual is starting a new business as part of her employment; and (iii) whether the individual is currently the owner who also manages the business. Positive response to any one of the questions above leads to the round of questions that would ascertain which entrepreneurship stage she is in and the industry she intends to compete in.

GEM classifies the individual and the new business as either *nascent entrepreneur*, *baby business* or *established business* according to the stage of business start-up, its age and if the business has generated any profits and/or made salary payments. If the individual is actively trying to start a firm, or has started a firm but has not received any profit or salary then it is considered as *nascent entrepreneur*. A *baby business* refers to an individual who owns or manages her own business, which is less than 42 months old and the new business has generated profit and/or made salary payment. *Established business* refers to an individual who owns and manages the business which is over 42 months old and the business has generated profit and/or made salary payments.

One of the questions asked during the survey is whether the entrepreneur will or is using new technology in the production of her goods or services. The question posed is, "[w]ere the technologies or procedures required for this product or services generally available more than a year ago?" A technology is considered new if it was not available a year ago in the region of interest even if the technology is known or used elsewhere. For the purposes of this study, I consider the "new" technology as foreign technology since the GEM definition of new technology implies that it is "new to the region" and that most developing countries are technology importers.[10]

I obtain the dependent variable, the share of entrepreneurs using new technology, by dividing the total number of entrepreneurs' acknowledging that they use new technologies by the total number of entrepreneurs per industry and industry sectors for the period 2002 – 2004. This variable captures the nascent entrepreneur and the baby businesses in the sample, which I loosely refer to as new entrepreneurs. The GEM research team considers *nascent entrepreneurs* and *baby businesses* as representative of the country's "total entrepreneurial activity" (TEA). TEA is defined as the share of the working adult-age individuals (18-64) who are either actively trying to start new entrepreneurial companies, or who are currently acting as owner-mangers of

[10]Throughout the rest of this paper, I use the terms "new technology" and "foreign technology" interchangeably.

new entrepreneurial companies.[11]

Fourteen countries of interest are captured in this sample, although not all were consistently surveyed from 2002 – 2004. Ten of these countries can be considered "developing" while four are "developed".[12] In the sample, 85% of the new entrepreneurs surveyed respond that they use new technology in the production of their goods or services. But only 42% of them use new technology to produce for the local market. I only consider the subset of entrepreneurs who produce for the local market given that IPR protection is national in application. Putting it differently, TRIPS implementation is national in scope, and thus entrepreneurs who use the technology and produce their goods and services using the technology for the local market are the ones who would be affected by TRIPS. Entrepreneurs producing for overseas market would be affected by the IPR protection in those foreign markets.

Figures 4.1 and 4.2 on show the total count of new entrepreneurs who mention that they use new technology for the year 2002 for eleven countries. Peru, Uganda and Venezuela were not surveyed in the year 2002 and thus do not appear in these figures. While the share of entrepreneurs using new technologies in their production is high in comparison to the whole entrepreneur population (Fig. 4.1) only a small percentage of those using new technology can classify them as medium- or high-technologies (Fig. 4.2). This graphical result is not surprising if we consider that most small businesses are marginal businesses, simple and small-scaled (see Bhide, 2000). Furthermore, entrepreneurs in developing countries may not have the proper financing to use medium- or high-technology in their production or engage in innovative activities.

[11] I do not have enough information from the raw data to ascertain which firms are established businesses and so omit this entrepreneur proxy from our study.

[12] Countries self-select themselves into categories "developing" and "developed" at the World Trade Organization (WTO), while the least-developed countries (LDCs) are identified by the United Nations. In our sample one of the countries defined as "developed" can be considered "developing", i.e. Mexico, while another which defines itself as "developing" can be considered "developed" from income level perspective, i.e. Singapore. Nevertheless, we bundle these countries together and consider them as "developing countries" to increase our sample size for the purposes of this research study.

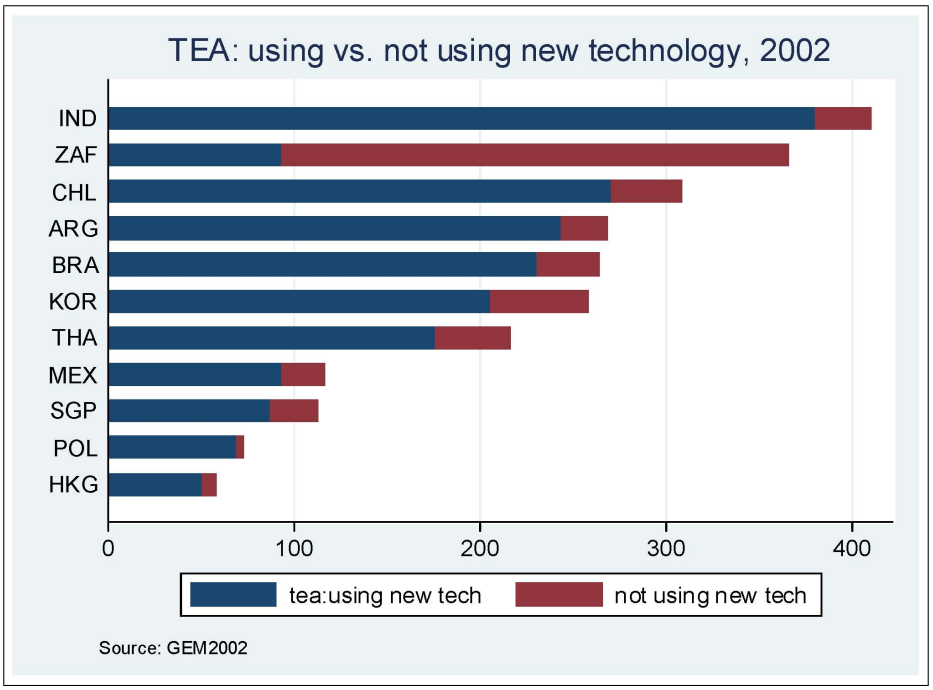

Figure 4.1: TEA: new technology vs. no new technology, 2002

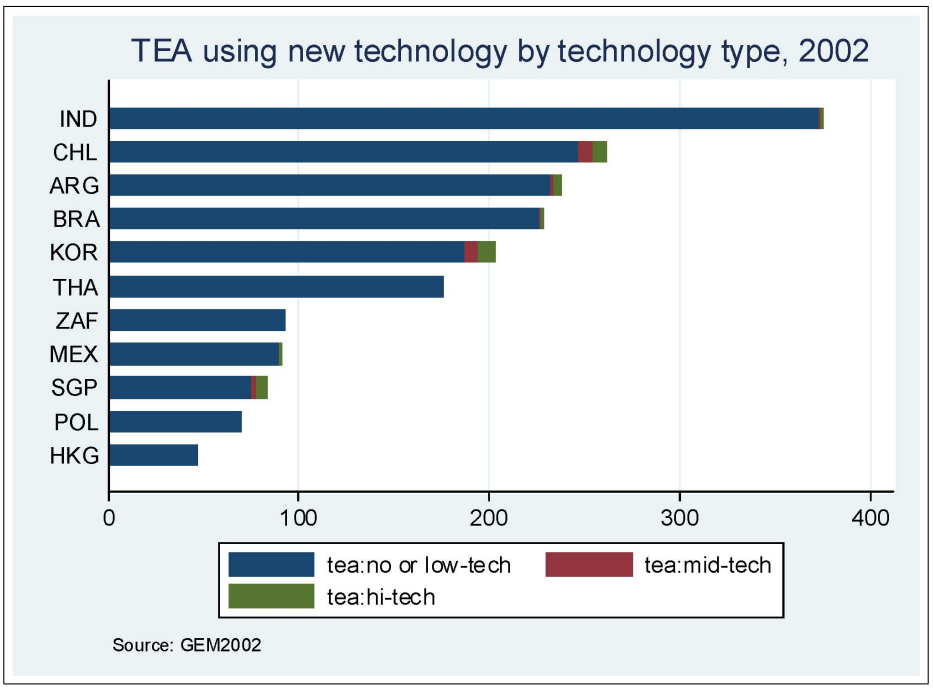

Figure 4.2: TEA: using new technology by type, 2002

4.3.2 TRIPS index

The main variable of interest is the implementation of the TRIPS agreement. The Agreement sets out the minimum IPR protection standard, enforceable through the World Trade Organization's (WTO) dispute settlement mechanism.[13]

The TRIPS index built by Hamdan-Livramento (2009) capture our countries' compliance with the Agreement, ranging from 0 – 7, where a score of 7 implies that the country is fully TRIPS compliant. It covers seven IPR types: copyright and related rights, trademark, geographical indication, industrial designs, patents, layout designs of integrated circuits and undisclosed information. A bivariate dummy variable is assigned to each IPR category when the country complies with that category. The TRIPS index is calculated as an unweighted sum of the seven IPR categories:[14]

IPR Category		**Total**
Copyright and related rights		1
Computer program	$\frac{1}{3}$	
Rental rights	$\frac{1}{3}$	
Related rights	$\frac{1}{3}$	
Trademark		1
Geographical indications		1
Industrial designs		1
Patents		1
Patents	$\frac{1}{3}$	
Pharmaceutical patents	$\frac{1}{3}$	
Plant varieties	$\frac{1}{3}$	
Layout designs of integrated circuits		1
Undisclosed information		1
Trade secrets	$\frac{1}{2}$	
Data submission	$\frac{1}{2}$	
Total		7

Table 4.1: TRIPS index method

I mentioned briefly in the subsection 4.2.3 of the distinction between in-book TRIPS compliance and actual enforcement of the TRIPS rules and regulations. The "actual enforcement" of TRIPS refer to the non-statutory enforcement of the Agreement, whereby the government actually commits to practising the TRIPS laws that it has committed to follow. I employ a yearly index produced by the IMD institution in Lausanne, Switzerland, on perceived enforcement of IPR protection as a proxy. Senior business leaders are queried as to whether local IPR protection "are adequately enforced". The index ranges from 1 – 10, with 10 the highest achievable score. I collect this data from the IMD's *World Competitiveness Yearbook*.

[13]For more information on the controversial nature of this agreement see Correa (2000).
[14]See Hamdan-Livramento (2009) for more information on how the index is built.

I introduce a third proxy of TRIPS, the product of the TRIPS in-book compliance and its enforcement. This variable ranges from 0 to 70, where a score of 70 implies that the country has fully implemented its TRIPS obligations into its legislation *and* is strongly enforcing the TRIPS rules and regulations.

I am also interested to see how countries that have implemented all seven IPR categories of the TRIPS agreement fare against the other countries. So we create a dummy that takes the value of 1 when the country has achieved full TRIPS compliance, i.e. TRIPS index of 7, and 0 otherwise. I interact this dummy with the enforcement proxy to see how countries that have full TRIPS compliance influence their local entrepreneurs' use of new foreign technologies.

4.3.3 Control variables

In my analysis I control for the competition level, opportunity to open business and gross domestic product (GDP) growth of the countries in the sample.

Competition level - Share of entrepreneurs who compete in highly competitive market by country and industry sectors. I expect that highly competitive market would positively influence the use of new technology since the new firm would need to differentiate itself from the incumbents. Data is collected from the GEM database for the years 2002–2004.

Opportunity - Share of entrepreneurs who identify that opportunity is the sole reason for opening the business by country and industry sectors. I assume that new business that are opportunity-based would positively influence the use of new technology in the production. Data is from the GEM database for the years 2002–2004.

GDP growth - Rate of country growth and proxy for country's boom or recession periods. For developing countries, an economic boom may negatively impact entrepreneurship as employment opportunities may be better elsewhere than starting one's own business. Putting it differently, the opportunity cost of starting one's own business may be higher in times of good economic growth. Data is obtained from the World Bank's World Development Indicator database.

I present the descriptive statistic for the variables and the Pearson pairwise correlation of these variables in the appendix on pages 112 and 113. There are no serious problems of correlation between the explanatory variables, except with the interaction variable of the dummy for full TRIPS compliance and the product of the dummy for full TRIPS compliance with enforcement.

4.4 Econometrics specification and analysis

This research paper examines how a developing country's compliance with the TRIPS agreement influences the share of entrepreneurs using new technology in the production of their goods or services, where the dependent variable proxies for access and exploitation of new technology by entrepreneurs residing in developing countries.

I have two variables of interest which are measured yearly, in-book TRIPS compliance and its enforcement for fourteen countries for 2002 – 2004. I interact these two measures of local IPR protection together to examine how statutory compliance and enforcement of TRIPS affect our share of entrepreneurs using new technology.[15] I assume that any changes in the IPR system will only take effect a year after, and so I lag these measures by a year.[16] In addition I generate a dummy variable that takes the value of 1 when a country is fully compliant with its TRIPS obligations (score of 7) and 0 otherwise to compare with countries that are not fully TRIPS compliant.

I assume that the impact of TRIPS compliance on the share of new entrepreneurs using new technology would be more relevant if the market that the entrepreneur competes in is local. Therefore we concentrate on the subset of entrepreneurs who intend to service and are servicing the local customers, and investigate how these entrepreneurs respond to the country's level of TRIPS implementation.

I have a panel dataset for the fourteen countries for 2002 – 2004 per 4-digit industry sectors (ISIC Rev. 3). Thus we have information of the share of new entrepreneurs using new technology for every industry sector at the 4-digit level per country for the 3 years, giving us a total of 1,536 observations. However, not all countries are consistently observed over the 3 years and we are missing information on the TRIPS enforcement proxy for Peru. Therefore we are left with an unbalanced panel dataset of 1,408 observations.

4.4.1 Econometrics model

First, I pool the data and run ordinary least squares (OLS) regression, correcting for heteroscedasticity as a benchmark for the following equation:[17]

[15] I use the term IPR protection to refer to the general intellectual property rights protection. TRIPS is a specific IPR standard.

[16] TRIPS legislation has not changed much over the years of study 2002—2004 for our 14 developing countries and thus one year of lag is adequate. For robustness check, we tried up to two years of lag and the result is consistent with the one year lag.

[17] I further estimate our model using OLS cluster where the standard errors are computed using the sandwich estimator, with no significant difference from the first OLS regression without cluster.

$$Y_{it} = \alpha + \beta * X_{it-1} + \gamma * Z_{it} + \epsilon_{it} \tag{4.1}$$

Y is the share of entrepreneurs using new technology per total population of entrepreneurs servicing the local market. X is a vector containing the following TRIPS variables, the TRIPS index ($TRIPS$), its enforcement (IMD), a dummy for full TRIPS compliance ($d(TRIPS)$), an interaction between the TRIPS index with the perceived IPR strength ($TRIPS*IMD$)and interaction term of the dummy for full TRIPS compliance with the IPR strength index ($d(TRIPS)*IMD$), all lagged by one year. And finally Z is the vector with the control variables mentioned in subsection 4.3.3.

FE estimation allows us to control for country-specific effects, and deals with possible omitted variables issue. This method explains the variation of the dependent variable from its mean by exploiting the unobservable country-specific constant term, which can be measured by the difference of the explanatory variables from its mean per country and industry sector for the case:

$$Y_{it} - \overline{Y}_i = \beta * (X_{it-1} - \overline{X}_i) + \gamma * (Z_{it} - \overline{Z}_i) + (\epsilon_{it} - \bar{\epsilon}_i) \tag{4.2}$$

The drawback of using the FE estimation is that the TRIPS dummy variable *d(TRIPS)* drops because it does not vary over the time period of study. And thus we no longer can observe how being fully TRIPS compliant in-book affects the share of entrepreneurs' using foreign technology. I consider using the random effects (RE) estimation but the Hausman test rejects the null hypothesis that the coefficients estimated under FE are the same as under RE. Thus I stick to FE estimation. In addition, under the assumption that FE model is correct, estimation of the coefficients produced by OLS and RE regressions are inconsistent. Table 4.2 below displays the result of our FE estimation while Table 4.9 on page 115 in the appendix compares the OLS with the RE-estimations.

The *baseline* column in the table is the regression of our dependent variable on our control variables. It shows that the share of entrepreneurs using new technology in the production of their goods or services is negatively affected by GDP growth but are positively influenced by the competition level at home and the opportunity-based reason for starting the business. All of the coefficients of the control variables are statistically significant at the 5% level. The coefficient signs fall within our expectations.

Columns I – III, corresponding to models I – III, are regressions of our dependent variable

	FE					
	baseline	**I**	**II**	**III**	**IV**	**V**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
Highly competitive market	0.628***	0.569***	0.521***	0.628***	0.469***	0.510***
	(0.042)	(0.044)	(0.044)	(0.042)	(0.045)	(0.044)
Opportunity-based	0.553***	0.522***	0.526***	0.552***	0.510***	0.523***
	(0.050)	(0.050)	(0.047)	(0.050)	(0.045)	(0.046)
GDP growth %	-0.004**	-0.005**	-0.002	-0.004*	-0.012***	-0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
TRIPS		-0.413***			-0.612***	
		(0.093)			(0.107)	
IMD			0.204***		0.203***	0.179***
			(0.025)		(0.026)	(0.025)
TRIPS*IMD				0.000	-0.050***	
				(0.007)	(0.007)	
d(TRIPS)						*(drop)*
d(TRIPS)*IMD						-0.430***
						(0.105)
cons	0.148***	2.641***	-0.939***	0.137	4.279***	0.377
	(0.016)	(0.558)	(0.131)	(0.206)	(0.777)	(0.339)
R^2	0.645	0.659	0.693	0.645	0.713	0.702
N	1,408	1,408	1,408	1,408	1,408	1,408

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$
Robust standard errors in brackets

Table 4.2: Fixed effects estimation with robust std. errors

on the baseline model and the three different proxies for TRIPS compliance respectively. The coefficient for the TRIPS compliance index, *TRIPS*, is significant and negative, indicating that a unit increase in the country's compliance with the TRIPS legislation decreases the share of entrepreneurs using foreign technology by 41%. However, a unit increase in TRIPS enforcement, *IMD*, leads to a 20% increase in our dependent variable. The interaction term of in-book TRIPS implementation and TRIPS enforcement, *TRIPS*IMD* is not significant however.

In column VI, corresponding to model VI of the same Table 4.2, I regress our dependent variable on the three proxies of TRIPS, *TRIPS*, *IMD* and *TRIPS*IMD*, along with the control variables altogether. As in the earlier regression models of I–II, TRIPS implementation decreases the share of entrepreneurs using foreign technology while its enforcement has a positive effect on the same variable. However, unlike model III, the interaction term between in-book TRIPS compliance and its enforcement is now significant and negative. The interpretation of these IPR proxies can be decomposed in the following manner:

$$dY = \beta_{TRIPS} * dTRIPS + \beta_{IMD} * dIMD + \beta_{TI} * TRIPS * dIMD + \beta_{TI} * IMD * dTRIPS \quad (4.3)$$

I show the impact of TRIPS implementation and its enforcement effect on the dependent variable in the Table 4.3 below by considering what happens in the "average" case where TRIPS

is equal to 5.3 and its enforcement variable, *IMD*, equals to 5.7. I also consider the extreme cases, the upper limit case of *TRIPS* equals 7 and *IMD* is equal to 10 and the lower limit case of *TRIPS* equals 0 and *IMD* is equal to 1. For interest purposes, we also analyze the impact for the lowest observable value of *TRIPS* and *IMD* in our sample, 0.83 and 3 respectively.

	$\frac{dY}{dIMD}$	$\frac{dY}{dTRIPS}$	
TRIPS=7	-0.147	-1.112	IMD=10
TRIPS=5.3	-0.062	-0.897	IMD=5.7
TRIPS=0.83	0.1615	-0.762	IMD=3
TRIPS=0	0.203	-0.662	IMD=1

Table 4.3: Analysis of IPR proxy impact for Model V

Table 4.3 shows that TRIPS implementation negatively influences the share of entrepreneurs using new technology. However, this negative impact can be slightly mitigated if its enforcement is weakened. It then follows that a country's low compliance with the TRIPS agreement but strongly enforces the Agreement positively affects the share of entrepreneurs using new technology in the production of their goods or services.

For the last model in column V of Table 4.2, I run the control variables along with the dummy variable for countries that have reached full TRIPS compliance, *d(TRIPS)*, the TRIPS enforcement index, *IMD* and the product of full TRIPS compliance dummy with the enforcement index, *d(TRIPS)*IMD*. This regression model examines how countries that have achieved full TRIPS compliance differ from those that have not. The results show that there is a significant difference between countries that have and have not implemented the TRIPS agreement fully. In general, strengthened IPR protection reduces the share of entrepreneurs using new technology by 25% on the share of entrepreneurs using foreign technologies.[18]

4.4.2 TRIPS impact varies by industry sector

My second proposition argues that the impact from countries' TRIPS implementation on the share of entrepreneurs using foreign technology should vary across industry sectors. I exploited the industry classifications at the 1-digit industry code and also by categories, and find that the results from the FE regressions concur with our second proposition.

I re-run regressions of models I – VI for every sector at the 1-digit ISIC code and by categories. I examine to see if TRIPS implementation impacts the entrepreneurs in these sectors and categories differently.[19] In order to save space, I only report the estimates of TRIPS implementation ($TRIPS$), its enforcement (IMD), the product of TRIPS implementation and its

[18]This value is calculated by: 17.9%-43%=-25%.

[19]The industrial categories are: extractive, transforming, business service and consumer oriented.

TRIPS enforcement ($TRIPS * IMD$), and the interaction term of the dummy for full TRIPS compliance and enforcement ($d(TRIPS) * IMD$) per the sectors and categories examined.

Table 4.10 on page 116 in the appendix displays the estimated coefficients for each of the IPR proxies. The columns numbers and the respective models correspond to those in Table 4.2 but are by sectors, both at the 4 category level and 1-digit ISIC Rev. 3 industry code. We can observe in Column II that TRIPS implementation is negative and significant for the transforming and consumer-oriented industry categories, and specifically affects industries such as manufacturing; mining and construction; transportation, communication and utilities; wholesale, motor vehicle sales and repair; and retail, hotel and restaurant. The proxy for TRIPS enforcement is positive and significant for all of the industry categories except for the financial, insurance and real estate sectors and statistically insignificant for the health, education and social services sector.

Model IV estimation in Table 4.4 shows how TRIPS implementation proxy, its enforcement and the interaction term between the two affect the share of entrepreneurs using new technology. We can observe that the top three sectors significantly and adversely affected by TRIPS are the manufacturing, consumer service and the transportation, communications and utilities sectors respectively.

I conduct a similar exercise as I have done for Model IV in the previous subsection, by examining how each IPR proxy affects the share of entrepreneurs using new technology per industry category and sector. I only examine the categories and sectors that are significantly affected by TRIPS implementation in Table 4.11 on page 117 of the appendix. When examining the impact of a unit increase in TRIPS implementation while holding its actual enforcement constant in Table 4.11, we find that the manufacturing, consumer services and the retail, hotel and restaurant sectors are the top three sectors significantly affected. Similar to the general case, we find that this adverse effect of TRIPS implementation can be partially offset by weakening TRIPS' actual enforcement per sectors.

Results of FE regression on Model V give further support that TRIPS implementation affect varies by industry category and sector. Here I examine how full TRIPS compliance impacts the share of entrepreneurs using foreign technology per sector, as well as per category. Unlike in Model IV, the highest adverse impact of full TRIPS compliance is on the consumer services sector. It is unusual and interesting that the TRIPS enforcement index impacts the financial, insurance and real estate sector negatively, when for other sectors its influence is positive.

	IV			
	TRIPS (coef/se)	**IMD** (coef/se)	**TRIPS*IMD** (coef/se)	**N**
4 categories				
Extractive	-0.886	0.347**	-0.135***	97
	(0.601)	(0.138)	(0.053)	
Transforming	-0.745***	0.225***	-0.043***	539
	(0.129)	(0.052)	(0.013)	
Business service	-0.130	0.245***	-0.044**	2 48
	(0.258)	(0.069)	(0.018)	
Consumer oriented	-0.620***	0.197***	-0.055***	524
	(0.181)	(0.039)	(0.011)	
SIC 1-digit				
Agriculture, forestry, hunting, fishing	-0.886	0.347**	-0.135**	89
	(0.603)	(0.139)	(0.053)	
Mining, construction	-0.687***	0.284***	-0.018	67
	(0.170)	(0.086)	(0.017)	
Manufacturing	-0.918***	0.389***	-0.085***	258
	(0.342)	(0.105)	(0.031)	
Transportation, communications, utilities	-0.831***	0.066	-0.029	105
	(0.230)	(0.104)	(0.023)	
Wholesale, motor vehicles sales, repair	-0.748***	0.112*	-0.043**	143
	(0.290)	(0.062)	(0.018)	
Retail, hotel, restaurant	*(drop)*	-0.429**	-0.085	47
		(0.213)	(0.059)	
Financial, insurance, real estate	-0.732***	0.270***	-0.055***	278
	(0.198)	(0.054)	(0.014)	
Business service	-0.154	0.243***	-0.044**	201
	(0.264)	(0.088)	(0.021)	
Health, education, social services	0.015	0.055	-0.016	103
	(0.491)	(0.090)	(0.019)	
Consumer services	-0.881*	0.148**	-0.084***	117
	(0.509)	(0.069)	(0.029)	

Robust standard errors in brackets
note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Table 4.4: FE estimates for models IV by industry category & sector

	V		
	IMD (coef/se)	**d(TRIPS)*IMD** (coef/se)	**N**
4 categories			
Extractive	0.241**	-0.701	97
	(0.110)	(0.446)	
Transforming	0.242***	-0.111	539
	(0.048)	(0.199)	
Business service	0.190***	-0.700**	248
	(0.060)	(0.291)	
Consumer oriented	0.162***	-0.566***	524
	(0.039)	(0.152)	
SIC 1-digit			
Agriculture, forestry, hunting, fishing	0.241**	-0.701	89
	(0.111)	(0.448)	
Mining, construction	0.331***	0.072	67
	(0.073)	(0.247)	
Manufacturing	0.367***	-0.266	258
	(0.092)	(0.596)	
Transportation, communications, utilities	0.124	0.202	105
	(0.094)	(0.433)	
Wholesale, motor vehicles sales, repair	0.068	-0.522*	143
	(0.058)	(0.292)	
Retail, hotel, restaurant	-0.257***	-0.656***	47
	(0.058)	(0.080)	
Financial, insurance, real estate	0.243***	-0.508***	278
	(0.054)	(0.181)	
Business service	0.190***	-0.666**	201
	(0.073)	(0.337)	
Health, education, social services	0.020	-0.169	103
	(0.097)	(0.425)	
Consumer services	0.063	-1.317***	117
	(0.075)	(0.467)	

Robust standard errors in brackets
note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Table 4.5: FE estimates for models V by industry category & sector

4.4.3 Further regressions

The OLS estimations that I conducted in the preceding section assume that the variable is continuous and unbounded. Recall that the dependent variable is the share of entrepreneurs using foreign technology in the production of their goods or services. It is thus a continuous variable bounded between 0 and 1, with most of the observations stacked at either ends as seen in Table 4.3. I can use OLS to estimate the equation but run the risk that the predicted values of the dependent variable could be above or below its bound, i.e. $0 < \hat{Y} > 1$. So I use the two-limit or "doubly censored" Tobit estimation as recommended by Loudermilk (2007).

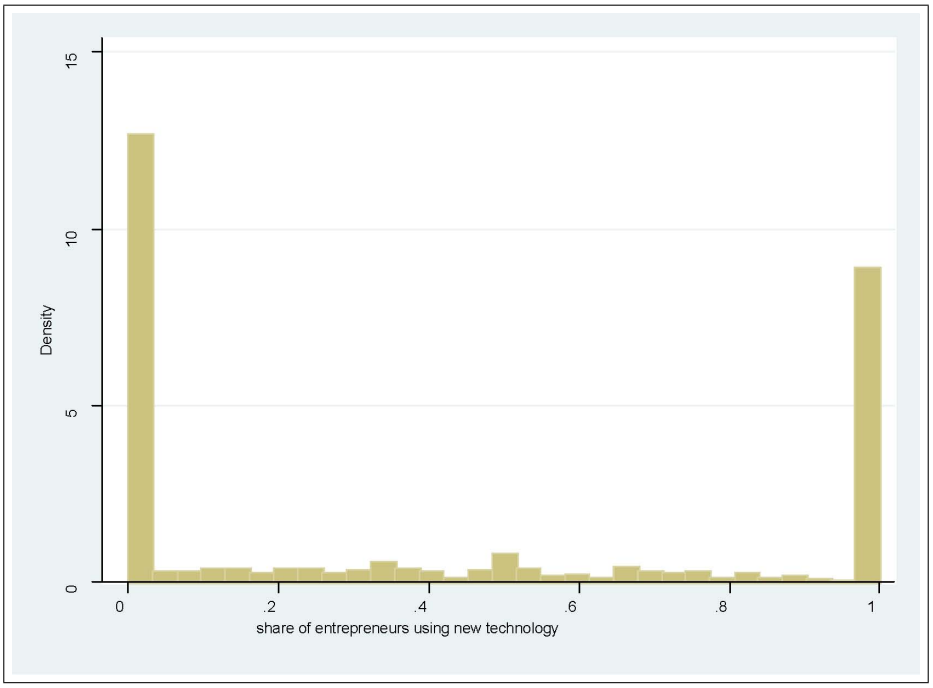

Figure 4.3: Dispersion of share of entrepreneurs using new technology, 2002–2004

First I pool the data and run the Tobit estimation, correcting for heteroscedasticity with robust standard errors.[20] I then run the panel random-effects Tobit regression and test whether the pooled Tobit regression can be used. The likelihood ratio test reveal that I can use the pooled Tobit estimation. The results of these pooled Tobit and Tobit random effects regressions are in Section 4.5.1 of page 98 of the appendix.

I then run the pooled Tobit estimation and introduce the dummies for countries, thus running a pseudo-fixed effects Tobit estimation.[21] In addition, I correct for potential heteroscedasticity

[20] I further estimate our model using pooled Tobit estimation with country-cluster where the standard errors are computed using the sandwich estimator. Result shows no significant difference from the first pooled Tobit regression without cluster.

[21] I cannot run fixed-effects panel Tobit estimation in Stata.

using robust standard errors. I later test whether the inclusion of country-specific effect into our pooled two-limit Tobit model is appropriate using the likelihood ratio test and reject the null hypothesis of no unobserved country effects.

	Tobit					
	baseline	**I**	**II**	**III**	**IV**	**V**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
Highly competitive market	1.462***	1.351***	1.274***	1.451***	1.216***	1.273***
	(0.088)	(0.088)	(0.088)	(0.088)	(0.088)	(0.087)
Opportunity-based	1.328***	1.264***	1.252***	1.322***	1.216***	1.245***
	(0.096)	(0.093)	(0.090)	(0.095)	(0.089)	(0.090)
GDP growth %	-0.013***	-0.013***	-0.008*	-0.007	-0.022***	-0.024***
	(0.005)	(0.005)	(0.004)	(0.006)	(0.007)	(0.009)
TRIPS		-1.385***			-1.274***	
		(0.263)			(0.301)	
IMD			0.530***		0.473***	0.497***
			(0.066)		(0.066)	(0.067)
TRIPS*IMD				0.029	-0.071***	
				(0.020)	(0.024)	
d(TRIPS)						4.531***
						(0.919)
d(TRIPS)*IMD						-0.594**
						(0.282)
cons	-0.033	9.709***	-1.884***	-0.712	8.938***	-4.282***
	(0.075)	(1.850)	(0.234)	(0.476)	(2.479)	(0.554)
Country effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
lnσ	-0.313***	-0.334***	-0.365***	-0.314***	-0.379***	-0.368***
	(0.053)	(0.053)	(0.053)	(0.053)	(0.053)	(0.053)
Log-Likelihood	-1'000.06	-986.49	-965.77	-999.17	-958.06	-963.96
χ^2	546.965	567.018	579.752	550.581	595.087	581.382
McFadden's R^2	0.346	0.355	0.368	0.346	0.373	0.369
McKelvey and Zavoina's R^2	0.184	0.19	0.206	0.183	0.212	0.207
N	1'408	1'408	1'408	1'408	1'408	1'408

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$
Robust standard errors in brackets.
McFadden's and McKelvey and Zavoina's R^2 are reported for completeness

Table 4.6: Pooled Tobit estimation with country effects

However, I encounter a problem with the Tobit estimation in that its marginal effect for most of the explanatory variables are above the value 1. The marginal effect of the Tobit estimation can be interpreted in a similar manner as the OLS estimates. If we believe the Tobit estimation of the dependent variable, we find that a unit increase in TRIPS compliance, *TRIPS*, leads to a decrease in the share of local entrepreneurs using new technologies by 1.4 units (corresponds to estimate in column II), which implies that TRIPS *de jure* implementation reduces the share of entrepreneurs by over 100%. However the sign and significance of the variables of interest TRIPS index, its enforcement and the interaction of the index and the enforcement term concur with the OLS estimates. This regression method deserves more study.

I also run probit estimation to check both the robustness of the Tobit and OLS estimation

results. I collapse the continuous dependent variable into binary outcomes variable by using the mean value of our dependent variable as separator. Observations of the dependent variable with values above 0.421266 are assigned 1 and 0 otherwise. I also tested a different separator value, the median of the dependent variable, but find that the direction and significance of impact does not differ. The estimates from the probit regression with country effects largely agrees with our pooled Tobit estimation with country-specific effects. I report the result of the probit regression in Table 4.13 on page 119 of the appendix.

4.4.4 Future research

In the near future I hope to conduct detailed analysis of the current research by trying to determine how entrepreneurs in developing countries with differing imitative abilities react to TRIPS implementation. I did not conduct this analysis here because of the limited sample of countries and because they have similar imitative abilities. Breaking the countries into their levels of imitative abilities, measured by the *ArCo* technological index of Archibugi and Coco (2004), shows that we have three *leaders*, three *potential leaders*, seven *latecomers*, and one *marginalized* country. However the fact there are unbalanced observations per country over the period of study poses a concern for me.

In addition I would like to pursue the estimations of the Tobit regression further. Model V of the Tobit regression in Table 4.6 shows that countries fully compliant with their TRIPS obligations have 450% more entrepreneurs exploiting new technologies than the rest. While the estimate itself is high, the sign of this marginal effect suggests that there is difference between countries who have completely complied with their TRIPS obligations and those who haven't. The FE estimation did not capture this impact since the regression method drops any variable that does not change over time. Most of the changes in the TRIPS index for countries in this sample are for those with TRIPS index values between 0 and 6.

Needless to say, I would like to re-run the regressions here with more observations per country, per sector and for more years.

4.5 Conclusion

I attempt to study how developing countries' implementation of the TRIPS agreement may influence access to new technology. I exploit the GEM data on new entrepreneurs' use of new technology in their production of goods or services to investigate the impact.

In answering the first proposition I find that TRIPS implementation adversely influences local entrepreneurs' use of new technology. This evidence implies any possible access to new technology may be outweighed by the increase in cost to acquire and later exploit that technology. Considering that the bulk of developing countries in this sample has potential to imitate foreign technology, the results presented here is contrary to argument that strengthened IPR protection would encourage more exploitation of new foreign technologies. Instead, they lend support to the argument that strengthened IPR system creates higher barrier to using technologies from abroad for developing countries.

A possible explanation for this reduction could be that entrepreneurs now face higher cost of exploiting the foreign technologies due to the strengthened IPR protection. For example, pirated copies of new softwares could be made scant in countries enforcing their TRIPS obligations. Therefore locals would have to pay the higher price of using the copyrighted softwares rather than paying the cost of reproducing the pirated versions. However, this is could be short-run effect of TRIPS implementation.

While strengthening of IPR protection in these developing countries have adversely affected the entrepreneurs using foreign technologies, the IPR reform also brings more inflow of foreign technologies and activities to the countries via the traditional channels of exposure: trade, FDI and licensing, as I have shown in the previous chapter. Depending on how these channels of exposure take place, the local knowledge pool could increase thereby building the countries' innovative capacities. Therefore in the long-run, it is possible that the benefits to increased access to foreign technologies outweighs the cost of reduction in share of local entrepreneurs using foreign technologies. However, more study into this matter will have to be conducted.

4.5.1 Limitation

The evidence produced in this paper show that TRIPS implementation adversely affects entrepreneurs' exploitation of new technology. This may be partially mitigated by weak IPR enforcement. However, our result is not without limitations.

Firstly, capturing entrepreneurial activities across countries is a difficult endeavor. Even with the standardized questionnaire and survey design that attempt to capture entrepreneurial activity, the result may be influenced by the domestic culture. Respondents in some countries may be overly optimistic in their answers in comparison to others, leading to an overestimation of entrepreneurial activity in these particular countries.

Secondly, responses to the question that I am interested in, the exploitation of foreign technology, assumes that the respondent knows her market well. It is unlikely that an entrepreneur is fully aware of the kinds of technology considered new to the market, especially at the beginning of the start-up.

Thirdly, I assume that the identification of the industry sectors of participation at the 4-digit level are accurate. This is problematic especially for nascent entrepreneurs who may not know which area they would be operating in. However, I have tried to circumvent this problem by looking at the aggregated industry categories and the 1-digit sector level.

In addition, I would prefer to have more numbers of observations for entrepreneurs at every sectorial level. It would be prudent to repeat this exercise I have undertaken here in the future when more observations have been gathered.

Turning away from problems of using the GEM data, the TRIPS implementation variable may be an inadequate attempt at quantifying legislation changes but it is the only available index that reasonably tries to measure the changes. The construction of this index is based on the broad obligations highlighted in the Agreement. It does not take into consideration the different legal nuances and interpretations of the provisions which each country may adopt.

And lastly, the variable for TRIPS enforcement is based on the average response of senior business leaders to the question of whether local IPR protection is adequate. The response of the business leaders would depend on their familiarity with the local business environment, and how they judge the term “adequate”.

APPENDIX

Countries in the sample

Geographical region	Countries	ArCo classification
Asia	Hong Kong, China	leader
	India	latecomer
	South Korea	leader
	Singapore	leader
	Thailand	latecomer
Latin America	Argentina	potential leader
	Brazil	latecomer
	Chile	potential leader
	Mexico	latecomer
	Peru	latecomer
	Venezuela	latecomer
Africa	South Africa	latecomer
	Uganda	marginalized
Europe	Poland	potential leader

The ArCo technological capabilities indicator classify countries according to the country's creation of technology capabilities, the technological infrastructures and the development of human skills. The countries are then subdivided into four main groups: *leader*, *potential leader*, *latecomers* and *marginalized*. *Leaders* are the group of countries with ability to create and sustain technological innovation. *Potential latecomers* have invested in the necessary infrastructure, such as human capital and technological infrastructure, to build the countries' innovative capacity but have yet to achieve significant levels of innovation. *Latecomers* refer to countries that are in the process of building their human capital and technological infrastructure concurrently. And lastly, the *marginalized* are group of countries that do not even have significant access to "old" technologies. They mostly consist of least-developed countries.

Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Dependent variable:					
Use new technology	1536	0.421266	0.432296	0	1
IPR variables:					
TRIPS	1536	5.703885	2.227044	0.833333	7
IMD	1409	5.471065	1.404857	3.08	8.06
d(TRIPS)=1 (if country meets full compliance)	1536	0.539714	0.498583	0	1
TRIPS*IMD	1409	30.09207	13.70749	4.966667	54.93333
d(TRIPS)*IMD	1409	2.634798	2.529688	0	6.49
Control variables (Z):					
Highly competitive market	1536	0.262661	0.369658	0	1
Opportunity-based reason	1536	0.239737	0.358647	0	1
GDP growth	1536	4.009686	5.328753	-10.8945	17.85457

Table 4.7: Descriptive statistics

Correlation table

		1	2	3	4	5	6	7	8
1	TRIPS	1							
2	IMD	-0.2818*	1						
3	TRIPS*IMD	0.6954*	0.4576*	1					
4	d(TRIPS)=1 (if TRIPS=7)	0.6304*	-0.4043*	0.2218*	1				
5	d(TRIPS)*IMD	0.5440*	-0.1139*	0.4061*	0.9183*	1			
6	Highly competitive market	0.0456	0.0594*	0.0239	0.0199	0.0112	1		
7	Opportunity-based reason	-0.0187	0.0967*	0.0087	-0.0113	-0.0007	0.3802*	1	
8	GDP growth	0.025	0.0105	0.05	0.0176	-0.0035	-0.1561*	-0.0671*	1

Table 4.8: Pearson pairwise correlation table

Proposition 1

Comparison

	Pool						RE					
	baseline	**I**	**II**	**III**	**IV**	**V**	**baseline**	**I**	**II**	**III**	**IV**	**V**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
Highly competitive market	0.541***	0.544***	0.542***	0.545***	0.526***	0.532***	0.551***	0.554***	0.555***	0.554***	0.534***	0.543***
	(0.049)	(0.047)	(0.050)	(0.049)	(0.060)	(0.049)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Opportunity-based	0.471***	0.466***	0.474***	0.471***	0.478***	0.475***	0.479***	0.475***	0.481***	0.479***	0.488***	0.483***
	(0.043)	(0.040)	(0.039)	(0.043)	(0.040)	(0.039)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
GDP growth /%	-0.007***	-0.006**	-0.007***	-0.006***	-0.007***	-0.008***	-0.006***	-0.006***	-0.006***	-0.006***	-0.008***	-0.008***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
TRIPS		-0.013*			0.103**			-0.013**			0.115***	
		(0.007)			(0.048)			(0.005)			(0.016)	
IMD			-0.009		0.117**	0.027			0.002		0.135***	0.043***
			(0.021)		(0.046)	(0.039)			(0.007)		(0.017)	(0.009)
TRIPS*IMD				-0.003***	-0.019**					-0.003***	-0.021***	
				(0.001)	(0.008)					(0.001)	(0.002)	
d(TRIPS)						0.343						0.416***
						(0.237)						(0.074)
d(TRIPS)*IMD						-0.062						-0.076***
						(0.042)						(0.014)
cons	0.202***	0.278***	0.250*	0.298***	-0.477*	0.030	0.197***	0.275***	0.187***	0.289***	-0.598***	-0.066
	(0.051)	(0.031)	(0.140)	(0.068)	(0.274)	(0.227)	(0.014)	(0.035)	(0.039)	(0.026)	(0.106)	(0.054)
R^2	0.528	0.531	0.529	0.538	0.551	0.538	0.529	0.533	0.529	0.540	0.552	0.539
N	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408

$^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Robust std. errors in brackets

Table 4.9: Pooled OLS and RE estimation for comparison

Proposition 2

FE estimations of models I – III

	I **TRIPS** (coef/se)	**II** **IMD** (coef/se)	**III** **TRIPS*IMD** (coef/se)	*N*
4 categories				
Extractive	0.299	0.248**	-0.041	97
	(0.486)	(0.116)	(0.037)	
Transforming	-0.640***	0.249***	0.021**	539
	(0.108)	(0.046)	(0.010)	
Business service	0.033	0.187***	-0.015	248
	(0.196)	(0.064)	(0.012)	
Consumer oriented	-0.391**	0.200***	-0.005	524
	(0.155)	(0.037)	(0.011)	
SIC 1-digit				
Agriculture, forestry, hunting, fishing	0.299	0.248**	-0.041	89
	(0.487)	(0.116)	(0.037)	
Mining, construction	-0.868***	0.329***	0.047**	67
	(0.161)	(0.074)	(0.020)	
Manufacturing	-0.520**	0.386***	0.013	258
	(0.252)	(0.088)	(0.020)	
Transportation, communications, utilities	-0.693***	0.121	0.031*	105
	(0.133)	(0.098)	(0.018)	
Wholesale, motor vehicles sales, repair	-0.453*	0.105*	-0.004	143
	(0.258)	(0.059)	(0.016)	
Retail, hotel, restaurant	*(drop)*	-0.202**	0.034	47
		(0.088)	(0.047)	
Financial, insurance, real estate	-0.553***	0.278***	0.002	278
	(0.181)	(0.052)	(0.015)	
Business service	-0.017	0.173**	-0.010	201
	(0.192)	(0.073)	(0.012)	
Health, education, social services	0.082	0.033	-0.011	103
	(0.443)	(0.086)	(0.026)	
Consumer services	-0.446	0.169**	-0.021	117
	(0.368)	(0.071)	(0.030)	

$^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$
Robust std. errors in brackets

Table 4.10: FE estimations on models I – III

Model IV: Impact across sectors

	$\frac{dY}{dIMD}$				$\frac{dY}{dTRIPS}$			
	TRIPS=7	**TRIPS=5.3**	**TRIPS=0.83**	**TRIPS=0**	**IMD=10**	**IMD=5.7**	**IMD=3**	**IMD=1**
Transforming	-0.076	-0.0029	0.189	0.225	-1.175	-0.9901	-0.874	-0.788
Consumer oriented	-0.188	-0.0945	0.151	0.197	-1.17	-0.9335	-0.785	-0.675
Mining, construction	0.284	0.284	0.284	0.284	-0.684	-0.684	-0.684	-0.684
Manufacturing	-0.206	-0.0615	0.318	0.389	-1.768	-1.4025	-1.173	-1.003
Transportation, communication, utilities	-	-	-	-	-0.831	-0.831	-0.831	-0.831
Wholesale, motor vehicles sales, repair	-0.189	-0.1159	0.076	0.112	-1.178	-0.9931	-0.877	-0.791
Retail, hotel, restaurant	-0.115	-0.0215	0.224	0.27	-1.282	-1.0455	-0.897	-0.787
Consumer services	-0.44	-0.2972	0.078	0.148	-1.721	-1.3598	-1.133	-0.965

Table 4.11: Proposition 2: IPR impact by industry category & sector

Further regressions

Comparison of pooled Tobit and Tobit random effects estimations

	Pooled tobit with robust std. errors						Tobit panel					
	I	**II**	**III**	**IV**	**V**	**VI**	**I**	**II**	**III**	**IV**	**V**	**VI**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
Highly competitive market	1.512***	1.517***	1.569***	1.563***	1.502***	1.531***	1.515***	1.520***	1.572***	1.566***	1.506***	1.535***
	(0.082)	(0.082)	(0.090)	(0.089)	(0.089)	(0.089)	(0.080)	(0.080)	(0.089)	(0.088)	(0.086)	(0.088)
Opportunity reason	1.400***	1.395***	1.475***	1.451***	1.452***	1.459***	1.404***	1.399***	1.478***	1.454***	1.456***	1.463***
	(0.089)	(0.089)	(0.097)	(0.095)	(0.095)	(0.096)	(0.082)	(0.082)	(0.092)	(0.090)	(0.089)	(0.090)
GDP growth %	-0.014***	-0.014***	-0.015***	-0.013***	-0.016***	-0.018***	-0.014***	-0.014***	-0.015***	-0.013***	-0.016***	-0.018***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)
TRIPS		-0.014			0.249***			-0.015			0.252***	
		(0.010)			(0.051)			(0.010)			(0.051)	
IMD			-0.033*		0.269***	0.069**			-0.033*		0.273***	0.071**
			(0.018)		(0.056)	(0.027)			(0.018)		(0.058)	(0.029)
TRIPS*IMD				-0.009***	-0.046***					-0.009***	-0.047***	
				(0.002)	(0.008)					(0.002)	(0.008)	
d(TRIPS)						0.954***						0.968***
						(0.213)						(0.209)
d(TRIPS)*IMD						-0.174***						-0.177***
						(0.039)						(0.038)
cons	-0.311***	-0.230***	-0.162	-0.081	-1.886***	-0.775***	-0.313***	-0.232***	-0.163	-0.081	-1.914***	-0.788***
	(0.039)	(0.066)	(0.104)	(0.068)	(0.362)	(0.169)	(0.042)	(0.067)	(0.105)	(0.067)	(0.384)	(0.186)
lnσ, σ_u	-0.341***	-0.342***	-0.265***	-0.279***	-0.298***	-0.279***	0.137	0.132	0.021	0.000	0.183	0.130
	(0.051)	(0.051)	(0.053)	(0.053)	(0.053)	(0.053)	(0.155)	(0.160)	(0.180)	(0.914)	(0.145)	(0.208)
σ_e							0.699***	0.699***	0.768***	0.758***	0.721***	0.747***
							(0.040)	(0.040)	(0.032)	(0.032)	(0.047)	(0.047)
Log-Likelihood	-1,106.42	-1,105.32	-1,034.38	-1,024.53	-1,012.41	-1,022.95	-1,105.64	-1,104.54	-1,033.60	-1,023.69	-1,011.39	-1,022.04
χ^2	581.017	585.266	504.804	519.195	530.794	515.289	614.973	615.897	522.027	533.715	549.607	532.696
N	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408

note: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Table 4.12: Comparison of the pooled Tobit and Tobit random effects estimations

Probit estimation

	Probit 1						Probit 2					
	baseline	**I**	**II**	**III**	**IV**	**V**	**baseline**	**I**	**II**	**III**	**IV**	**V**
	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)	(coef/se)
Highly competitive market	2.223***	2.067***	2.058***	2.205***	1.972***	2.059***	2.435***	2.274***	2.290***	2.419***	2.200***	2.291***
	(0.143)	(0.145)	(0.147)	(0.144)	(0.149)	(0.147)	(0.161)	(0.163)	(0.165)	(0.162)	(0.167)	(0.165)
Opportunity-based	1.853***	1.768***	1.809***	1.845***	1.765***	1.801***	1.991***	1.904***	1.928***	1.984***	1.884***	1.918***
	(0.141)	(0.142)	(0.142)	(0.142)	(0.143)	(0.142)	(0.155)	(0.156)	(0.156)	(0.156)	(0.157)	(0.155)
GDP growth /%	-0.028***	-0.028***	-0.011	-0.020*	-0.042***	-0.043**	-0.026***	-0.026***	-0.013	-0.020*	-0.041***	-0.049***
	(0.009)	(0.009)	(0.009)	(0.011)	(0.014)	(0.019)	(0.009)	(0.009)	(0.009)	(0.012)	(0.013)	(0.019)
TRIPS		-2.910***			-2.778***			-2.542***			-2.460***	
		(0.555)			(0.694)			(0.555)			(0.688)	
IMD			1.087***		0.960***	1.027***			0.932***		0.828***	0.859***
			(0.130)		(0.135)	(0.133)			(0.129)		(0.135)	(0.133)
TRIPS*IMD				0.045	-0.159***					0.031	-0.143***	
				(0.040)	(0.055)					(0.039)	(0.052)	
d(TRIPS)						9.085***						8.793***
						(1.970)						(1.928)
d(TRIPS)*IMD						-1.190*						-1.324**
						(0.621)						(0.609)
cons	-0.595***	19.825***	-4.494***	-1.650*	19.200***	-9.339***	-0.368***	17.462***	-3.664***	-1.111	17.339***	-7.696***
	(0.111)	(3.895)	(0.484)	(0.942)	(5.791)	(1.101)	(0.115)	(3.890)	(0.474)	(0.935)	(5.693)	(1.099)
Country effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
R^2	0.471	0.487	0.510	0.472	0.519	0.511	0.487	0.499	0.515	0.488	0.523	0.518
N	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408	1,408

$^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$

Table 4.13: Probit estimation for robust check

Chapter 5

Conclusion

This collection of three research papers attempts to answer the question of whether strengthening intellectual property rights (IPR) through the implementation of *Trade-related Aspects of Intellectual Property Rights* (TRIPS) agreement encourages access to foreign technologies for developing countries.

5.1 Summary

In my first paper I underscore how the TRIPS agreement, harmonized global IPR protection, is different from previous international IPR agreements. I then make the case that available indexes such as the Ginarte and Park (1997) and Rapp and Rozek (1990) do not capture countries' implementation of the TRIPS and proceed to build my own index. I consult national IPR legislations, various IPR-specific reports, and legal experts and practitioners, whenever possible, to construct the index for 53 developing countries for the period 1994 – 2007. Analysis of the data collected shows three implementation trends. Firstly, almost all developing countries profit from the transition period clause of the Agreement (Art. 65), and in some cases exceeding the implementation deadline. Secondly, implementation efforts of developing countries vary, and not necessarily because of their income levels. And lastly, countries in regional trade agreements (RTAs) that include IPR obligations tend to comply with TRIPS earlier than the rest. The results confirm that the TRIPS agreement leads to a convergence of global IPR protection across countries. It also makes the case that the Agreement's implementation is an external factor, not entirely influenced by the country's level of economic development.

I then proceed to use the index I built in my first paper to examine whether TRIPS implementation increases access to foreign technology for developing countries. Controlling for country-specific factors, I find that developing countries' compliance with the TRIPS agreement

increases access to foreign technology through foreign direct investment (FDI) and licensing. When I include an enforcement term to proxy for actual enforcement of the TRIPS obligations, I observe significant impact of the TRIPS implementation on all three channels of access to foreign technologies which varies according to their imitative abilities.

The last paper investigates how TRIPS implementation affect local exploitation of foreign technologies. Using the Global Entrepreneurship Monitor (GEM) database on entrepreneurship, I find significant and adverse effects of TRIPS. The level of impact changes according to the industrial sectors and categories of the entrepreneurial activities. The results show that stronger IPR protection, via TRIPS implementation, raises the cost to using new technology by the entrepreneurs in developing countries. I suggest that TRIPS' negative effect on the exploitation of foreign technologies in developing countries may be attributable to the higher cost of acquiring them.

5.2 Reflections

Access to foreign technologies is important for many developing countries. The spillover benefits for in tapping into the global knowledge pool allows developing countries to profit from research and development (R&D) conducted elsewhere and access technologies that work, thus minimizing duplicative costs of re-inventing these technologies on their own. In addition, it is not obvious if countries that have little imitative abilities can re-engineer the existing technologies on their own. Thus by accessing foreign technologies, developing countries can endeavor to *catch up* to developed countries.

The relevant issue is then to answer this three part question: (i) whether the institutionalization of IPR regime facilitates this access to foreign technology, (ii) if IPR regime affects the exploitation of this foreign technology, and (iii) if the access and exploitation of foreign technologies is beneficial for developing countries to build its own capacity to innovate.

In my second research paper, I find that implementation of the TRIPS agreement does facilitate developing countries' access to foreign technologies, through trade, foreign direct investment and licensing activities. So my answer to the first part of the question is "most likely."

Results from the third paper shows that TRIPS implementation reduces the exploitation of foreign technologies in developing countries. Therefore, while the implementation of the Agreement facilitates access to foreign technologies, it reduces local exploitation of these technologies.

Based on the result of this single study here, the answer to question (ii) is "no." However, more investigation in this subject matter is needed.

More access to but less use of foreign technology because of strengthened IPR rights leads to an uncertain answer for the last part of the question above. This question can only be answered when there is more evidence to study the subject matter. But I proceed to discuss how this last question could be answered.

5.3 Developing own technology

The leap from accessing, exploiting and learning from foreign technologies, to build developing countries' own capacities to innovate is big. The only way to tackle this question is to analyze it according to need for the technology and countries' absorptive capacities.[1]

Firstly, assuming that developing countries have access to foreign technologies, they would have to use these technologies in order to learn from them. And in order to learn from these technologies, developing countries need to have some level of absorptive capacities. But if the access to foreign technologies is dependent on strengthened IPR regimes, then it becomes more difficult for developing countries to use these technologies without incurring licensing fee. Countries that used to profit from using pirated softwares, for example, would now have to pay the licensing fee for using the original software which can be a significant cost burden. If users in those countries affected cannot pay the licensing fee then they would have to stop using it altogether. This would be a negative impact, albeit extreme, of TRIPS compliance.

Even if developing countries have access to foreign technologies and the cost of exploiting the technologies does not pose a significant burden, technologies that are not relevant for these countries will not be used. As Trajtenberg (2008) argues, the types of technologies that are useful for developing countries are the ones that are adapted to the local conditions, not the latest technological gadgets.

Therefore the cost of using and the usefulness of the foreign technology to local markets influence developing countries' exploitation of foreign technologies.

Secondly, learning from foreign technologies is highly dependent on the countries' level of absorptive capacities. Lall (2003) makes a convincing argument that countries that will profit from strengthened IPR protection are the ones with some level of innovative abilities. The

[1] I use the term absorptive capacity in a general manner.

same can be applied to countries who endeavor to learn from foreign technologies. Countries that have some absorptive capacities are likelier to benefit from accessing and exploiting foreign technologies.

Take least-developed countries (LDCs) as an example. LDCs are known to have limited human capital development and inadequate technology infrastructure. Thus they are unlikely to learn from acquiring foreign technology unless the technology is of a general nature and can be applied to the local market without any modification. For example, the introduction of mobile phones in African countries inadvertently addressed the problem of inadequate telephone network infrastructure, and significantly improved these countries' productiveness in its daily economic activities.

The TRIPS agreement imposes limits on how developing countries can learn from foreign technologies to develop their own technological industries. Historically, countries have learnt from one another's technologies by reverse-engineering and copying these technologies. But under TRIPS, blatant copying of new technologies are no longer possible. Therefore countries who endeavor to develop their technological industries like South Korea, Taiwan, the United States of America and some European countries have done, are no longer able to do so. Thus any learning from technologies from abroad would have to be different from what most countries have done historically.

Answering question (iii) proves to be difficult. TRIPS protection facilitates access to foreign technologies but it may raise the barrier of exploiting the technology. In addition, TRIPS protection narrows the policy space for developing countries to pursue policies that may help them develop their technological industries, as other industrialized and newly industrializing countries have done. Therefore new avenues of research would need to be conducted in order to address the issue of how to build innovative capacities when constrained under TRIPS protection. A possible solution lies in the example of *open source* platform for software development (see Ghosh and Soete, 2006; Arora and Nandkumar, 2007). Moreover, even if a developing country implements the TRIPS agreement fully, it could use the information gleaned from patent application of foreign technology at a different patent office and use it locally, especially if the rights holder of that technology does not file for patent application in the particular country.

The heart of the matter is that we need more time to gather evidences on how TRIPS affects developing countries. Showing how TRIPS influences access to foreign technologies is not enough, it is prudent to also examine how this increased access translates into more use of these technologies.

5.4 Data availability

A big portion of my research work was dedicated to finding data on developing countries. There were several times that I started collecting data for developing countries only to realize half-way that the reliability of those data were questionable. For example, patent database.

Information contained in patent application is highly useful to conduct studies on innovative activities across countries. I attempted to collect patent application at local patent offices using the World Intellectual Property Organization (WIPO) database. Unfortunately, I was made aware that this database has a double-counting problem. So while the information contained within the WIPO application is useful as an indicator of intention to patent in specific countries, it cannot be used as an indicator of actual patenting in those countries.[2] I also attempted to use the PATSTAT database, which addresses the issue of double-counting and simplifies search of patent application for several countries at once. Unfortunately, the data I collected had many missing values and its reliability was hard to confirm. As a last effort, I tried to obtain patent data from national patent offices, for example for Malaysia, but was informed that there may be problems in accessing the data because of administrative and bureaucratic reasons. I had 52 other national patent offices to contact in order to complete my data collection, and seeing how difficult it was to collect for a country like Malaysia, I abandon this search.

If it weren't for organizations like the United Nations, the World Bank, or the International Monetary Fund (IMF), data collection for developing countries would be almost impossible. However, there are some database that require some "financial contribution" regardless of whether you are researching for academic purposes or not. As a budget constrained PhD student this cost posed a significant barrier for me and so most of the data collected for this research were obtained by using databases that were "free-of-charge."

Lastly, we need new measures to capture "innovation" in developing countries. In order to design well informed based policies, data on innovative activities in developing countries need to be collected. Lack of data on innovation in these countries does not mean that there are no innovative activities taking place. Rather, it is our inability to capture these activities that is inadequate. Recent developments to conduct innovation surveys in developing countries, such as Africa, is a good step in the right direction (see Gault, 2008).

[2]Filing patent application at WIPO simplifies the administrative procedure of filing in several patent offices. Inventors can indicate which countries that they would be applying for patent grant in the WIPO patent application filing. However, the inventor would need to go through the *national phase* of actually applying to the national patent offices in order to receive her patent grant.

5.5 Outlook

There is still so much to learn about how developing countries are affected by their current TRIPS obligations. There are three aspects to understanding how TRIPS may impact developing countries' economic activities. The first aspect is in regards to accessing the global pool of knowledge. The second is in regards to building innovative capacities, and the last is to sustain, if not improve, the level of innovative activities. For most developing countries, and especially LDCs, the first two aspects to examining TRIPS are crucial.

While current research show that countries who do implement IPR protection gain better access to foreign technologies, the issue is not clear in regards to how this IPR regime will help developing countries build their innovative capacities. The TRIPS agreement, when read together with other WTO-related agreements such as the *General Agreement on Tariffs and Trade* (GATT) and *Subsidies and Countervailing Measures* (SCM) to name a few, bind developing countries to develop their innovative capacities in an open trading framework. This is a feat that has not been done before. Given that there are no data collectible on this subject matter, country case studies should be conducted to examine what other policies these developing countries are pursuing in order to build their innovative capacities. For example, when countries like Qatar attract skilled foreign labor to their countries to fill in open positions that cannot be filled by locals because of their lack of technological expertise.

Another interesting avenue of research would be to study how innovative activities in firms of developing countries are affected by the TRIPS agreement. Several countries such as Malaysia and Brazil have undertaken to run the innovation survey based on the European *Community Innovation Survey* (CIS). Exploiting these national innovation survey could yield interesting results to understand how TRIPS is influencing innovative activities in developing countries.

Many studies have focused on the problem of access to medicine for developing countries, which is an integral part of the TRIPS agreement. But there are other components of TRIPS which should be explored, for example in regards to copyright, traditional knowledge, geographical indications and industrial design to name a few. The World Bank publication edited by Finger and Schuler (2004) highlight various kinds of "poor people's knowledge" that may be protected under TRIPS agreement and could benefit these countries. Further studies on this subject matter would be highly welcomed.

There are many more research possibilities in this area of understanding TRIPS and its impact on developing countries. I have highlighted the three that I think are interesting and

would be useful to understand so as to ensure that TRIPS is beneficial for developing countries.

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Analyzed, drew policy relevance and reported on trade in a highly political and intense working environment under the immediate supervision of the Director-General

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Surveyed and examined the status and future direction of small- and medium-sized industries (SMI) in Malaysia for AMCHAM, summary of research published in AMCHAM Dateline

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Researched key issues relating to the Asian economy, and wrote memoranda to Members of Congress to promote international trade, e.g. the fast track legislation and the GSP

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Bilingual in English and Malaysian (both mother tongue), fluent in Indonesian, intermediate in Spanish, French and Portuguese languages

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References

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